School of Science

Welcome to the School of Science at IUPUI!

The School of Science at IUPUI provides an environment where students are both challenged and nurtured by each other, faculty and staff on a campus with a multitude of resources to help students succeed.

The School of Science offers over 25 undergraduate, ten masters, and nine Ph.D. degree programs across seven departments. In addition to preparing students for science or technology-related careers and for advanced study in graduate school, an undergraduate program in one of the sciences is an excellent background for professional study in medicine (including veterinary medicine), dentistry, business administration, law, and areas of the social sciences where quantitative methods are important.

Students here reap the benefits of small classes, an interactive learning environment, and challenging material and lab work. As early as their freshman year, our undergraduates are able to participate in real research with renowned faculty. Our undergraduate students have co-authored research papers and presented at national conferences.

We're a community of learners and students thrive here. Students support each other through peer-led mentoring, providing a unique environment where students become leaders by teaching others. Student organizations and volunteer programs are just a couple of the ways for students to get involved outside of the classroom.

We're great scientists, but more importantly, we're innovative teachers. As a school and a university, we've developed teaching methods that engage and encourage students—and are used at universities throughout the United States. Simply put, we care about our students.

The School of Science and its seven departments are situated in the heart of Indianapolis, near five hospitals, the Indiana University schools of medicine, dentistry and nursing, and countless science and technology companies. Through internships and undergraduate research, our students have opportunities to collaborate across disciplines, across campus, and across the academic and business communities. Our graduates emerge as well-rounded scientists whose experiences have prepared them to solve the problems of the future.

The School of Science at IUPUI is critical to the success of the life, health and technology industries in central Indiana —our graduates are the life blood of an economy that needs innovative thinkers, contributing team members and eager learners. Committed to having real impact in their work and community, our graduates emerge from the School of Science as well-rounded scientists whose experiences have prepared them to solve the problems of the future.

Overview

The School of Science offers undergraduate and graduate programs that prepare students for a variety of careers. As part of its instructional mission, the school also provides non-science majors with the scientific background to help them become more aware and better-informed consumers and citizens. Scientists advance the boundaries of our knowledge of the natural world through applied and basic research. Science benefits society by providing fundamental knowledge and technical advances in such areas as health, ecology, computer and software design, mathematical modeling, and chemistry. Science informs the social sciences with scientific understanding of psychology, applications of statistics, and an understanding of environmental issues. Science contributes to the arts and humanities by offering knowledge of the physical universe and the symmetry and wonder of nature. In addition to preparing students for science-related careers and for advanced study in graduate school, an undergraduate program in one of the sciences is an excellent background for professional study in medicine (including veterinary medicine), dentistry, business administration, law, and areas of the social sciences where quantitative methods are important. An education in the sciences also opens the door to employment in the high-tech industry in sales and management.

Over 140 faculty members, with ranks ranging from lecturer through full professor, are dedicated to helping students take steps toward reaching their educational, professional, and career goals. Our average student to faculty ratio is 17:1. We pride ourselves on our interdisciplinary approach, extensive undergraduate research opportunities, professional school placements, and service to our students. An education from the School of Science pays off: our students go on to top graduate programs, medical schools, and careers in academia, research, and the private sector.

Last Updated: April 2018

History

Indiana University (IU) established its first extension center at Indianapolis in 1916, although the first IU course was taught in Indianapolis in 1890. The Indianapolis campus of Purdue University (PU) grew out of World War II training programs sponsored by Purdue, and began its major operations in 1946. Indiana University established the Indianapolis regional campus in the mid-1960s. In 1968, the Trustees of Indiana University created Indiana University at Indianapolis, and less than a year later, in 1969, the Trustees of Indiana and Purdue universities merged their Indianapolis operations to form Indiana University–Purdue University at Indianapolis (IUPUI). Indiana University was selected to administer the campus. Purdue brought to the merger a growing complex of degree programs and Purdue's traditional strengths in the physical sciences, engineering, and technology.

A restructuring of undergraduate programs at IUPUI in the Fall of 1972 created three new schools: the School of Liberal Arts (humanities and the social sciences), the School of Engineering and Technology, and the School of Science (physical, behavioral, and life sciences).

After being housed for almost 22 years on the 38th Street campus, the School of Science made a historic move in two phases into two buildings on the main campus during 1991-1993.

The name of the campus was changed to Indiana University–Purdue University Indianapolis in 1992. As of Fall 2015, IUPUI enrolled more than 28,000 students.

In late 2013, The Science and Engineering Laboratory Building (SELB), the first non-medical building to be built on campus in 20 years, was completed along the Science corridor on Blackford Street between New York and Michigan Streets. The $25 million project is the new home for biology, chemistry and psychology research and teaching labs.

Innovation Hall, located on the southeast corner of Michigan and Blackford streets, was completed in early 2021. The building was contructed to meet the evolving teaching and research needs for programs in the School of Science, the School of Engineering and Technology, and the School of Informatics and Computing. Innovation Hall was designed specifically to enhance innovative collaboration across the three schools. In addition, this building is home to the university's first Class 100 Clean Room, a specific type of space that provides high levels of cleanliness. This provides the opportunity for faculty and students to fabricate nanodevices.

Mission, Core Values, and Vision

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The School of Science offers over 20 undergraduate, 10 masters, and 9 doctoral degree programs across seven departments. In addition to preparing students for science or technology-related careers and for advanced study in graduate school, an undergraduate program in one of the sciences is an excellent background for professional study in medicine (including veterinary medicine), dentistry, business administration, law, and areas of the social sciences where quantitative methods are important.

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Mission

The IUPUI School of Science is dedicated to conducting fundamental and applied scientific research and providing the highest quality undergraduate education and graduate training. In both our research and teaching, we promote an understanding of basic science and interdisciplinary approaches for addressing scientific questions, an appreciation of academic values, and translation of scientific findings to our communities. We foster an environment where students can access faculty for personalized mentoring and instruction, and where they can be meaningfully engaged in research and scholarship. The School is committed to providing the State of Indiana and beyond with graduates who possess deep knowledge of modern science and who are fully equipped to make an impact in science, industry, schools, and communities.

Core Values

The School of Science will achieve its mission through outstanding teaching, innovative research, strong commitment to diversity among faculty and students, relentless pursuit of academic excellence, and dedication to IUPUI’s vision as an urban research university with national and global impact.

Vision

The IUPUI School of Science is recognized in the state of Indiana, nationally and internationally as a major contributor of high quality fundamental and applied research. For undergraduate education and graduate training, the School is recognized in the state of Indiana and nationally as the destination of choice for students seeking the highest quality science education that provides students with basic science education and problem solving skills they need to succeed. The School offers an environment that is supportive to a diverse population of students, faculty, and staff.

Administration

Administrative Officers

- JOHN F. DiTUSA, Ph.D., Dean
- RAJEEV R. RAJE, Ph.D., Associate Dean for Planning and Finance
- DAVID G. SKALNIK, Ph.D., Associate Dean for Research and Graduate Education
- JANE R. WILLIAMS, Ph.D., Associate Dean for Academic Affairs and Strategic Initiatives

Departmental Chairpersons

- THEODORE R. CUMMINS, Ph.D., Department of Biology
- PARTHA BASU, Ph.D., Department of Chemistry and Chemical Biology
- SHIAOFEN FANG, Ph.D., Department of Computer and Information Science
- ANDREW P. BARTH, Ph.D., Department of Earth Sciences (Interim)
- JEFFREY X. WATT Ph.D., Department of Mathematical Sciences
- ANDREW D. GAVRIN, Ph.D., Department of Physics
- STEPHEN L. BOEHM II, Ph.D., Department of Psychology (Interim)

Program Directors

- THEODORE R. CUMMINS, Ph.D., Biotechnology
- GABRIEL M. FILIPPELLI, Ph.D., Environmental Science
- CHRISTINE J. PICARD, Ph.D., Forensic and Investigative Sciences
- JANE R. WILLIAMS, Ph.D., Interdisciplinary Studies
- TERI L. BELECKY-ADAMS, Ph.D., Neuroscience (Interim)

Bulletin Designation and Program Planning

Bulletin Designation

All colleges and universities establish certain academic requirements that must be met before a degree is granted. These regulations concern such things as curricula and courses, majors and minors, and campus residence. Advisors, directors, and deans will aid students in meeting these requirements, but students are responsible for fulfilling them. At the end of the course of study, the faculty and the Board of Trustees vote on the conferring of degrees. If requirements have not been satisfied, degrees will be withheld pending satisfactory completion of these requirements. For this reason, students need to acquaint themselves with all regulations and to remain informed throughout their university career.

This bulletin lists the requirements and regulations in effect for students who are admitted to the School of Science in August 2021 (Fall semester). Students who enter after this date may be subject to different requirements; students who entered before August 2021 may elect to follow the graduation requirements that were in effect at the time of their admission to their degree program or the graduation requirements that became effective thereafter. However, the requirements chosen must be from only one bulletin. If a student has not completed a bachelor's degree program within eight years of admission, the student may be obliged by the major department to meet the requirements of a subsequent bulletin. Additionally, students in good standing who have not been enrolled at the university for two or more consecutive years must satisfy the requirements of the School of Science bulletin in effect upon their return.

Program Planning and Advising Guidelines

The experience of academic advisors and of successful students suggests the following guidelines for effective planning of undergraduate programs:

- Students should be thoroughly familiar with all academic requirements that must be met before a degree is granted.
- Students should seek appointments with academic advisors in their major departments before the dates established by the university calendar for registration. In such conferences students should, as a minimum objective, make certain that they review their degree requirements and that they have made an appropriate plan for the next semester.
- Each student should understand that the responsibility for determining an appropriate academic program and for meeting every degree requirement rests with the student; faculty or staff members acting in the capacity of advisors are obligated only to assist students in meeting this responsibility. Any student who needs clarification of any of the requirements for the degree program is urged to obtain this clarification from an academic advisor or from the School of Science, Science Building, Room LD 222, phone (317) 274-0625.

Degree, Minor and Certificate Programs

Degree Programs in the School of Science

The School of Science at Indiana University–Purdue University Indianapolis awards students degrees from both Purdue University (PU) and Indiana University (IU). This list shows all the degrees awarded and the institution granting the degree.

Biology

- Bachelor of Arts - PU
  - Biology Teaching Option
- Bachelor of Science - PU
- Bachelor of Science (Biology) / Master of Science (Bioinformatics) dual degree program - PU/IU
- Bachelor of Science (Biology) / Master of Public Health (Public Health) dual degree program - PU/IU
- Bachelor of Arts (Biology) / Master of Public Health ((Public Health) dual degree program - PU/IU
- Master of Science - PU
  - Biology for Educators Concentration Option
- Master of Arts in Teaching Online Degree Program - IU
- Doctor of Philosophy - PU

Biotechnology

- Bachelor of Science - PU

Chemistry

- Bachelor of Arts - PU
  - Chemistry Teaching Option
- Bachelor of Science in Chemistry - PU
  - Biological Chemistry Option
  - Chemistry Option
  - Medicinal Chemistry Option
- Master of Science - PU
- Doctor of Philosophy[1] - PU

Computer and Information Science

- Bachelor of Arts - PU
- Bachelor of Science - PU
  - Biocomputing Option
- Bachelor of Science in Artificial Intelligence - PU
  - Concentration in Data ad Computational Science
- Bachelor of Science (Computer Science) / Master of Science (Computer Science) dual degree program - PU/PU
- Master of Science - PU
- Master of Science - Computational Data Science
- Doctor of Philosophy - PU

Environmental Science

- Bachelor of Science - IU
  - Earth and Water Resources Concentration
  - Environmental Management Concentration
  - Environmental Remote Sensing & Spatial Analysis Concentration

Forensic and Investigative Sciences

- Bachelor of Science in Forensic and Investigative Sciences - PU
  - Forensic Biology Concentration
  - Forensic Chemistry Concentration
- Master of Science - PU

Geology

- Bachelor of Arts - IU
- Bachelor of Science - IU
- Bachelor of Science (Geology) / Master of Science (Geology) dual degree program - IU/IU
- Master of Science - IU
- Doctor of Philosophy in Applied Earth Sciences - IU

Interdisciplinary Studies

- Bachelor of Science - PU

Mathematical Sciences

- Bachelor of Science - PU
  - Actuarial Science
  - Applied Math
  - Applied Statistics
  - Pure Math
  - Math Education
- Bachelor of Science (Mathematical Sciences) / Bachelor of Science (Physics) double major - PU
- Master of Science - PU
  - Pure/Applied Math
  - Applied Statistics
  - Computational Data Science
  - Math Education
- Doctor of Philosophy (Mathematics) - PU
  - Applied Math
  - Pure Math
  - Mathematical Statistics
- Doctor of Philosophy (Biostatistics)[2] - IU

Neuroscience

- Bachelor of Science - PU
- Bachelor of Science (Neuroscience) / Master of Science (Biomedical Engineering) dual degree program - PU

Physics

- Bachelor of Science - PU
  - Biophysics Option
  - Physics Teaching Option
- Bachelor of Science (Physics) / Bachelor of Science (Electrical Engineering) dual degree program - PU
- Bachelor of Scince (Physics) / Bachelor of Science (Mathematical Sciences) double major - PU
- Bachelor of Science (Physics) / Master of Science (Mechanical Engineering) dual degree program - PU
- Master of Science - PU
- Doctor of Philosophy[1] - PU

Psychology

- Bachelor of Arts - PU
- Bachelor of Science - PU
- Master of Science - PU
  - Industrial/Organizational (I/O) Psychology
  - Clinical Psychology
  - Applied Social and Organizational Psychology - IU
- Doctor of Philosophy in Addiction Neuroscience - PU
- Doctor of Philosophy in Applied Social and Organizational Psychology - IU
- Doctor of Philosophy in Clinical Psychology - PU

Several departments participate in the joint M.D.-Ph.D. program with the Indiana University School of Medicine. In this program, students concurrently earn an Indiana University Doctor of Medicine degree and a Ph.D. degree in the School of Science.[1]

1. Indiana University Ph.D. Programs, pursued at IUPUI, in departments or programs of the Indiana University School of Medicine in which School of Science faculty hold adjunct appointments.
2. Indiana University Ph.D. program, pursued at IUPUI, in collaboration with the Richard M. Fairbanks School of Public Health. The degree is awarded through the Richard M. Fairbanks School of Public Health.

Minors in the School of Science (PU)

- Applied Computer Science
- Biology
- Chemistry
- Computer and Information Science
- Forensic and Investigative Sciences
- Health Psychology
- Mathematics
- Neuroscience

- Physics
- Psychology

Minors in the School of Science (IU)

- Geology
- Geochemistry

Graduate Minors in the School of Science (for eligible IU doctorate programs)

- Computer Science

Certificate Programs in the School of Science (PU)

The School of Science at Indiana University–Purdue University Indianapolis also awards Purdue University (PU) certificates.

Computer and Information Science

Undergraduate

- Certificate in Applied Computer Science
- Certificate in Data Analytics

Graduate

- Certificate in Biocomputing
- Certificate in Biometrics
- Certificate in Computer Security
- Certificate in Databases and Data Mining
- Certificate in Software Engineering

Contact Information

The School of Science
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Indianapolis, IN 46202-3276

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Amy Christoffersen
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Lori Vanatsky
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Graduate Student Affairs

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Angel A. Campbell
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Pre-Professional and Career Preparation (PREPs)

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Kimberly Shea
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Barbara Lambert
Academic Specialist
E-mail: baralamb@iupui.edu

Academic Policies & Procedures

- Academic Regulations
- Academic Standing

Academic Regulations

See the Office of the Registrar's website for general information about grades. The following policies are specific to the School of Science.

Pass/Fail Option During the four years of their undergraduate program, all undergraduates in good standing (with an overall GPA of 2.00 or higher) may enroll in up to eight elective courses to be taken with a grade of P or F. The Pass/Fail option is open for a maximum of two courses per year, including summer sessions. For this option, the year is defined as August 15 to August 15. The Pass/Fail option form is available in School of Science departmental offices and in the School of Science, LD 222.

The course selected for Pass/Fail grading must be an elective. It may not be used to satisfy any of the school area requirements, nor may it be counted as a part of the student's major. If the course is at the 300-level or higher, with a grade of P, the course may apply to the 32 credit hour School of Science residency requirement. After the form is submitted to the Office of the Registrar, a grade of P cannot be subsequently changed to a grade of A, B, C, or D.

For additional information, visit the Student Central website: https://studentcentral.iupui.edu/grades-progress/pass-fail.html

Withdrawal for Undergraduate and Graduate Students

Students may officially withdraw from classes without penalty during the first half of a semester or session if they secure the approval of their advisor; a grade of W (Withdrawal) is recorded on the final grade report. Students may withdraw from classes during the second half of a semester or session only under extraordinary circumstances. In such cases, the student must secure the approval of their advisor, the instructor of the course, and the dean of their school; the instructor may assign a grade of W or F. A written justification from a doctor, member of the clergy, advisor, etc., must be presented indicating that the student could not have withdrawn earlier. The grade so assigned is recorded on the final grade report. The necessary form for withdrawal from a course is available in School of Science departmental offices and in the School of Science, LD 222. To maintain integrity as to how students are accountable in this area, the policy for School of Science students is considered to be the policy for all students served by the School, regardless of academic unit or school.

Students who alter their schedules, whether by personal incentive or by departmental directive, must follow correct withdrawal procedures. Students who do not follow these procedures risk jeopardizing their record by incurring a failing grade in a course not properly dropped, or they risk not receiving credit for work done in a course that has not been properly added.

This policy applies to students in both undergraduate and graduate programs.

Grade Replacement Policy for Undergraduate Students Only (this policy is not available to graduate students)

The Grade Replacement Policy is available only to undergraduate students. This policy does not apply to graduate students. It may be exercised for a maximum of 15 credit hours, no more than two times for a given course, with each attempted replacement counting toward the 15 credit hour limit. Any grade may be replaced with the last grade earned for the course, as long as the most recent grade is equal to or higher than the grade being replaced. The replaced grade will then be excluded from the cumulative grade point average. However, the course listing and the replaced grade will remain on the student's academic record with an "X" notation indicating that the grade is excluded from the cumulative grade point average.

The policy became effective beginning with the Fall 1996 semester, and any courses being used to replace an earlier grade must have been taken in the Fall of 1996 or later. Grades previously granted FX will be honored and will count toward the 15 credit hour limit. Once invoked, a student may not subsequently request reversal of the grade replacement granted for a given course. Also, this policy is not available for graduate students or students seeking any second undergraduate degree. A science major interested in the Grade Replacement Policy should contact the School of Science, LD 222. For more information about the policy, visit https://studentcentral.iupui.edu/grades-progress/grade-replacement.html

Special Credit

Special credit by examination, by credentials, and/or by experience may be awarded in order to help qualified students earn their degrees more quickly. Each instructional department determines which of its courses are available for special credit and establishes procedures to determine student eligibility, administer evaluations for special credit, and grade students. The evaluations are as comprehensive as those given in the course. Credit earned by examination will be assigned an A (highest passing grade) or S (passing grade). Credit earned by credentials and/or experience will be assigned an S. An S (passing) grade is considered to be equivalent to performance at a minimum grade level of C.

Responsibility for initiating a request for special credit in a specific course normally rests with the student. To find out if special credit is warranted, the student should consider meeting first with the department chair, advisor, or course instructor.

For additional information, refer to the front part of this bulletin under "Special Credit" or go to the following website: https://facultystaffcentral.iupui.edu/enrollment/special-credit.html

Auditing Courses

University policy permits the auditing of courses, but audited courses may not be retaken later for academic credit. Written permission from the instructor to audit a class must be obtained before the student attempts to

register. See the Student Central website for general information about auditing courses.

Incomplete Grade Process for Undergraduate and Graduate Students

You can ask your instructor for a grade of Incomplete if you satisfactorily competed a substantial portion of your coursework, but extenuating circumstances during the term prevented you from completing all coursework as of the end of the semester.

Your instructor has the right to set a specific date, up to one year, by which you must complete all unfinished work

In some cases, your instructor may recommend or require you to attend another term (or portion of a term) of a course to remove your I. In this case, don't register for the course a second time. Instead, make arrangements with your instructor to sit in on the course as required. Note that sitting in on a course does not count as part of your full-time or part-time load for financial aid purposes or for loan deferments. If your original instructor isn't available or is no longer with IUPUI, contact the chair of the school or department that offers the course for assistance.

Once you've completed the work the instructor will change your I to the appropriate letter grade. You can track the progress of your request or check your academic record for grade information.

If you fail to complete the coursework and turn it in to your instructor in the time allowed, your I will automatically become an F.

See the IUPUI Student Central website for information: https://studentcentral.iupui.edu,/grades-progress/incompletes.html

This policy applies to students in both undergraduate and graduate programs.

Review of Final Grade in a Course

A student has the right to request and receive a review of the student's final grade in a course. However, the request for such a review must be made in a timely manner; that is, within one year of the completion of the course. This policy applies to students in both undergraduate and graduate programs.

Petition for Grade Change

Faculty Petition A faculty member may request a change of grade for a student. This request can be honored only after approval of the department chair and the School of Science Executive Director for Academic and Student Affairs.

Student Petition In certain cases, a student may request a change of grade. Students should contact the School of Science, LD 222, for information about procedures and time limits for applicable cases. This option is primarily used by undergraduate students and is generally not available for graduate students. Information is available at https://studentcentral.iupui.edu/grades-progress/grade-changes/index.html.

Residency Requirements

For undergraduate students: Residence at IUPUI for at least two semesters and completion, while at IUPUI, of at least 32 credit hours of work in courses at the 300 level or higher are required.

At least four courses totaling a minimum of 12 credit hours in the major subject must be completed at IUPUI.

With the approval of the executive Director of Academic and Student Affairs or the Associate Dean for Academic Affairs, students who have had at least four semesters of resident study may complete up to 15 credit hours of the senior year at another approved college or university. In order to transfer back to IUPUI, a transfer course msut be a grade of C or higher. Students should be aware that completing coursework at another college or university may result in a postponment of their graduation for at least one semester.

For graduate students: At least 30 academic credits are required for the master's degree and at least 90 academic credits are required for the Ph.D. Some programs may require more credits. The maximum number of didactic transfer credits allowed is 12 hours, but some programs may allow fewer. The student's major department and the Office of the Associate Dean for Research and Graduate Education determine acceptability of transfer credits from another college or university. No work may be transferred from another institution unless the grade is a B or higher.

Students must meet graduate school resident study requirements. At least one-half of the total credit hours used to satisfy a Purdue master's degree must be earned while in residence at IUPUI. At least 30 credit hours of IU graduate work must be completed while enrolled on a campus of Indiana University to satisfy the master's degree. At least one-third of the total credit hours used to satisfy degree requirements must be earned (while registered for doctoral study) in continuous residence on the IUPUI campus. The major department should be consulted for other more specific rules.

Candidates for Baccalaureate Degrees

Students are considered to be candidates in good standing for baccalaureate degrees awarded by the School of Science when they have been admitted as regular students by the Undergraduate Admissions Center, when their last semester's grade point average is not below a 2.00, and when their cumulative grade point average is not below this same level (2.00).

Degree Grade Point Average

The School of Science computes a school grade point average, which is the basis for recommending the awarding of a degree. This grade point average is computed at the completion of the degree program. Only the most recent grade in repeated courses counts in computing the school grade point average for the purpose of graduation. Remedial courses and courses that overlap are also excluded. Other course exclusions may apply.

Double Major

A double major is awarded to students who complete the requirements for two Purdue Bachelor of Science degree programs or two Purdue Bachelor of Arts degree programs in the School of Science. Students who plan to double major must have their programs approved by both major departments and the academic dean or director. A

form to declare a double major can be obtained from the School of Science, LD 222. A student declaring a double major must satisfy the departmental requirements for the second major as stated in the School of Science bulletin in effect when the second major is approved.

Double Degree

A student may be awarded two degrees by completing bachelor's degree programs from two different schools at IUPUI or by simultaneously completing two baccalaureate major programs from the School of Science, one leading to a Purdue Bachelor of Arts degree and the other leading to a Purdue Bachelor of Science degree, or one leading to a Purdue degree and the other leading to an Indiana University degree. A student who plans to pursue a double degree must receive approval from the two major departments and the academic deans of the schools awarding the degrees. A form to petition for a double degree can be obtained from the School of Science, LD 222. A student who declares a double degree, and who is accepted by a department in the School of Science for the additional degree program, must satisfy the requirements for that program as stated in the School of Science bulletin in effect when the additional degree program is approved.

Change of Major within the School of Science

A student who desires to change majors within the School of Science should petition the School of Science by completing the Internal Admissions Application. If the petition is approved, the student may be placed under the bulletin in effect during the time of admission into the new major.

Second Baccalaureate Degree

Normally the holder of a bachelor's degree who wishes to pursue a further educational goal is encouraged to consider a graduate degree program. However, a student interested in pursuing a second degree should apply through the IUPUI Undergraduate Admissions Center, Campus Center Room 255, 420 University Boulevard, Indianapolis, IN 46202. Further information and application forms may be obtained at this address, by calling (317) 274-4591, or online at https://admissions.iupui.edu/.

In order to be admitted to the degree program, the applicant must meet admission requirements of the School of Science and of the department. If admitted, the candidate will be placed under the bulletin in effect during the time of admission into the second-degree program.

Degrees Awarded with Distinction

IUPUI recognizes outstanding performance in course work by awarding bachelor's degrees with distinction. Purdue degrees are awarded with distinction and highest distinction. Indiana University degrees are awarded with distinction, high distinction, and highest distinction.

To award graduation with distinction for baccalaureate degrees, there must be at least 20 students in the respective pool of Spring semester candidates.

To be eligible for graduation with distinction, candidates must complete all the requirements of their degree programs. Additionally, the following conditions apply:

- A candidate for a baccalaureate degree with distinction must have a minimum of 65 credit hours of course work from Purdue University or Indiana University applicable to the graduation index (degree grade point average) on record.
- The minimum graduation index for distinction (Purdue and IU degrees) shall be no less than the 90th percentile of the graduation indexes of all the graduates in the school for the spring semester, provided that the index is at least 3.30;
- Of those who qualify for distinction under these rules for the Spring semester, the six-tenths of the baccalaureate graduates having the highest graduation indexes shall be designated as graduating with high distinction (IU degrees only);
- Of those who qualify for distinction under these rules for the Spring semester, the three-tenths of the baccalaureate graduates having the highest graduation indexes shall be designated as graduating with highest distinction (Purdue and IU degrees);
- The minimum graduation indexes determined for the Spring semester for graduation with distinction, high distinction, and highest distinction shall be applied for graduation with those respective levels of distinction for the subsequent Summer sessions and Fall semester.

Academic Standing

Science Scholars List and Dean's Honor List (Undergraduate Only)

The School of Science recognizes exceptional academic performance in baccalaureate and associate degree programs before graduation from the university by periodically publishing the Science Scholars List and the Dean's Honor List. This recognition does not apply to students pursuing graduate level degrees.

Science Scholars List eligibility includes:

- Full-time enrolled student (between 12 or more credit hours) who has completed at least 26 credit hours of course work at IUPUI and who has a semester and IU cumulative grade point average (GPA) of 3.75 or higher.
- Part-time enrolled student (between 5 and 11 credit hours) who has completed at least 26 credit hours of course work at IUPUI and who has a semester and IU cumulative grade point average (GPA) of 3.75 or higher.

Dean's Honor List eligibility includes:

- Full-time enrolled student (12 or more credit hours) who has a semester grade point average (GPA) of 3.50 or higher.
- Part-time enrolled student (between 5 and 11 credit hours) who has completed at least 26 credit hours of course work at IUPUI and who has a semester and IU cumulative grade point average (GPA) of 3.50 or higher.

Courses assigned a deferred grade (R) will count toward the 12 credit hour minimum required of full-time students. Courses taken on a Pass/Fail basis will not count toward the 12 credit hour minimum. Students who received an Incomplete (I) will not be placed on the Science Scholars List or the Dean's Honor List. No Science Scholars List or Dean's Honor List is published for the summer sessions.

Academic Warning (Undergraduate Only)

A student whose IU semester grade point average (GPA) falls below a 2.00, but whose IU cumulative GPA is a 2.00 or higher will be placed on academic warning. Students on academic warning will be required to meet with their academic advisor before being able to register for classes. A student will be advised of academic warning status by letter from the Associate Dean for Academic Affairs. This policy does not apply to students pursuing graduate level degrees.

Academic Probation (Undergraduate Only)

A student whose IU cumulative grade point average (GPA) falls below a 2.00 will be placed on probation. The student may continue studies provided the student achieves an IU GPA of at least 2.00 for each semester while on probation. Once the IU cumulative GPA is at least 2.00, the student will be removed from probationary status. A student will be advised of probationary status by letter from the Associate Dean for Academic Affairs. This policy does not apply to students pursuing graduate level degrees.

Dismissal (Undergraduate Only)

A student on probation who has completed a minimum of 12 IUPUI grade point average (GPA) hours is subject to dismissal if the student fails to attain an IU semester GPA of at least 2.00 in any two consecutive IUPUI semesters (Fall and Spring), including the semester that the student was first placed on probation and when the student's IU cumulative GPA is below a 2.00. This portion of the policy does not apply to students pursuing graduate level degrees.

(Graduate and Undergraduate)

A student can also be dismissed from the university when, in the opinion of the Associate Dean for Academic Affairs of the School of Science, the student has ceased making progress in the degree program. This policy may be applied to students at either the undergraduate or graduate level.

Readmission (Undergraduate Only)

A student dismissed for the first time must remain out of school at least one regular (Fall or Spring) semester. During the semester out of school, the student may petition the School of Science for readmission. A student dismissed for the second time must remain out of school at least two regular semesters (Fall and Spring), but may petition for readmission during the second semester out of school. Readmission after a second dismissal is extremely rare.

In order to allow sufficient time for considering a petition for readmission, a student eligible to submit a petition should do so before June 15 for the Fall semester, October 15 for the Spring semester, or March 15 for either Summer session.

A student readmitted will be so informed by letter from the Associate Dean for Academic Affairs. The letter will indicate any conditions and restrictions affecting readmission and continuance in the degree program.

Area Requirements

Area Requirements for Baccalaureate Degrees

The faculty of the School of Science has adopted the following degree requirements for the Bachelor of Arts and Bachelor of Science degrees. Students may follow the School of Science and departmental requirements that are in effect when they enter the School of Science, or they may choose new requirements that become effective after that date.

School of Science requirements are the minimal requirements in various areas, and individual departments may require more, as stated in their degree descriptions. Students should consult with departmental advisors in planning their courses of study.

- Bachelor of Arts Degree and Bachelor of Science Degree Requirements

Bachelor of Arts Degree and Bachelor of Science Degree Requirements

The requirements for these bachelor's degree programs include the common general education core approved by the faculties of both the School of Liberal Arts and the School of Science. This general education core, together with the major, is a curriculum based on the IUPUI Principles of Undergraduate Learning (see the front part of this bulletin for a description of these principles).

First-Year Experience Course

Each beginning freshman and transfer student (with less than 19 credit hours) in both the Bachelor of Arts and Bachelor of Science programs in the School of Science is required to take either SCI-I120 Windows on Science (1 cr.) or an equivalent freshman experience course that may be offered by a department in which the student is a major. Beginning computer science majors are encouraged to take CSCI 12000 Windows on Computer Science (1 cr.).

Area I English Composition and Communication Competency

Both Bachelor of Arts and Bachelor of Science students are required to take two courses in English composition worth at least 3 credit hours each and COMM-R110 Fundamentals of Speech Communication (3 cr.). The English composition requirement is partially satisfied by completing ENG-W131 (or ENG-W140 Honors). The second composition course must have ENG-W131 (or ENG-W140) as a prerequisite. An appropriate course in technical or research writing may be used to complete the second composition course requirement. Consult departmental guidelines. A grade of C or higher must be obtained in both composition courses.

Area II World Language Competency

1. A first-year proficiency in a world language is required for the Bachelor of Arts degree program. Note that American Sign Language may be used to satisfy this requirement. This requirement may be satisfied in one of the following ways:

- by completing first-year courses (8-10 credit hours) in a single language with passing grades;
- by completing a second-year or third-year course with a grade of C or higher;
- by taking a placement test and placing into the 200 level or higher. See the School of Liberal Arts section of this bulletin for items related to the

placement test, courses numbered 117, nonnative speakers, and credit for lower division language courses.

2. Check the department section of the bulletin for any reference to a language proficiency requirement for a Bachelor of Science degree program (e.g. Mathematical Sciences).

Area III

IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies

Four courses totaling 12 credit hours are required. The courses are to cover each of four areas:

1. One course in arts and humanities from List H

2. One course in social sciences from List S

3. One additional course from either List H or List S

4. One course in cultural understanding from List C

Courses taken from lists H, S, and C must be outside the student's major. For example, psychology majors cannot take a PSY-B course to satisfy one of the List H, S, or C requirements below.

It is recommended that the student see an academic advisor for updated lists.

Note that some courses may appear on more than one list. A cross-listed course may apply to only one of the required areas specified by the lists.

List H: Arts and Humanities

- ART 21000 History of Architecture 1 (3 cr.)
- CLAS-C101 Ancient Greek Culture (3 cr.)
- CLAS-C102 Roman Culture (3 cr.)
- CLAS-C205 Classical Mythology (3 cr.)
- COMM-T130 Introduction to Theatre (3 cr.)
- ENG-L105 Appreciation of Literature (3 cr.)
- ENG-L115 Literature for Today (3 cr.)
- ENG-L202 Literary Interpretation (3 cr.)
- ENG-L203 Introduction to Drama (3 cr.)
- ENG-L204 Introduction to Fiction (3 cr.)
- ENG-L205 Introduction to Poetry (3 cr.)
- ENG-L207 Women and Literature (3 cr.)
- ENG-L213 Literary Masterpieces I (3 cr.)
- ENG-L214 Literary Masterpieces II (3 cr.)
- ENG-W206 Introduction to Creative Writing (3 cr.)
- ENG-W207 Introduction to Fiction Writing (3 cr.)
- ENG-W208 Introduction to Poetry Writing (3 cr.)
- ENG-W210 Literacy and Public Life (3 cr.)
- ENG-W260 Film Criticism (3 cr.)
- FILM-C292 Introduction to Film (3 cr.)
- HER-E101 Beginning Drawing I (3cr.)
- HER-E105 Beginning Painting I (3 cr.)
- HER-E109 Color and Design for Non-Art Majors (3 cr.)
- HER-E111 Metalsmithing and Jewelry Design (3 cr.)
- HER-E201 Photography I (3 cr.)
- HER-E209 Drawing for Interior Design (3 cr.)
- HER-E214 Visual Learning: From the Simpsons to the Guerrilla Girls (3 cr.)
- HER-H100 Art Appreciation (3 cr.)
- HER-H101 History of Art 1 (3 cr.)
- HER-H102 History of Art 2 (3 cr.)
- HER-H200 Understanding Contemporary Art (3 cr.)
- HER-H221 Art Past and Present (3 cr.)
- HER-V214 History of Visual Communication (3 cr.)
- HIST-H195 Introduction to Digital Humanities (3 cr.)
- MHHS-M201 Introduction to Medical Humanities and Health Studies (3 cr.)
- MSTD-A101 Understanding Museums (3 cr.)
- MUS-E241 Introduction to Music Fundamentals (3 cr.)
- MUS-L100 Guitar Elect/Secondary (2 cr.)
- MUS-L101 Beginning Guitar Class (2 cr.)
- MUS-M174 Music for the Listener (3 cr.)
- MUS-V100 Voice Elective and Secondary (1 - 4 cr.)
- MUS-Z111 Introduction to Music Theory (3 cr.)
- MUS-Z201 History of Rock and Roll Music (3 cr.)
- NEWM-N100 Foundations of New Media (3 cr.)
- NEWM-N102 Digital Media Imagery (3 cr.)
- NEWM-N131 Game On! A History of Video Games
- NEWM-N201 Design Issues in Digital Media (3 cr.)
- NEWM-N260 Scriptwriting (3 cr.)
- PHIL-P110 Introduction to Philosophy (3 cr.)
- PHIL-P120 Ethics (3 cr.)
- PHIL-P162 Logic (3 cr.)
- PHST-P105 Giving & Volunteering in America (3 cr.)
- PHST-P211 Philanthropy and the Humanities (3 cr.)
- REL-R133 Introduction to Religion (3 cr.)
- REL-R173 American Religion (3 cr.)
- REL-R180 Introduction to Christianity (3 cr.)
- REL-R212 Comparative Religions (3 cr.)
- REL-R243 Introduction to New Testament (3 cr.)
- REL-R257 Introduction to Islam (3 cr.)

List S: Social Sciences

- BUS-F260 Personal Finance (3 cr.) NOTE: BUS-F260 is equivalent to F-151, F-152 and F-251 combined
- BUS-F151 Personal Finances of the College Student (1 cr.)
- BUS-F152 Basic Financial Planning and Investment (1 cr.)
- BUS-F251 Managing Personal and Financial Risk (1 cr.)
- BUS-W200 Introduction to Business & Management (3 cr.)
- BUS-X100 Business Administration: Introduction (3 cr.)
- COMM-C180 Introduction to Interpersonal Communication (3 cr.)
- COMM-M150 Mass Media & Contemporary Society (3 cr.)
- ECE 32700 Engineering Economics (3 cr.)
- ECON-E101 Survey of Economic Issues & Problems (3 cr.)
- ECON-E201 Introduction to Microeconomics (3 cr.)
- ECON-E202 Introduction to Macroeconomics (3 cr.)
- EDUC-P251 Educational Psychology for Elementary Teachers (1-4 cr.)
- ENG-Z205 Introduction to the English Language (3 cr.)

- FOLK-F101 Introduction to Folklore (3 cr.)
- GEOG-G110 Introduction to Human Geography (3 cr.)
- GEOG-G130 World Geography (3 cr.)
- HER-U101 Design Thinking (3 cr.)
- HIST-H105 American History I (3 cr.)
- HIST-H106 American History II (3 cr.)
- HIST-H108 Perspectives: World to 1800 (3 cr.)
- HIST-H109 Perspectives: World 1800 to Present (3 cr.)
- HIST-H113 History of Western Civilization I (3 cr.)
- HIST-H114 History of Western Civilization II (3 cr.)
- HLSC-H200 Survey of U.S. Health Care System Services (3 cr.)
- HLSC-H 220 Aging and the Older Person (3 cr.)
- HPER-F255 Human Sexuality (3 cr.)
- HPER-F258 Marriage and Family Interaction (3 cr.)
- HPER-H195 Principles of Lifestyle Wellness (3 cr.)
- INFO-I202 Social Informatics (3 cr.)
- INFO-I270 Intro to Human-Computer Interaction Prin and Practices (3 cr.)
- INFO-I275 Intro to Human-Computer Interaction Theory (3 cr.)
- JOUR-J110 Foundations of Journalism and Mass Communication (3 cr.)
- ME 32700 Engineering Economics (3 cr.)
- MSPT-Z100 Motorsports Studies (3 cr.)
- NEWM-N132 Game Design Psycology: Theory and Prototyping (3 cr.)
- OLS 20000 Introduction to Sustainable Principles and Practices (3 cr.)
- OLS 25200 Human Behavior in Organizations (3 cr.)
- OLS 26300 Ethical Decisions in Leadership (3 cr.)
- OLS 27400 Applied Leadership (3 cr.)
- PBHL-A140 Preparing for Disasters (3 cr.)
- PBHL-P109 Introduction to Public Health (3 cr.)
- PBHL-H101 Inflencing the Public's Health (3 cr.)
- PBHL-S120 Introduction to Community Health (3 cr.)
- PHST-P210 Philanthropy and the Social Sciences (3 cr.)
- PHST-P212 Philanthropy and Civic Engagement (3 cr.)
- POLS-Y101 Introduction to Political Science (3 cr.)
- POLS-Y103 Introduction to American Politics (3 cr.)
- POLS-Y217 Introduction to Comparative Politics (3 cr.)
- POLS-Y219 Introduction to International Relations (3 cr.)
- PSY-B110 Introduction to Psychology (3 cr.) NOTE: Course does not count for List S for psychology majors.
- SOC-R100 Introduction to Sociology (3 cr.)
- SOC-R121 Social Problems (3 cr.)
- SPEA-J101 American Criminal Justice System (3 cr.)
- SPEA-J150 Public Safety in America (3 cr.)
- SPEA-V170 Introduction to Public Affairs (3 cr.)
- SPEA-V221 Nonprofit & Voluntary Sector (3 cr.)
- SPEA-V222 Principles of Sustainability (3 cr.)
- SWK-S221 Human Growth and Development in the Social Environment (3 cr.)
- SWK-S251 History and Analysis of Social Welfare Policy (3 cr.)
- WOST-W105 Introduction to Women's Studies (3 cr.)

List C: Cultural Understanding

- AFRO-A140 Introduction to African American and African Diaspora Studies (3 cr.)
- AFRO-A150 Survey of the Culture of Black Americans (3 cr.)
- AFRO-A152 Introduction to African Studies (3 cr.)
- AMST-A101 Introduction to American Studies (3 cr.)
- AMST-A102 Asian American Culture (3 cr.)
- ANTH-A104 Cultural Anthropology (3 cr.)
- ASL-A131 First Year ASL I (3-5 cr.)
- ASL-A132 First Year ASL II (3-5 cr.)
- ASL-A211 Second Year ASL I (3-5 cr.)
- ASL-A212 Second Year ASL II (3-5 cr.)
- CLAS-C213 Sport & Competition in the Ancient World (3 cr.)
- CLAS-L131 Beginning Latin I (3-5 cr.)
- CLAS-L132 Beginning Latin II (3-5 cr.)
- COMM-C282 Experiencing Intergroup Dialogue (3 cr.)
- COMM-C299 Communicating Queer Identity (3 cr.)
- EALC-C131 Beginning Chinese I (3 - 5 cr.)
- EALC-C132 Beginning Chinese II (3-5 cr.)
- EALC-C201 Second Year Chinese I (2-4 cr.)
- EALC-C202 Second Year Chinese II (2-4 cr.)
- EALC-J131 Beginning Japanese I (3-5 cr.)
- EALC-J132 Beginning Japanese II (3-5 cr.)
- EALC-J201 Second Year Japanese I (2-4 cr.)
- EALC-J202 Second Year Japanese II (2-4 cr.)
- EDUC-E201 Multicultural Education and Global Awareness (3 cr.)
- ENG-L245 Introduction to Caribbean Literature (3 cr.)
- FREN-F131 First Year French I (3-5 cr.)
- FREN-F132 First Year French II (3-5 cr.)
- FREN-F203 Second Year French I (3-4 cr.)
- FREN-F204 Second Year French II (3-4 cr.)
- GER-G131 First Year German I (3-5 cr.)
- GER-G132 First Year German II (3-5 cr.)
- GER-G203 Second Year German I (3-4 cr.)
- GER-G204 Second Year German II (3-4 cr.)
- HIST-H100 Introduction to History (3 cr.)
- INTL-I100 Introduction to International Studies (3 cr.)
- ITAL-M131 Beginning Italian I (3-5 cr.)
- ITAL-M132 Beginning Italian II (3-5 cr.)
- ITAL-M200 Intermediate Italian I (3 cr.)
- ITAL-M250 Intermediate Italian II (3 cr.)
- ITAL-M131 Beginning Italian I (3-5 cr.)
- ITAL-M132 Beginning Italian II (3-5 cr.)
- ITAL-M200 Intermediate Italian I (3 cr.)
- ITAL-M250 Intermediate Italian II (3 cr.)
- LATS-L101 Introduction to Latino Studies (3 cr.)
- LATS-L228 An Interdisciplinary Look at U/S/ Latino/a Identities (3 cr.)
- MUS-M394 Survey of African American Music (3 cr.)
- MUS-Z105 Traditions in World Music (3 cr.)
- NAIS-N101 Introduction to Native American and Indigenous Studies (3 cr.)

- NELC-A131 Basic Arabic I (3-5 cr.)
- NELC-A132 Basic Arabic II (3-5 cr.)
- NELC-A200 Intermediate Arabic I (3-5 cr.)
- NELC-A250 Intermediate Arabic II (3-5 cr.)
- PBHL-A120 Regional Cultures and Mortality (3 cr.)
- PSY-B203 Ethics and Diversity in Psychology (3 cr.) NOTE: PSY-B203 does not count for List C for psychology major.
- REL-R101 Religion and Culture (3 cr.)
- REL-R103 The Bible and Culture (3 cr.)
- SPAN-S131 First Year Spanish I (3-5 cr.)
- SPAN-S132 First Year Spanish II (3-5 cr.)
- SPAN-S203 Second Year Spanish I (3-4 cr.)
- SPAN-S204 Second Year Spanish II (3-4 cr.)
- SWK-S102 Understanding Diversity in a Pluralistic Society (1-4 cr.)
- TCM 18000 Exploring Intercultural Technical Communication (3 cr.)
- TSEM-T208 Global Tourism Geography (3 cr.)
- TSEM-T234 Cultural Heritage Tourism (3 cr.)

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

Both Bachelor of Arts and Bachelor of Science students are required to complete at least four science lectures courses totaling a minimum of 12 credit hours outside the major department. At least one of the courses must have a laboratory component.

Courses that do not count in Area IIIC include AST-A130; BIOL-N100, BIOL-N200, CHEM-C100, FIS 10500, GEOL-G103, GEOL-G130, PHYS 10000, PHYS 14000, PHYS 20000, and all agriculture courses.

NOTE: This is not a complete list. If you have a question about whether a course is applicable or not, please speak with your academic advisor prior to registering to confirm.

Topics or variable credit hour courses (e.g., BIOL-N222) must receive approval from the School of Science Academic Dean's Office. Consult with your major department or the School of Science Academic Dean's Office for additional course restrictions.

Courses that do not count for any credit toward any degree program in the School of Science include, but are not limited to, BIOL-N120 and PHYS 01000.

Except for laboratory courses combined with corresponding lecture courses, 1 credit hour and, in general, 2 credit hour courses do not apply to this area. In addition, students must obtain grades of C- or higher in their Area IIIC courses. However, a single grade of D+ or D will be allowed for one course only. Check with the major department for additional restrictions or requirements. Some majors may require a minimum grade of C or higher.

Note that if credit has been established for both GEOL-G132 and GEOL-G107, then only GEOL-G107 may apply to Area IIIC. In this case, GEOL-G132 may count as a general elective provided that credit was established in GEOL-G132 preceding GEOL-G107.

Note that GEOG-G107 Physical Systems of the Environment (3 cr.)/GEOG-G108 Physical Systems of the Environment: Laboratory (2 cr.) may apply to Area IIIC with approval of the student's major department. Also, GEOG-G185 Global Environmental Change (3 cr.) is an acceptable substitute for GEOL-G185 Global Environmental Change (3 cr.).

IIID Analytical Reasoning Competency

Bachelor of Arts students must have at least one course of at least 3 credit hours in mathematics and one course of at least 3 credit hours in computer programming.

Bachelor of Science students must have at least two courses beyond college algebra and trigonometry, totaling 6 credit hours. In addition, one course of at least 3 credit hours in computer programming is required. Courses in applied statistics are not acceptable.

MATH-M010, 00100, MATH-M001, 00200, 11000, 11100, 12300, 13000, 13200, 13600; BUS-K201, BUS-K204, CSCI-N100-level courses; CIT 10600 do not count for any credit toward any degree in the School of Science. Computer Science CSCI-N241 and CSCI-N299 do not count in this area, but may count as general electives.

Students must obtain grades of C- or higher in their Area IIID courses. However, a single grade of D+ or D will be allowed for one course only. Check with the major department for additional restrictions or requirements. Some majors may require a minimum grade of C or higher.

Area IV

Major Department

Consult the listing of the major department for courses required within the major subject as well as courses required by the major department in the other areas (e.g. Biotechnology, Environmental Science, and Forensic & Investigative Sciences).

Capstone Experience Course

Each undergraduate major in the School of Science is to be provided a Capstone Experience (research, independent study/project, practicum, seminar, or field experience). The capstone, required of all majors, is to be an independent, creative effort of the student that is integrative and builds on the student's previous work in the major. See departmental sections of the bulletin for specific information about capstone courses.

Undergraduate Programs

The Purdue School of Science offers the following undergraduate degree programs:

Baccalaureate Degrees

- Biology (B.A.)
- Biology (B.S.)
- Biology Secondary School Teaching
- Biotechnology
- Chemistry (B.A.)
- Chemistry (B.S., ACS certified)
- Chemistry Secondary School Teaching
- Computer and Information Science

- Earth Science Secondary School Teaching
- Environmental Science
- Forensic and Investigative Sciences (B.S. FEPAC accredited)
- Geology (B.A.)
- Geology (B.S.)
- Interdisciplinary Studies
- Mathematics
- Mathematics Teaching B.S.
- Neuroscience
- Physics
- Physics Secondary School Teaching
- Psychology (B.A. & B.S.)

General Requirements

School of Science requirements are the minimal requirements in various areas, and individual departments/programs may require more, as stated in their degree descriptions. Students should consult with departmental/program advisors in planning their courses of study.

1. A minimum of 120 credit hours for all programs must be completed. Approval must be obtained from the School of Science to use as credit toward graduation any course that was completed 10 or more years previously.
2. A minimum grade point average of 2.00 is required.
3. A minimum of 24 credit hours must be taken in a major subject (see program requirements) with a minimum grade point average of 2.00. No grade below C- is acceptable in the major subject. Some majors may have higher minimum grade requirements (see program requirements).
4. At least four courses totaling a minimum of 12 credit hours in the major subject must be completed at IUPUI (see departmental/program requirements).
5. Residence at IUPUI for at least two semesters and completion, while at IUPUI, of at least 32 credit hours of work in courses at the 300 level or higher are required.
6. With the approval of the Executive Director of Academic and Student Affairs or the Associate Dean for Academic Affairs, students who have had at least four semesters of resident study may complete up to 15 credit hours of the senior year at another approved college or university. In order to transfer back to IUPUI, a transfer course must be a grade of C or higher.
7. Courses taken on the Pass/Fail option may be applied only as general electives and not toward degree AREA requirements of the school or department/program. Courses taken on the Pass/Fail option may apply to the 32 credit hours residency requirement listed in item 5 if the course is at the 300-level or higher.
8. No more than 64 credit hours earned in accredited junior or community colleges can be applied toward a degree.
9. Students may enroll in independent study (correspondence) courses for general electives up to a maximum of 12 credit hours with permission of the Executive Director of Academic and Student Affairs or the Associate Dean for Academic Affairs. Independent study (correspondence) courses may not apply to the 32 credit hours residency requirement listed in item 5. Independent study (correspondence) courses may not apply to course requirements in minors or certificates.
10. With permission of the appropriate department or program, credit may be earned through special credit examination. Credits earned by special credit examination may be used toward the total credit hours required and to satisfy AREA requirements for a degree.
11. The following courses do not count for any credit toward any degree program in the School of Science: AGR 10100; BIOL-N120; BUS-K201, BUS-K204; CSCI-N100-level courses; CIT 10600; all remedial and developmental courses; EDUC-U205, EDUC-W200, EDUC-W201, EDUC-X100, EDUC-X150, EDUC-X151, EDUC-X152; ENG-G010, ENG-G011, ENG-G012, ENG-W001, ENG-W031; MATH-M010, MATH 00100, MATH-M001, MATH 00200, MATH 11000, MATH 11100, MATH 12300, MATH 13000, MATH 13200, MATH 13600; PHYS 01000; UCOL-U112, UCOL-U210.

    NOTE: This is not a complete list. The School and department/program reserve the right to exclude course credit when it is deemed as overlapping with other earned credit or it is determined to be remedial in nature.

    - Note that CHEM-C100 may count for general elective credit only if the student has not already established credit in CHEM-C101 or CHEM-C105/CHEM-C106, or equivalent courses. Otherwise, CHEM-C100 does not count for credit in any given degree program.
    - Note that if credit has been established for both GEOL-G132 and GEOL-G107, then only GEOL-G107 may apply to AREA IIIC. In this case, GEOL-G132 may count as a general elective provided that credit was established in GEOL-G132 preceding GEOL-G107.

12. No more than 6 credit hours of studio, clinical, athletic, or performing arts course work will be approved unless the additional credit hours are required to complete a (or were previously applied to an earned) certificate, minor, or second degree. Verification of academic intent or program completion of a certificate, minor, or second degree is required. Also, any athletic or performance-type credit earned through military service that is eligible for transfer to IUPUI will count and not be considered as part of the 6-credit hour minimum. Consult a school or departmental/program advisor with questions.
13. No more than 8 credit hours of military credit can apply towards the degree program.
14. An online application for a degree or certificate graduation must be completed by the following

deadlines. Beginning Spring 2016 semester of graduation, only students who are not enrolled in any other course are required to enroll in CAND 99100. Authorization for this course will be given once the application has been submitted. Applications must be submitted by January 15 for August graduation; May 15 for December graduation; and October 15 for May graduation. If not enrolled in any other courses, students should also register for the appropriate section of CAND 99100 (0 credit hours) during their final semester before graduation. Degree candidates for December, May, or August graduation of a particular academic year may participate in the May Commencement (e.g. students having graduated in December 2015, May 2016, or August 2016 will participate in the May 2016 Commencement Exercises). Students completing a certificate program do not participate in Commencement Exercises.

15. In general, credit is not allowed for both of two overlapping courses. Examples of course overlaps include **(NOTE: This is not a complete list.)**:

    - BIOL-N100 and BIOL-K101/BIOL-K103
    - BIOL-N100 and BIOL-K102/BIOL-K104
    - BIOL-N212/BIOL-N213 and BIOL-N217
    - BIOL-N214/BIOL-N215 and BIOL-N261
    - CHEM-C101/CHEM-121 and CHEM-C105 and/or CHEM-C106
    - CHEM-C102 and CHEM-C341/CHEM-C343
    - CHEM-C110 and CHEM-C341
    - CHEM-C110/CHEM-C115 and CHEM-C341/CHEM-C343
    - CHEM-C360 and CHEM-C361
    - CHEM-C325 and CHEM-C410/CHEM-C411
    - GEOL-G110 and GEOG-G107
    - GEOL-G185 and GEOG-G185
    - GEOL-G221 and GEOL-G306
    - GEOL-G222 and GEOL-G306
    - MATH-M119 and MATH 22100 or MATH 23100 or MATH 16300 or MATH 16500
    - MATH 15100 or 15900 and MATH 15300/15400
    - MATH 15100 and MATH 15900
    - MATH 22100/MATH 22200 and MATH 23100/MATH 23200
    - MATH 22100/MATH 22200 and MATH 16300/MATH 16400 or MATH 16500/MATH 16600
    - MATH 23100/MATH 23200 and MATH 16300/MATH 16400 or MATH 16500/MATH 16600
    - MATH 16300 and MATH 16500
    - MATH 16400 and MATH 16600
    - PHYS-P201/PHYS-P202 or PHYS 21800/PHYS 21900 and PHYS 15200/PHYS 25100
    - PSY-B320 and BIOL-L391 Addictions (IU East)
    - SCI-I120 and UCOL-U110
    - STAT 30100 and PSY-B305

    In addition, any course that is retaken is considered an overlap. Consult with your academic advisor regarding other overlapping courses.

See statements about required First-Year Experience Course and Senior Capstone Experience in the description of the Bachelor of Arts degree and the Bachelor of Science degree programs.

Minors and Certificate Programs

Minors

Minors are often awarded with the completion of a bachelor's degree, but may be awarded earlier. Independent Study (correspondence) courses may not be used to fulfill course requirements in a minor program. Check with the department or program offering the minor for additional restrictions or requirements.

- Applied Computer Science (minor)
- Biology
- Chemistry
- Computer and Information Science
- Forensic and Investigative Sciences
- Geology
- Geochemistry
- Health Psychology
- Mathematics
- Neuroscience
- Physics
- Psychology

Certificate Program

- Applied Computer Science (certificate)
- Data Analytics

IUPUI Honors College and Science Honors

The School of Science Honors Program offers students from any School of Science major the opportunity to build on the school's challenging curricula through deeper, more engaging learning experiences in the classroom, in the lab, and throughout campus.

The IUPUI Honors College is open to students in both the Purdue and Indiana University degree programs. Students with an overall grade point average (GPA) of 3.5 after their first full academic year of work, entering freshmen with a minimum combined math and verbal (critical reading) SAT score of 1250 (taken prior to March 2016) or 1310 (taken March 2016 or later), or ACT of 28, and those with a cumulative high school GPA of 3.75 (weighted) are invited to apply for the Honors Program. The deadline to apply for entering Freshmen is November 15. Continuing students will apply via Science Honors. Applications for Science Honors are due mid-April each year. Students must have at least four semesters remaining after admission to complete the Science Honors Program. Students with a GPA of more than 3.5 who are not enrolled in the Honors College may be permitted to take honors courses. They should, however, discuss the matter with their academic advisor and the Honots College before doing so.

In general, students may take no more than 6 credit hours of honors coursework each semester. Students may earn honors credit by taking special Honors College courses (HON-H300, HON-H399, HON-H400), by taking specially designated honors course sections, by doing special overseas or internship work, or by contracting for honors credit using an H-Option contract in conjunction with regular classes.

H-Option contracts are the most popular and frequent way that students earn honors credit. An H-Option requires that a student work out with the instructor of a course a specific contract for a paper, field project, oral presentation, etc., early in the semester. The contract is not merely an exentsion of the regular class work, but an opportunity not provided by regular assianments. The Honors College reviews all contracts prior to students beginning projects.

In order to receive an honors notation at graduation, students must complete 24 hours of honors coursework with at least a 3.3 cumulative GPA. For students entering the Honors College via Science Honors, 12 of the required 24 hours must be science courses. In order to remain in good honors acadeic standing, student also must maintain a 3.3 semester and cumulative GPA, enroll in honors coursework each semester, achieve a B or higher in all honors courses, and take honors coursework each fall and spring semester.

For additional information, contact the IUPUI Honors College, 0124 University Library, 755 W. Michigan Street, Indianapolis, IN 46202-5164; phone (317) 274-2660; www.honorscollege.iupui.edu

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Departments & Centers

- Teaching Certification
- PreProfessional Programs
- Honors Program
- Undergraduate Research

Graduate Preprofessional Programs

Preparation for a career in the graduate health professions (e.g., medicine, dentistry, pharmacy, et al) is a multi-dimensional task. One important aspect is intellectual and academic development—the college education. The preprofessional student is urged to select a degree program that is of greatest interest to them. There is no preprofessional major. Most graduate health profession careers depend upon daily use of science, so a strong science foundation is critical in the student's preparation. These careers also require academic breadth and depth, so a balanced science/non-science curriculum is advised. While some health professional programs (dental, pharmacy, veterinary medicine) may not require an undergraduate degree for especially strong applicants, the vast majority of the successful applicants have an undergraduate degree. Having a bachelor's degree provides the necessary background, and serves as a backup plan if the student does not matriculate to a professional program.

Students may choose from a variety of majors while completing preprofessional requirements. Students are encouraged to consult with prospective major academic advisor, as well as the School of Science Preprofessions Healths advisor in the PREPs Office (if enrolled in a School of Science degree program; if not, see the health professions adviser in the Health and Life Sciences Advising Center).

There are many schools across the country for each health profession from which to choose and we encourage students to apply to multiple programs.

Post-baccalaureate students may choose to take prerequisite courses through the School of Science for entry into professional programs. These students should consult with the health professions' advisor for help with the admission process and course selection.

Graduate professional programs require not only specific prerequisite courses, a strong GPA, and a profession-specific or general entrance test, but also experience including shadowing in the field, volunteering and leadership activities. See your health professions adviser to discuss opportunities and resources to build professional development skills.

Pre-Medical Program

Students planning to apply to medical school must choose a degree program in addition to taking courses that fulfill the admission requirements for their chosen medical school. While many opt to complete their degrees with science majors, any major is acceptable. Freshmen should declare their chosen major and seek advising for their degree requirements from the academic advisor in their major department. Pre-Professional advising for pre-medical students, including the access of professional development resources for shadowing, internships, research, and volunteering as well as interview preparation is available in the Pre Professional and Career Preparation (PREPs) office.

IUPUI offers preprofessions health advising for the School of Science at the Preprofessional and Career Preparation (PREPs) office and for majors outside of the School of Science advising is conducted by the Health Life Sciences Advising Center (HLS). Pre-medical students should consult their preprofessions health advisor within their first semester at IUPUI. Baccalaureate students who are selecting courses in the School of Science to prepare for medical school are also invited to use the preprofessions health advising service for help with the admission process.

Following are the IUPUI courses that meet the requirements for application to IU School of Medicine and most medical schools around the country, and represent the content for the Medical College Admission Test (MCAT). Please see medical school websites for any school specific requirements. The premedical student should complete the bachelor's degree. The MCAT is required for all medical schools, both allopathic (M.D.) and osteopathic (D.O.).

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
CHEM-C342 Organic Chemistry II*	3 cr.
PHYS-P201 General Physics I	5 cr.
PHYS-P202 General Physics II	5 cr.
BIOL-K384 Biochemistry**	3 cr.
PSY-B110 Introduction to Psychology	3 cr.
SOC-R100 Introduction to Sociology	3cr.

*CHEM-C344 (Organic Chemistry II Laboratory) is not required for the IU School of Medicine. Students are strongly encouraged to complete the course as it may be required by other universities as well as a requirement for Science degree completion.

**Completion of Genetics and Molecular Biology (BIOL-K 322) or Cell Biology (BIOL-K 324) is required to enroll in this course.

Pre-Dental, Pre-Veterinary Medicine, Pre-Optometry

Dentistry, Veterinary Medicine, and Optometry are career goals and not majors at the undergraduate level. Students generally select a bachelor degree of their choice in which they can excel and incorporate specific pre-requisites prior to entering a dental, veterinary or optometry school. Since these careers involve a strong background in life and physical sciences as well as working with people, students often choose a major in Biology, Neuroscience, Psychology or Chemistry to fulfill their requirements. Students should also include coursework in humanities to ensure they are well rounded.

In very rare situations, a handful of students are admitted to these professional programs after completing only the 90 hours of pre-requisites; however this is not the norm. A bachelor degree is strongly recommended. Pre-Dental, Pre-Veterinary Medicine and Pre-Optometry coursework requires careful planning and preparation.

Advising for degree requirements is provided in the department where the major is housed. Pre-Professional advising on pre-dental, pre-optometry, and pre-veterinary professional development such as resources for shadowing, internships, research, and volunteering as well as interview preparation and assistance with personal statements is available in the Pre Professional and Career Preparation (PREPs) office. Post baccalaureate and graduate students working on pre-dental, pre-optometry, and pre-veterinary requirements are also advised in the same manner. Pre-requisites listed below are for Indiana University and Purdue University programs. Students applying to different programs are encouraged to check with the schools admissions office for a current listing of specific program pre-requisites.

Pre-Dentistry

The Dental Admission Test (DAT) is required for admission to dental school. Applicants should also show evidence of manual dexterity and complete 100 hours of shadowing in General Dentistry.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
BIOL-K384 Biochemistry**	3 cr.
BIOL-K356 Microbiology or BIOL-K 338 Immunology	3 cr.
BIOL-K324 Cell Biology or BIOL-K322 Genetic & Molecular Biology	3 cr.
BIOL-N217 Human Physiology	5 cr.
BIOL-N261 Human Anatomy	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
CHEM-C342 Organic Chemistry II*	3 cr.
PHYS-P201 General Physics I	5 cr.
PHYS-P202 General Physics II	5 cr.
PSY-B110 Introduction to Psychology	3 cr.
ENG-W131 Reading, Writing and Inquiry I	3 cr.
COMM-R110 Fundamentals of Speech Comm	3 cr.

*CHEM-C344 (Organic Chemistry II Laboratory) is not required for the IU School of Dentistry. Students are encouraged to complete the course as it may be required by other universities.

**Completion of Genetics and Molecular Biology (BIOL-K 322) or Cell Biology (BIOL-K 324) is required to enroll in this course.

Pre-Veterinary Medicine

The Graduate Record Exam (GRE) is required for admission to many veterinary schools. It is also recommended that students gain some practical experience working with animals before applying to a veterinary program.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
BIOL-K322 / BIOL-K323 Genetics and Molecular Biology/Lab	3 cr./2 cr.
BIOL-K356 / BIOL-K357 Microbiology/Lab	3 cr./2 cr.
BIOL-K384 Biochemistry*	3 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
CHEM-C342 / CHEM-C344 Organic Chemistry II/Lab	3 cr./2 cr.
PHYS-P201 General Physics I	5 cr.
PHYS-P202 General Physics II	5 cr.
STAT 30100 Elementary Statistical Methods I	3 cr.
(or STAT-N501 or SPEA-K300)	(3 cr.)
ENG-W131 Reading, Writing and Inquiry I	3 cr.
COMM-R110 Fundamentals of Speech Communication	3 cr.
Arts and Humanities electives	9 cr.

*Completion of Genetics and Molecular Biology (BIOL-K 322) or Cell Biology (BIOL-K 324) is required to enroll in this course

Pre-Optometry

The Optometry Aptitude Test (OAT) is required for admission. It is suggested that students also have some exposure to the Optometry profession before applying to a program.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II*	5 cr.
BIOL-K356 / BIOL-K357 Microbiology/Lab	3 cr./2 cr.
Advanced Biology: BIOL-K322 Genetics and Molecular Biology or	3 cr.
BIOL-K324 Cell Biology or	3 cr.
BIOL-N217 Human Physiology ** or	5 cr.
BIOL-N261 Human Anatomy**	5 cr.
BIOL-K384 Biochemistry***	3 cr.
BIOL-N217 Human Physiology*	5 cr.
BIOL-N261 Human Anatomy*	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
ENG-W131 Reading, Writing and Inquiry I	3 cr.
ENG-W270 Argumentative Writing	3 cr.
(or ENG-W231 Professional Writing Skills)	(3 cr.)
MATH 23100 Calculus for the Life Sciences I	3 cr.
(or MATH 22100 or MATH 16500 or MATH-M119)	(3 cr./4 cr.)
PHYS-P201 General Physics I	5 cr.
PHYS-P202 General Physics II	5 cr.
PSY-B110 Introduction to Psychology	3 cr.
STAT 30100 Elementary Statistical Methods I	3 cr.
(or STAT-N501 or PSY-B305 or ECON-E270)	(3 cr.)
If the student does NOT have a bachelor's degree, additional courses are required:	
Arts and Humanities	6 cr.
World language	6 cr.
(students having completed 2 or more years in high school with C or better are exempt)	
Social and Historical Studies	6 cr.
Additional credit hours to reach 90 credit hours	

*BIOL-K 103 is not required by the IU School of Optometry, but completion of this course is rquired to enroll in other required biology coursework.

**BIOL-N217 and BIOL-N261 are strongly recommended but not required by the IU School of Optometry. Students are encourage to complete these courses as they may be required by other universities.
***Completion of Genetics and Molecular Bioloty (BIOL-K 322) or Cell Biology (BIOL-K 324) is required to enroll in this course.

Pre-Pharmacy

The Pre-Pharmacy program at IUPUI consists of approximately 70-90 hours of coursework required to apply to pharmacy schools. A bachelor degree is not

required however; many students elect to complete a degree program in a science major before application to Pharmacy school. Students declaring pre-pharmacy upon admission are assigned to the Department of Biology for completion of the required courses. Admission information as well as professional development activities including resources for shadowing, internships, research and volunteering as well as interview preparation and assistance with personal statements is provided by the Pre-Professional and Career Preparation (PREPs) Office. The Pharmacy College Admission Test (PCAT) is required by approximately 2/3 of Pharmacy schools. Purdue University does not require the PCAT for admission. Additional categories of electives are required for graduation from the pharmacy program at Purdue. Since they are not required for admission to the program, they may be completed concurrently with pre-requisite coursework or after admission to the program. Pre-requisite courses listed below are for the Purdue University School of Pharmacy. Students are encouraged to check with all schools they are applying to for specific course requirements.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
BIOL-K356 / BIOL-K357 Microbiology/Lab	3 cr./2 cr.
BIOL-K384 Biochemistry*	3 cr.
BIOL-K338 Immunology	3 cr.
BIOL-N261 Human Anatomy	5 cr.
BIOL-N217 Human Physiology	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
CHEM-C342 / CHEM-C344 Organic Chemistry II/Lab	3 cr./2 cr.
ECON-E101 Survey of Economic Issues and Problems	3 cr.
MATH 23100 Calculus for the Life Sciences I	3 cr.
(or MATH 22100 or MATH 16500)	3 cr. or 4 cr.
STAT 30100	3 cr.
(or PSY-B305 or SPEA-K300 or ECON-E270 or SOC-R359)	(3 cr.)
PHYS-P201 General Physics I	5 cr.
ENG-W131 Reading Writing and Inquiry I	3 cr.
COMM-R110 Fundamentals of Speech Communication	3 cr.

*Completion of Genetics and Molecular Biology (BIOL-K 322) or Cell Biology (BIOL-K 324) is required to enroll in this course.

Pre-Occupational Therapy (OT)

Students may select any undergraduate major and include a set of core courses needed for pre-requisites for a doctoral degree in Occupational Therapy. Undergraduate degree programs in Biology, Psychology, or Neuroscience may be of interest to the pre-occupational therapy student. Advising for undergraduate degree requirements is available in the major department. Additional pre-professional advising including resources such as shadowing, internships, volunteering, and research as well as application and admission assistance to OT programs is provided in the Pre-Professional and Career Preparation (PREPs) Office. An advisor in the IUPUI School of Health and Human Sciences is also available for consultation. Applicants must have completed a bachelor degree for consideration for a graduate program in OT. The Graduate Record Examination (GRE) is required for admission to many OT programs. The GRE is not required for the OT program at IUPUI. Students must have 40 observational hours in three different OT settings. Pre-requisite courses listed below are for Indiana University School of Health and Human Sciences. Students are encouraged to check with all schools they are applying to for specific course requirements.

BIOL-N217 Human Physiology	5 cr.
BIOL-N261 Human Anatomy	5 cr.
PSY-B110 Introduction to Psychology	3 cr.
PSY-B310 Life Span Development	3 cr.
PSY-B380 Abnormal Psychology	3 cr.
SOC-R100 Introduction to Sociology	3 cr.
(or ANTH-A104 Cultural Anthropology)	(3 cr.)
STAT 30100 Elementary Statistical Methods I	3 cr.
(or STAT-N501 or PSY-B305 or ECON-E270 or SPEA-K300 or SOC-R359)	(3 cr.)
CLAS-C210 Modern Terminology and Ancient Medicine	3 cr.
(or HIM-M330 Medical Terminology or RADI-R108 Medical Terminology (need dept. consent))	3 cr. or 1 cr.

*Students should be at or above the level of Mathematics in MATH 15300/15400 or MATH 15900 to be successful in Physics.

Pre-Physical Therapy (PT)

Students may select any undergraduate major and include a set of core courses needed for pre-requisites for a graduate degree in Physical Therapy. Undergraduate degree programs in Biology, Chemistry, Neuroscience, or

Psychology may be of interest to the pre-physical therapy student. Advising for undergraduate degree requirements is available in the major department. Additional pre-professional advising including resources such as shadowing, internships, volunteering, and research as well as application and admission assistance to PT programs is provided in the Pre-Professional and Career Preparation (PREPs) Office. An advisor in the IUPUI School of Health and Human Sciences is also available for consultation. Applicants must have completed a bachelor degree for consideration for a graduate program in PT. The Graduate Record Examination (GRE) is required for admission to many doctoral (DPT) programs. The GRE is not required for the IUPUI DPT program. Students must have 40 clinical observation hours for admission; 20 hours in an in-patient setting and 20 hours in an outpatient setting. Pre-requisite courses listed below are for Indiana University School of Health and Human Sciences. Students are encouraged to check with all schools they are applying to for specific course requirements.

BIOL-N217 Human Physiology	5 cr.
BIOL-N261 Human Anatomy	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
PHYS-P201 General Physics I & PHYS-P202 General Physics II	5 cr. & 5 cr.
(or PHYS 21800 & 21900 General Physics)	4 cr. & 4 cr.
PSY-B110 Introduction to Psychology	3 cr.
PSY-B310 Life Span Development	3 cr.
STAT 30100 Elementary Statistical Methods I	3 cr.
(or STAT-N501 or PSY-B305 or ECON-E270 or SOC-R359 or SPEA-K300)	(3 cr.)
Two 3-credit hour courses in the humanities, social sciences area.	6 cr.
CLAS-C210 Modern Terminology and Ancient Medicine	3 cr.
or HIM-M330 Medical Terminology or RADI-R108 Medical Terminology (need dept. consent))	3 cr. or 1 cr.

Pre-Physician Assistant (PA)

Students may select any undergraduate major and include a set of core courses needed for pre-requisites for a graduate program as a Physician Assistant. Undergraduate degree programs in Biology, Chemistry, Neuroscience, or Psychology may be of interest to the pre-PA student. Advising for undergraduate degree requirements is available in the major department. Additional pre-professional advising including resources such as shadowing, internships, volunteering, and research as well as application and admission assistance to PA programs is provided in the Pre-Professional and Career Preparation (PREPs) Office. An advisor in the IUPUI School of Health and Human Sciences is also available for consultation. Applicants must have completed a bachelor degree for consideration for a graduate program as a Physician Assistant. The Graduate Record Examination (GRE) is required for admission to many PA programs. The GRE is not required for the IUPUI PA program. In addition, PA programs also require that students have accumulated a significant number of hours working or volunteering in a direct patient care setting prior to acceptance to a PA graduate program. Pre-requisite courses listed below are for Indiana University School of Health and Human Sciences. Students are encouraged to check with all schools they are applying to for specific course requirements.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II*	5 cr.
BIOL-N261 Anatomy & BIOL-N217 Physiology	5 cr. & 5 cr.
BIOL-K356 & K357 Microbiology and Lab	(3/2 cr.)
CHEM-C105/CHEM-C125 Principles of Chemistry I/ Lab	3/2 cr.
CHEM-C106/CHEM-C126 Principles of Chemistry II/ Lab	3/2 cr.
CHEM-C341/CHEM-C343 Organic Chemistry I/Lab	3/2 cr.
STAT 30100 (or SPEA-K300, or PSY-B305 or SOC-R359)	3 cr.
PSY-B110 Introduction to Psychology (or SOC-R100)	3 cr.
CLAS-C210 Modern Terminology and Ancient Medicine	3 cr.
or HIM-M330 Medical Terminology or RADI-R108 Medical Terminology (need dept. consent)	3 cr. or 1 cr.
Advanced Biology with lab: BIOL-K322/BIOL-K323 Genetics and Molecular Biology/Lab	3 cr./2 cr.
or BIOL-K324/BIOL-K325 Cell Biology/Lab	3 cr./2 cr.
or BIOL-K338/BIOL-K339 Immunology/Lab	3 cr./2 cr.

*BIOL-K 103 is not required by the IUPUI Schol of Health and Human Sciences, but completion of this course is required to enroll in other required biology coursework.

Pre-Professional and Career Preparation for Science Students: PREPs

PREPs provides comprehensive career services and pre-professional advising for all School of Science undergraduate students, graduate students, and alumni. This includes individual appointments, walk-in advising, workshops, and classroom presentations. Our staff can help with each step of the career development process including career exploration, developing professional experience through internships, job shadowing and volunteering, and preparing for professional school, graduate school and the world of work. We help students learn to identify and articulate their unique skills and strengths, particularly through creating effective résumés, cover letters, personal statements and preparing for interviewing and networking. Since most students seek higher education in order obtain good career prospects or to advance to graduate or professional school, PREPs should be a component of your academic and professional planning.

The PREPs Office is located in University Tower - 200. Get more information at science.iupui.edu/career-services/index.html.

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Teaching Certification

Becoming a Licensed Teacher

Top quality science and mathematics teachers are in high demand, and the IU School of Education at IUPUI is recognized as a leader in urban education. Students who want to become teachers of middle school and/or high school science or mathematics must take specific programs of study aligned to the standards for teaching these subject areas. Teachers must fully understand the content they teach, the realities of schools, and methods for successfully teaching every child. This requires earning a major or a degree in the School of Science and completing a teacher preparation program in the School of Education.

Mathematics and science majors who want to become teachers need to seek advising from the School of Science as soon as possible so that they take the right courses as they complete their majors. Mathematics majors often find they can complete both their major in mathematics and the (as part of their bachelor's degree. Science majors typically complete their bachelor's degree in science and then enter the (as post baccalaureate students, earning the first half of their master's degree in this 12-month teacher education program. The *Transition to Teaching* program is also an option for mathematics graduates or returning students.

Admission to either the undergraduate (LTTL) or the graduate (T2T) teacher education program is competitive. Students must complete a formal application and have most of the required courses in the major, passing PRAXIS test scores, a clear criminal history check, and at least a 2.50 overall GPA. Specific information about admission to each program is available on the School of Education Web site.

Both the *Learning to Teach/Teaching to Learn* program and the *Transition to Teaching* program enable students to earn Rules 2002 Indiana Teacher Licenses. The LTTL program consists of 43 credit hours of undergraduate study, sequenced across four semesters including a final semester of student teaching. The T2T program is 18 credit hours (plus program fees) of graduate study done while practice teaching in schools everyday for one school year.

Note: Information about teacher education and licensing may change for many reasons, including legislative mandates and state policies. Students need to check for current information on the School of Education web site and meet with School of Education advisors regularly.

Student Learning Outcomes

- Biology
- Biotechnology
- Chemistry
- Computer and Information Science
- Environmental Science
- Forensic and Investigative Sciences
- Geology
- Interdisciplinary Studies
- Mathematics
- Neuroscience
- Physics
- Psychology

Bachelor of Arts & Bachelor of Science in Biology

Students who graduate with a B.A. or B.S. in Biology will be able to:

1. Demonstrate knowledge of how biological molecules such as DNA, RNA, proteins, lipids, and carbohydrates contribute to the structure and function of prokaryotic and eukaryotic cells.
2. Integrate the cellular, molecular and physiological basis of how organisms develop structure, carry out functions, sense and control their environment, and respond to external change.

3. Describe how genetic principles associated with natural selection contribute to the functioning of an organism and the evolutionary diversity of life on earth.
4. Access, evaluate, and communicate information relevant to the study of biological sciences.
5. Work safely and effectively with basic laboratory techniques and instrumentation.
6. Exhibit problem solving and critical thinking skills needed to design and implement laboratory projects, and gather, analyze and draw conclusions from data.
7. Apply basic principles of chemistry, math, and other disciplines to the functioning of living systems.
8. Successfully complete a laboratory or literature-based research project with supervision from a faculty sponsor.

Biotechnology

Students who graduate with a B.S. degree in Biotechnology (B.S.B.):

1. Enter IUPUI with the ***Skills And Knowledge Standards For Associate Degree In Biotechnology Programs In Indiana*** (Indiana Commission for Higher Education) as an outcome of prior completion of an Associate Degree in Biotechnology from Ivy Tech Community College.

2. Demonstrate knowledge of how biological molecules such as DNA, RNA, proteins, lipids, and carbohydrates contribute to the structure and function of prokaryotic and eukaryotic cells.

3. Integrate the cellular, molecular, genetic, and biochemical basis of how organisms carry out functions, sense and control their environment, and respond to external change.

4. Access, evaluate, and communicate information relevant to the study of biological sciences.

5. Work safely and effectively with basic laboratory techniques and instrumentation.

6. Exhibit problem solving and critical thinking skills needed to design and implement laboratory projects, and gather, analyze and draw conclusions from data.

7. Apply basic principles of chemistry, math, and other disciplines to the functioning of living systems.

8. Successfully complete a biotechnology-based internship or research project prior to attending IUPUI.

Chemistry

Bachelor of Arts in Chemistry (B.A.)

Students who graduate with a B.A. in Chemistry will be expected to:

1. Understand major concepts and theoretical principles in organic chemistry, analytical chemistry, and physical chemistry.
2. Exhibit problem solving and critical thinking skills relevant to the field of chemistry.
3. Access, retrieve, and interpret accurate and meaningful information from the chemical literature.
4. Communicate scientific information effectively, in both oral and written formats.
5. Work effectively in teams in both classroom and laboratory.
6. Design, carry out, record, analyze the results and draw conclusions from chemical experiments.
7. Use instrumentation for chemical analysis and separation.
8. Use computers in experiments, data analysis, and in communication.
9. Understand and follow safety guidelines in chemical labs.
10. Be aware of and abide by ethical standards in chemical discipline.
11. Integrate knowledge from mathematics, physics, and other disciplines in support of chemistry.

Bachelor of Science in Chemistry (B.S.)

Students who graduate with a B.S. in Chemistry will be expected to:

1. Understand major concepts, theoretical principles, and experimental findings in organic chemistry, analytical chemistry, inorganic chemistry, physical chemistry and biochemistry.
2. Exhibit problem solving and critical thinking skills relevant to the field of chemistry.
3. Access, retrieve, and interpret accurate and meaningful information from the chemical literature.
4. Communicate scientific information effectively, in both oral and written formats.
5. Work effectively in teams in both classroom and laboratory.
6. Design, carry out, record and analyze the results of chemical experiments.
7. Use instrumentation for chemical analysis and separation.
8. Use computers in experiments, data analysis, and in communication.
9. Understand and follow safety guidelines in chemical labs.
10. Be aware of and abide by ethical standards in chemical discipline.
11. Integrate knowledge from mathematics, physics and other disciplines in support of chemistry.
12. Conduct research projects with supervision.

Computer and Information Science

The Department's Undergraduate Committee states the following Student Learning Outcomes. After graduation, a student should be able to:

1. Write software programs in multiple programming languages.
2. Understand the theoretical foundations of computer science, including the study of discrete computational structures.
3. Understand and use different programming language paradigms such as procedural, object-oriented, etc.
4. Use different data structures such as linked lists, arrays, stacks, trees, graphs, hash tables, etc. to improve efficiency of software, and mathematically or experimentally analyze them and operations on them.
5. Know a diverse array of computational algorithms and their analysis techniques, as related to

searching, sorting, optimization, and graph problems.
6. Know fundamental limitations of designing efficient algorithms and the theoretical meaning of the P?=NP problem.
7. Know the basic concepts in formal language theory and their application to compiler design.
8. Understand the basic design of computer architecture and their relationship to software design.
9. Understand and design the basic functionalities of different computer operating systems.
10. Acquire knowledge in multiple advanced areas of computer science, such as databases, data mining, multimedia, graphics, computing security, networking, software engineering, bio-computing, etc.
11. Design, develop, and test small scale software projects.
12. Write scientific project reports and software documentation.

Bachelor of Science in Environmental Science (B.S.)

Broad Earth Sciences Undergraduate Program Goals

Upon graduating, students with an undergraduate degree in Environmental Science (BSES) will:

- gain access to employment in professions of their choosing related to Earth Science, Science Education, and/or Environmental Science.
- gain acceptance to reputable graduate programs in the Earth Sciences, Environmental Sciences, or a program of their choosing.
- successfully complete state and/or national professional competency examinations in Earth Sciences.

Student Learning Outcomes for BS degree in Environmental Science (BSES)

Students who graduate with a BSES degree will achieve the following objectives:

1. Solve environmental science problems using the scientific method and critical thinking.
2. Evaluate physical, chemical and biological cycles related to surficial earth processes and how they operate to describe integrated earth systems from a local to global scale.
3. Demonstrate competence in communicating environmental science problems to a broad audience through written, oral, and visual means.
4. Describe the structure and function of major environmental systems.
5. Effectively apply analytical skills, including basic measurement and monitoring skills, and use of appropriate technology.
6. Understand current thinking and research on the nature, causes, and solutions of environmental problems as they affect human health and the environment.
7. Develop knowledge in advanced disciplines of environmental sciences and evaluate inter-relationships between disciplines.

Specialization leading to an advanced understanding of one of the three component areas that are central to the BSES program:

Earth and Water Resources

1. Understand interactions between land, soil, and water and quantitatively assess processes in soils, hydrogeology, and biogeochemistry.
2. Describe physical, chemical, and biological interactions and processes affecting soil and water resources.
3. Apply advanced analytical techniques related to environmental quality assessments.

Environmental Remote Sensing and Spatial Analysis

1. Develop spatial analytical techniques using remote sensing (satellite and airborne sensors), geographic information system (GIS), and global positioning system (GPS) technologies.
2. Integrate technologies of remote sensing and spatial analysis to problems of environmental modeling and analysis.

Environmental Management

1. Apply skills needed to characterize hazards, track the fate and transport of pollutants.
2. Identify health and environmental effects of pollutants and plan and manage programs to control environmental hazards.
3. Identify and solve problems in solid and hazardous waste, water quality and wastewater treatment, and air quality.

Forensic and Investigative Sciences

Students who graduate from the Forensic and Investigative Sciences program will learn:

Program Level Student Learning Outcomes

Aligned with IUPUI Plus+

1. Generalize the forensic science system in the United States including crime scene investigation, crime laboratories and organization, specialized disciplines, and preparation for a career in forensic science
    1. Communicator: Evaluates Information and Conveys Ideas Effectively
    2. Community Contributor: Builds Community and Behaves Ethically

2. Identity common pattern evidence in forensic science and determine the appropriate analytical techniques used to examine patterned evidence, such as fingerprints, tool marks, physical matches, and firearms
    1. Problem Solver: Thinks Critically and Analyzes, Synthesizes, and Evaluates
    2. Innovator: Investigate and Creates/Designs

3. Interpret the use of chemical and instrumental techniques in forensic analysis and examine common chemical evidence, such as illicit drugs, fire residue, explosives, inks, and paint
    1. Problem Solver: Thinks Critically and Analyzes, Synthesizes, and Evaluates
    2. Innovator: Investigate and Creates/Designs

4. Identify and analyze forensic biological evidence, such as bodily fluids, blood spatter, DNA and interpret evidence using population genetics
    1. Problem Solver: Thinks Critically and Analyzes, Synthesizes, and Evaluates
    2. Innovator: Investigate and Creates/Designs
5. Recognize and demonstrate the use of ethics, bias, criminal and civil laws, rules of evidence, and expert testimony in the practice of forensic science
    1. Community Contributor: Behaves Ethically and Anticipates Consequences
    2. Innovator: Confronts Challenges and Makes Decisions
6. Characterize common microscopes used in analysis of trace evidence and investigate common trace evidence with microscopes such as fibers, hairs, glass, biological and chemical materials
    1. Problem Solver: Thinks Critically and Analyzes, Synthesizes, and Evaluates
    2. Innovator: Investigate and Creates/Design
7. Design a forensic science research project, formulate original ideas and present findings professionally
    1. Communicator: Evaluates Information and Conveys Ideas Effectively
    2. Innovator: Investigate and Creates/Designs

FIS 20500

1. Describe crime scene investigation procedures and the role of forensic science in crime scene investigations
2. Describe the fundamentals of crime laboratory culture and organization along with the possible job functions of forensic scientists
3. Identify, characterize, and individualize evidence and various types of physical evidence
4. Explain the rules of evidence, ethics in forensic science, and quality assurance and control
5. Summarize and interpret techniques used in areas of forensic science by generalizing each area with specific types of evidence analysis; topics include, fingerprints, impressions, firearms, toolmarks, footwear, questioned documents, and computer forensics
6. Explain the role of specialized disciplines in forensic science in criminal and death investigations; disciplines include, taphonomy, pathology, entomology, anthropology and odontology

FIS 20600

1. Identify and investigate the basics of forensic chemistry and forensic biology evidence and job functions
2. Explain the principles and terminology associated with microscopy, spectroscopy, and separation methods
3. Identify and apply microscopy, spectroscopy, and separation techniques to forensic science
4. Classify, Illustrate and Identify commonly encountered forensic evidence in casework
5. Interpret the use of common forensic evidence and the different methods used to analyze evidence; common evidence includes Blood Spatter, DNA, Population Genetics, Illicit Drugs, Toxicology, Fire Residue, Explosives, Fibers, Hairs, Glass, Soil, Paint

FIS 30100

1. Differentiate how commonly encountered trace evidence, such as fibers, hairs, glass, biological and chemical evidence, is analyzed in a forensic laboratory
2. Explain the principles, instrumentation and applications of microscopic techniques such as stereomicroscopy, compound light microscopy, and polarized light microscopy
3. Investigate the application of physical matches and impression evidence comparison such as fingerprints, tire treads, firearms, footwear and tool mark analysis used in forensic science

FIS 30101

1. Prepare and examine trace evidence samples such as glass, hairs, fibers, chemical and biological materials and patterned evidence samples such as fingerprints and tool marks
2. Analyze and compare samples using microscopic techniques such as stereomicroscope, compound light microscopy, and polarized light microscopy

FIS 30500

1. Describe the fundamentals of crime laboratory culture, organization and quality assurance and control used in forensic science laboratories
2. Define ethics/conduct and demonstrate how ethics/conduct are applied in the analysis of forensic evidence and to the presentation of expert testimony in court
3. Identify the major features of the Code of Ethics of the American Academy of Forensic Sciences and of other major forensic science organizations
4. Distinguish the different types of bias encountered in forensic science and demonstrate methods to reduce or eliminate bias in forensic science

FIS 41500

1. Describe how ethics are applied to the presentation of expert testimony in court
2. Recognize the United States system of justice including the structure, participants, stages, philosophies and dynamics
3. Distinguish the role of an expert witness in the justice system and correlate how to present and communicate forensic examinations and findings in a court of law
4. Summarize the sources and evolution of the law of the United States and the development of the rules of evidence and specifically the admission of expert testimony and evidence in a court of law
5. Apply the evidentiary rules and law of evidence in the collection of evidence, examination of the evidence, and preparation of scientific reports and testimony
6. Demonstrate the ability to conduct accurate, comprehensive and focused scientific investigations and apply appropriate rules of evidence

7. Conduct a literature search on a forensic science research topic and communicate your findings orally and in writing

FIS 49000 - Faculty-Mentored Research Capstone

1. Conduct literature search on a forensic science topic using peer-reviewed resources
2. Synthesize and communicate ideas on a forensic science topic in a professional presentation

FIS 48000 - Forensic Science Professional Capstone

1. Prepare a graduate school application and resume and cover letter for a job search in the forensic science field
2. Identify ways to network appropriately, demonstrate proper interview skills and recognize skills, talents, and interests that help inform searching for a suitable and engaging workplace
3. Identify ways to manage workplace stress

Bachelor of Arts & Bachelor Science in Geology

Broad Earth Sciences Undergraduate Program Goals

Upon graduating, students with an undergraduate degree in Geology (BA and BS) will:

- gain access to employment in professions of their choosing related to Earth Science, Science Education, and/or Environmental Science.
- gain acceptance to reputable graduate programs in the Earth Sciences, Environmental Sciences, or a program of their choosing.
- successfully complete state and/or national professional competency examinations in Earth Sciences.

Student Learning Outcomes for BA and BS in Geology

Students who graduate with a BA or BS Degree will achieve the following objectives:

1. Solve earth science problems using the scientific method and critical thinking.
2. Describe spatial and temporal variations in Earth processes through modeling, mapping, observation and measurement.
3. Understand the evolution of physical Earth and life as reflected in the geologic time scale.
4. Understand the structural and chemical controls on the physical properties and behavior of Earth materials.
5. Evaluate how physical, chemical and biological cycles are integrated into Earth systems from the local to global scale.
6. Understand how events of the geologic past control the current distribution of resources.
7. Assess the impact of physical and chemical cycles on human health and welfare.
8. Evaluate impacts and potential mitigation strategies for natural hazards, resource utilization, climate and environmental change.
9. Demonstrate competence in communicating Earth science problems to a broad audience through written, oral and visual means.
10. Understand the interdependence of the diverse sub-disciplines of Earth science.

Bachelor of Science in Interdisciplinary Studies (B.S.)

"The purpose of the Bachelor of Science (B.S.) in Interdisciplinary Studies Program is to provide an opportunity for IUPUI students to construct individual majors that are science-based, interdisciplinary, and not represented by an existing major program". Interdisciplinary Studies Majors create individualized courses of study; each student, in consultation with his or her faculty mentor, will individually develop student learning outcomes. The following SLOs, however, are common for all Interdisciplinary Studies Majors:

1. Create and develop an individualized plan of study for the proposed major, the interdisciplinary nature between science and at least one other discipline.
2. Design, in consultation with a faculty mentor, 4-6 individualized Student Learning Outcomes that specify an action or outcome of the plan of study that is *observable, measurable, and capable of being demonstrated.*
3. Successfully design, present, and defend an experimental or literature-based research project or internship experience, culminating with a written report or presentation of the findings.

Bachelor of Science in Mathematics and Mathematics Education (B.S.)

The Department of Mathematical Sciences synthesized the IUPUI's Principles of Undergraduate Learning, the National Council of Teachers of Mathematics Standards, and the Mathematics Association of America's competencies for undergraduate mathematics majors to create the following 10 Student Learning Outcomes for the undergraduate mathematics programs. Students will be able to:

1. Understand and critically analyze mathematical arguments.
2. Understand, appreciate, and identify connections between different areas of mathematics.
3. Understand, appreciate, and solve some applications of mathematics to other subjects.
4. Develop a deeper knowledge and competence of at least one area of mathematics.
5. Develop and demonstrate abstract reasoning in a mathematical context.
6. Develop and demonstrate the principle modes of discovery in mathematics.
7. Develop and demonstrate careful and ethical analysis of data.
8. Develop and demonstrate problem-solving skills.
9. Demonstrate effective communication skills of mathematical ideas precisely and clearly, both orally and in writing.
10. Utilize a variety of technological tools (CAS, statistical packages, programming languages, etc.) in analyzing and solving mathematical problems.

Concentrations include: Applied Mathematics, Pure Mathematics, Actuarial Science, Applied Statistics, and Secondary School Teaching

All majors should work on a senior-level project that requires them to analyze and create mathematical arguments and leads to a written and oral report (capstone).

Bachelor of Science in Neuroscience (B.S.)

Profiles of Learning

Upon successful completion of the neuroscience major, students will have developed the capacity to perform tasks related to each of the IUPUI Profiles of Learning, including:

Communicator Profile:

- Be able to research and evaluate questions relating to Neurosciene and related topics
- Be prepared to discuss different topics in Neurosience from multiple levels of organiation
- Communicate Neurosientific information in a clear, reasoned manner, both verbally and in writing

Problem Solver Profile:

- Integrate knowledge of nervous system function to explain complex processes underlying behavior
- Connect curricular and extracurricular experiences to potential future careers
- Identify various career options in neuroscience to prepare for and pursue one's chosen profession

Innovator Profile:

- Synthesize theoretical and empirical neuroscience information sufficient to then formulate hypotheses, design experiments, and engage in scientific research
- Understand, appreciate and utilize the development, organization, and function of the nervous system to provide new and inventive solutions to community health challenges
- Create new therapeutic treatments based on interpretation of quantitative scientific data

Community Contributor:

- Help build and connect local and global neuroscience communities
- Be able to adjust behaviors and help others adjust behaviors based on new scientific information
- Connect curricular and extracurricular experiences to potential future careers

Bachelor of Science in Physics (B.S.)

Students who graduate with a B.S. in Physics will achieve the following objectives:

1. Know and understand the basic and advanced concepts of classical and modern physics.
2. Master the mathematical skills relevant to the study of physics.
3. Apply the knowledge of physics and mathematics to solve physical problems.
4. Design and perform laboratory experiments in physics.
5. Use computers and software to solve physics problems and to obtain and analyze experimental data.
6. Successfully collaborate with peers, attain the necessary skills, and develop the work ethic to perform and complete physics research.
7. Prepare a written technical document and deliver an oral presentation relevant to physics.
8. Apply her or his skills to other areas or problems.

Bachelor of Arts and Bachelor of Science in Psychology

Student graduating with a B.A. or B.S. in Psychology will demonstrate the following learning outcomes.

Goal 1: Knowledge Base in Psychology

Student Learning Outcomes

1.1 Describe key concepts, principles, and overarching themes in psychology

1.2 Demonstrate working knowledge of psychology's content domains (biological, developmental, cognitive, social)

1.3 Describe how concepts, principles, and themes in psychology are applied to individual, social, and organizational issues

Goal 2: Scientific Inquiry

Student Learning Outcomes

2.1 Use scientific reasoning to interpret psychological phenomena

2.2 Demonstrate psychology information literacy

2.3 Interpret, design, and gain experience in conducting basic psychological research

Goal 3: Critical Thinking

Student Learning Outcomes

3.1 Generate essential questions to solve problems

3.2 Gather and assess relevant information to come to well-reasoned conclusions

3.3 Recognize and assess assumptions and biases of self and others

Goal 4: Ethical and Social Responsibility in a Diverse World

Student Learning Outcomes

4.1 Apply ethical standards to evaluate psychological science and practice

4.2 Build and enhance interpersonal relationships

4.3 Exhibit respect for members of diverse groups

Goal 5: Communication

Student Learning Outcomes

5.1 Demonstrate effective writing for different purposes

5.2 Exhibit effective presentation skills for different purposes

5.3 Demonstrate professionalism in formal and informal communication with others

Goal 6: Professional Development

Student Learning Outcomes

6.1 Apply psychological content and skills to career goals

6.2 Exhibit self-efficacy and self-regulation

6.3 Develop meaningful professional direction for life after graduation

General Requirements for Graduate Degrees

Students must be seeking graduate degrees and meet the general requirements of the Indiana University Graduate School or the Purdue University Graduate School, depending on the degree. Specific requirements of the individual department in which the student enrolls must also be met. Special departmental requirements are listed under the major department.

At least 30 academic credits are required for the master's degree and at least 90 academic credits are required for the Ph.D. Some programs may require more credits. The maximum number of didactic transfer credits allowed is 12 hours, but some programs may allow fewer. The student's major department and the Office of the Associate Dean for Research and Graduate Education determine acceptability of transfer credits from another college or university. No work may be transferred from another institution unless the grade is a B or higher.

Students must meet graduate school resident study requirements. At least one-half of the total credit hours used to satisfy a Purdue master's degree must be earned while in residence at IUPUI. At least 30 credit hours of IU graduate work must be completed while enrolled on a campus of Indiana University to satisfy the master's degree. At least one-third of the total credit hours used to satisfy degree requirements must be earned (while registered for doctoral study) in continuous residence on the IUPUI campus. The major department should be consulted for other more specific rules.

All non-native speakers of English must submit results of the Test of English as a Foreign Language (TOEFL). A minimal score of 550 on the paper version/PBT TOEFL or a minimal score of 213 on the computer-based version/ CBT TOEFL is required. Departments may set higher standards. Applicants in the Indianapolis area may substitute the IUPUI English as a Second Language (ESL) Placement Examination for the TOEFL. See the English for Academic Purposes web site for additional information. Information about this test is also available from the Office of International Affairs online at http://international.iupui.edu/.

Each student must file a plan of study that conforms to the departmental and disciplinary requirements. This is normally done in consultation with a faculty advisory committee. A tentative plan of study should be drawn up in advance of registration for the first semester of graduate work. The student and the graduate advisor should do this. Students and advisors should pay careful attention to the deadlines established by the graduate schools for filing plans of study.

Students must meet the grade and grade point average requirements. Only grades of A, B, or C are acceptable in fulfilling graduate school requirements in any plan of study. An advisory committee or department may require higher performance than C in certain courses. Grades of Pass (P) are not acceptable. Specific cumulative grade point average requirements, if any, are determined by the individual departments.

Students must fulfill departmental requirements regarding oral and written examinations. These requirements vary by program and students should consult the major department. The graduate school has no general requirement for oral and written examinations for the non-thesis master's degree.

Graduate Non-Degree Study

A student who has previously earned a bachelor's degree may enroll in graduate courses without making formal application as a degree-seeking student. Application as a graduate non-degree student is, however, required and may be obtained through the IUPUI Graduate Office at the Web site www.iupui.edu/~gradoff/gnd.

Additional information can be obtained at the IUPUI Graduate Office, University Library, Room UL 1170, 755 West Michigan Street, Indianapolis, IN 46202; phone (317) 274-1577. Students should consult the major department to determine how many credits earned in a non-degree status may be transferred into a graduate degree program.

Contact Information

Department of Biology

723 West Michigan Street, SL 306
Indianapolis, IN 46202-5132
Phone: (317) 274-0577; fax: (317) 274-2846
https://science.iupui.edu/biology/

Department of Chemistry and Chemical Biology

Science Building, LD 326
402 North Blackford Street
Indianapolis, IN 46202-3274
Phone: (317) 274-6872, fax: (317) 274-4701
https://science.iupui.edu/chemistry/

Department of Computer and Information Science

Engineering, Science and Technology Building, SL 280
723 West Michigan Street
Indianapolis, IN 46202-5132
Phone: (317) 274-9727; fax: (317) 274-9742
https://science.iupui.edu/cs/

Department of Earth Sciences

Engineering, Science, and Technology Building, SL 118
723 West Michigan Street
Indianapolis, IN 46202-5132
(317) 274-7484; fax (317) 274-7966
https://science.iupui.edu/earthsciences/

Forensic and Investigative Sciences Program

Science Building, LD 326
402 North Blackford Street
Indianapolis, IN 46202-3274
Phone: (317) 274-8969; fax: (317) 274-4701
https://science.iupui.edu/forensic/

Department of Mathematical Sciences

Science Building, LD 270
402 North Blackford Street

Indianapolis, IN 46202-3216
Phone: (317) 274-6918; fax: (317) 274-3460
https://science.iupui.edu/math/

Department of Physics
Science Building, LD 154
402 North Blackford Street
Indianapolis, IN 46202-3273
Phone: (317) 274-6900; fax: (317) 274-2393
https://science.iupui.edu/physics

Department of Psychology
Science Building, LD 124
402 North Blackford Street
Indianapolis, IN 46202-3275
Phone: (317) 274-6947; fax: (317) 274-6756
https://science.iupui.edu/psychology/

Degree Programs
Graduate Certificates

Purdue University Graduate Certificates, offered through the Department of Computer and Information Science, include Databases and Data Mining, Computer Security, Software Engineering, Biocomputing, and Biometrics. For more information on these graduate certificates visit the Computer and Information Science department website.

Master of Science Degrees

Purdue University Master of Science degrees are offered in all School of Science departments except Earth Sciences, which offers an Indiana University Master of Science degree. All departments award either a thesis or nonthesis option.

- Applied Statistics
- Biology
- Chemistry
- Computer and Information Science
- Computational Data Science (Computer and Information Science)
- Computational Data Science (Mathematical Sciences)
- Forensic and Investigative Sciences (Thesis Track FEPAC Accredited)
- Geology
- Industrial Organizational Psychology
- Mathematics
- Mathematics Education
- Physics

Doctor of Philosophy Degrees

A Purdue University Ph.D. program in Clinical Psychology is offered by the Department of Psychology. Purdue University Ph.D. Programs pursued at IUPUI, arranged through Purdue, West Lafayette, are available in biology, chemistry, computer science, mathematics, physics, and an additional area of psychology.

The Department of Earth Sciences offers an Indiana University Ph.D. program in Applied Earth Sciences.

In addition, together with the Division of Biostatistics in the Indiana University School of Medicine, the Department of Mathematical Sciences administers and offers an Indiana University Doctor of Philosophy in Biostatistics, with all requirements completed on the IUPUI campus.

Indiana University Ph.D. Programs pursued at IUPUI in departments or programs of the Indiana University School of Medicine in which School of Science faculty hold adjunct appointments are available.

- Addiction Neuroscience
- Applied Earth Sciences
- Applied Social and Organizational Psychology
- Biology
- Biostatistics
- Chemistry
- Clinical Psychology
- Computer and Information Science
- Mathematics
- Physics

Joint M.D. - Ph.D. Degrees
Several departments participate in the joint M.D. - Ph.D. program with the Indiana University School of Medicine. In this program, students concurrently earn an Indiana University Doctor of Medicine degree in the School of Medicine and a Ph.D. degree arranged through the School of Science. Students interested in this option should consult the program in which they wish to earn the Ph.D.

Admissions
- Biology
- Chemistry
- Computer and Information Science
- Earth Sciences
- Forensic and Investigative Sciences
- Mathematics
- Physics
- Psychology

Biology, MS & PhD
Students must hold a baccalaureate degree from an accredited institution of higher learning and demonstrate good preparation in the following subjects: Biological Sciences, Organic Chemistry, Physics, and Mathematics.

A minimum graduation grade-point index of 3.00 or equivalent is required for unconditional admission. An undergraduate GPA of 3.00 or higher does not guarantee admission. Applicants with GPAs of 3.00 or slightly above will be expected to have a science course GPA of 3.00.

Transfer Students
Transfer credits from other institutions of higher learning cannot be used to replace the minimum of 9 hours of Biology Department course work required for the M.S. thesis degree. Up to 12 hours of Biology graduate credits taken at IUPUI by graduate non-degree students may be transferred to the non-thesis option. At least half of the coursework hours in a Ph.D. program of study must be taken while enrolled at IUPUI.

Application Process
REMEMBER: ALL MATERIALS MUST BE SUMBITTED TO THE DEPARTMENT BEFORE THE GRADUATE COMMITTEE WILL REVIEW YOUR FILE.

Online Application

In the online application, please make sure you complete all sections. This includes the Personal Statement, Departmental Question, and Recommendations sections. It is helpful to include your name on all typed, uploaded documents.

In the Educational Objective Section, you must select: **Academic Objectives: Biology (Purdue University)**

For the **Personal Statement:** Provide a statement (approximately 750 words) that identifies your academic goals, career objectives, why you are applying to this specific program, and the qualifications you have that make you a strong candidate for this program. For M.S. Thesis and Ph.D. applicants, identify at least one faculty member with whom you would be interested in working.

In the **Departmental Question** section, you must specify which program you are pursuing. The choices are as follows: Pre-Professional Non-Thesis, M.S. Non-Thesis, M.S. Thesis, and Ph.D. Simply write a sentence saying "I am applying for the .... program." and upload it.

The last step before submitting an on-line application is the application fee. ***You must pay this fee in order to submit your application.***

IMPORTANT NOTE: An email will be sent to you when our department receives your complete application. If you do not receive an application submission email within 3-4 weeks, please email or call to verify that we have it. We have several students who mistakenly select the wrong Academic Objective and their application goes to another department. It is important to check your email to verify we received your application. If your application is misdirected, it can be easily switched over to our department.

Letters of Recommendation

At least 2 letters should come from professors in previous science courses and should address the applicant's aptitude and potential in a science program at the graduate level.

The preferred method is using the online section within the application. If you have a person who does not wish to fill out the recommendation online, he or she may write a standard letter and mail it to the department. They can also include an optional recommendation form, but it is NOT required (click here to print the form). You may call the Department of Biology at (317) 274-0577, or e-mail biograd@iupui.edu, with your address to have the optional form mailed to you. We also accept "committee packets" that universities put together for their students.

Official Transcripts

Send two (2) official copies of transcripts from all attended institutions (including any IU campus) directly to the Biology Department:

IUPUI Biology Department

ATTN: Graduate Secretary

723 West Michigan Street, SL 306
Indianapolis, IN 46202

Official GRE and TOEFL Scores

(TOEFL scores are for international students only)*

The GRE and/or subject tests are not required for Ph.D. and Thesis M.S. applicants; however, if submitted, the results are added to the applicant's file for consideration.

Only non-thesis M.S. applicants are required to take the Graduate Record Examination** (GRE) General test. Minimal score requirements for new GRE tests are as follows:

A combined GRE score of 295 for the verbal and quantitative sections

- Verbal score of 146 or greater
- Quantitative score of 145 or greater
- 5 score on the analytical portion of the test

MCAT or DAT scores will be considered ONLY for the Pre-Professional Non-Thesis M.S. program. An MCAT combined total score of 497 or greater (new test) taken within the last 3 years can be submitted or a DAT total score of 17 or greater, taken within the last 3 years can be submitted.

GRE and TOEFL codes: IUPUI = 1325, Biology Department = 0203

*Test of English as a Foreign Language (TOEFL) with a minimum score of 80 (out of 120) is required. Moreover, minimum scores for specific sections are as follows: Writing – 18; Speaking – 22; Listening – 16; Reading – 19.
**To find testing sites or to find scores, visit the ETS website at www.ets.org.

Application Deadlines

Ph.D.: Priority deadline of December 15. After this date please contact the Director of Graduate Studies (Dr. AJ Baucum or email biograd@iupui.edu).

M.S. Thesis (full time with support): May 1 for Fall entry or October 1 for Spring entry

Pre-Professional Non-Thesis and M.S. Non-Thesis: August 1 for Fall entry or December 1 for Spring entry

Chemistry, MS & PhD

Applications for full-time study should be completed by January 15th for entry the following fall semester to ensure complete consideration for fellowships and other financial support.

Late applications will be considered only if full-time positions are available. Applications for part-time graduate admission may be submitted up to two months prior to the intended starting date.

University Code: 1325

Application Process

Graduate Application Form: Complete the application online using the Online University Application.

Letters of Recommendation: We require three letters of recommendation from people familiar with you and your student and/or professional career. Your references will receive an automatic notification of a request for a letter of recommendation when you submit your application. Letters on letterhead are also acceptable and should be

addressed to Graduate Admissions, c/o Department of Chemistry and Chemical Biology.

Transcripts: One original copy of the official transcript(s) of all previous university work is required. All degrees awarded should be documented. A list of university courses and their titles that do not appear on the transcript(s) should also be sent to us.

GRE: All students are required to take the Graduate Record Examination general test. Please have the documentation of your score mailed directly to us from Educational Testing Service.

TOEFL: Foreign students must take the TOEFL or IELTS. The minimum scores required for admission are 80 (with subscores of 19-reading, 16-listening, 22-speaking, and 18-writing) for the TOEFL internet-based test. or 6.5 (ELTS),

Application Fee: An application fee will be charged which may be paid by credit or debit card.

Fellowships & Assistantship: If you are interested in applying for a fellowship, please download and mail to us the form: "Release of Confidential Information to the University Fellowship Subcommittee."

Note: Fall semester deadline to be considered for a Fellowship or a Teaching Assistantship is January 15th. In addition, University Fellowships are available.

Letters of recommendation and transcripts, should be mailed to:

Graduate Admissions Committee

Department of Chemistry and Chemical Biology

Indiana University-Purdue University Indianapolis

402 North Blackford Street, LD 326
Indianapolis, IN 46202-3274

Graduate Continuing Non-Degree (GCND) Students

Graduate Continuing Non-Degree (GCND) students who wish to enroll in courses, though not necessarily in a degree program, should contact the IUPUI Graduate Office. Students should be aware that no more than 12 credit hours earned as a non-degree student may be counted toward a degree program.

Computer and Information Science

Master of Science in Computer Science (M.S.)

Master of Science in Computational Data Science (M.S.)

Doctor of Philosophy in Computer Science (Ph.D.)

Graduate Certificate Programs

Graduate Certificate in Computer and Information Science

Admission criteria and the application process for Graduate Certificate programs are identical to those of the M.S. program; please consult the M.S. program information.

MS in Computer Science

The applicant to the graduate program must have a four-year bachelor's degree or equivalent. Interested students with 3-year degree should contact the department for information.

The applicant's record should exhibit outstanding achievement as indicated by the grade point average for each degree over his or her entire academic record. An applicant is expected to have a GPA of at least a 3.00 on a scale of 4.00. The record should also demonstrate strong individual accomplishments and recommendations from independent references.

Applicants who do not have a Bachelor's degree in Computer Science or a related field may be required to take prerequisite courses and pass with a grade of B+ or higher.

Application Process

1. 1. IUPUI online application
   2. Three (3) letters of recommendation.
   3. Statement of purpose
   4. Official transcripts, marksheets and evidence of degrees awarded (diploma/degree certificate) from each post-secondary school attended. If the original documents are in not in English, you must submit a certified translation of each official transcript and degree certificate. Notarized copies are NOT acceptable.
   5. Demonstration of English proficiency: Students whose native language is not English must demonstrate English proficiency through one of the following options:
      1. Official TOEFL* score report with the following minimum scores from a single test occurrence:
         80 (iBT) Section minimums are 19 Reading, 14 Listening, 18 Speaking & Writing
      2. Official IELTS (International English Language Testing System) score report with the following minimum scores: **6.5** overall band score - section minimums are 6.5 Reading, 6.0 Listening & Speaking, 5.5 writing
      3. International applicants who have received a degree in the U.S. are exempted from the TOEFL/IELTS requirement only if the degree was awarded within the last 3 years.
      4. TOEFL "MyBest" scores are not accepted.
   6. GRE* score: GRE scores are required for all applicants, however there is no specific minimum score that must be met.

*GRE and TOEFL school code: **1325**
GRE department code: **0402**
TOEFL department code: **78**

Electronic copies of documents attached to the online application are preferred over hard copies sent via the mail/courier. If you have additional questions during the application process, do not hesitate to contact a graduate advisor at (317) 274-9727 or email us at admissions@cs.iupui.edu

Hard copy application document may be sent to the following address.

Graduate Admissions Committee

723 W. Michigan Street, SL 280
Indianapolis, Indiana 46202

Application Deadlines
Fall Semester: January 15 (deadline to complete applications in order to be considered for University Fellowship nomination, April 1 (general admission)

Spring Semester: September 15

MS in Computational Data Science
Qualified graduate students are those that meet the MS admission criteria of the Computer & Information Science Department or Mathematical Sciences Department. Students will be admitted according to the department to which they applied (Computer & Information Science or Mathematical Sciences). The Graduate Committee of each department will be responsible for evaluating the case-by-case applications.

Prerequisite coursework and/or degrees:
4-year Bachelor's degree in Computer Science, Engineering, Mathematics, Statistics or related fields.
4-year Bachelor's degree in any other area of study will be considered on a case-by-case basis, based on the coursework and correspoonding grades in the applicant's transcripts, as well as on the overall potential of successfully completing this program.

GPA: Entering students are expected to have a minium cumulative grade point average (GPA) equivalent to at least 3.00 on a 4.00 scale.

GRE: Scores on the Graduate Record Exam (GRE) must be submitted for admission consideration.

Application Process
1. 1. IUPUI online application
   2. Three (3) letters of recommendation.
   3. Statement of purpose
   4. Official transcripts, marksheets and evidence of degrees awarded (diploma/degree certificate) from each post-secondary school attended. If the original documents are in not in English, you must submit a certified translation of each official transcript and degree certificate. Notarized copies are NOT acceptable.
   5. Demonstration of English proficiency: Students whose native language is not English must demonstrate English proficiency through one of the following options:
      1. Official TOEFL* score report with the following minimum scores from a single test occurrence:
         80 (iBT) Section minimums are 19 Reading, 14 Listening, 18 Speaking & Writing
      2. Official IELTS (International English Language Testing System) score report with the following minimum scores: **6.5** overall band score
      3. International applicants who have received a degree in the U.S. are exempted from the TOEFL/IELTS requirement only if the degree was awarded within the last 3 years.
      4. TOEFL "MyBest" scores are not accepted.
   6. GRE* score: GRE scores are required for all applicants, however there is no specific minimum score that must be met.

*GRE and TOEFL school code: **1325**
GRE department code: **0402**
TOEFL department code: **78**

Electronic copies of documents attached to the online application are preferred over hard copies sent via the mail/courier. If you have additional quesions during the application process, do not hesitate to contact a graduate advisor at (317) 274-9727 or email us at admissions@cs.iupui.edu.

Hard copy application document may be sent to the following address.

Graduate Admissions Committee

723 W. Michigan Street, SL 280
Indianapolis, Indiana 46202

Application Deadlines
Fall Semester: January 15 (deadline to complete applications in order to be considered for University Fellowship nomination), April 1 (general admission)

Spring Semester: September 15

PhD in Computer Science
Applicants must have a four-year bachelor's or equivalent degree. We place great weight on the quality of the institution. The applicant must have adequate computer science background, as determined by the admissions committee.

Applicants who begin a graduate program in computer science at another institution should complete at least a year in that program before applying to us. If the program is a master's program, we normally require completion of the program before registration here. If the program is a doctoral program, we ask for evidence of eligibility to continue that program.

Admissions Requirements:

- A B.S. degree in Computer Science or a related field is desirable.
- Background knowledge requirements - core CS topics, Data Structures, Math, etc. Applicants with deficiencies in these areas may be recommended to enroll in courses in Data Structures, Computer Architecture, Operating Systems, etc. as needed with guidance from faculty. Please contact the graduate program coordinator if you have questions about background knowledge requirements.

- We strongly encourage outstanding candidates from other disciplines to apply.

GPA. We expect our entering students to have a grade point average (GPA) equivalent to at least 3.00 (A = 4, B = 3, C = 2, D = 1, F = 0) in all their courses as well in computer science and mathematics courses.

Application Deadlines

Fall Admission: January 15 with consideration for University Fellowship nomination.
April 1 for general admission consideration

Spring Admission: September 15

Application Process

1. IUPUI online application
2. Three (3) letters of recommendation
3. Statement of purpose
4. Official transcripts, marksheets and evidence of degrees awarded (diploma/degree certificate) from each post-secondary school attended. If the original documents are not in English, you must submit a certiied translation of each official transcript and degree certificate. Notarized copies are NOT acceptable.
5. Demonstration of English proficiency: Students whose native language is not English must demonstrate English proficiency through one of the following options:
    1. Official TOEFL* score report with the following minimum scores from a single test occurrence: **80** (iBT) - section minimums are 19 Reading, 14 Listening, 18 Speaking & Writing
    2. Official IELTS (International English Language Testing System) score report with the following minimum scores: **6.5** overall band score - section minimums are 6.5 Reading, 6.0 Listening & Speaking, 5.5 Writing
    3. International applicants who have received a degree in the U.S. are exempted from the TOEFL/IELTS requirment only if the degree was awarded within the last 3 years.
    4. TOEFL "MyBest" scores are not accepted.
6. GRE* score: GRE scores are required for all applicants, however there is no specific minimum score requirement that must be met.

*GRE and TOEFL school code; 1325
GRE department code: 0402
TOEFL department code: 78

Electronic copies of documents attached to the online application are preferred over hard copies sent via the mail/courier. If you have additional questions during the application process, do not hesitate to contact a graduate advisor at (317) 274-9727 or email us at admissions@cs.iupui.edu.
Hard copy application document may be sent to the following address:

Graduate Admissions Committee
723 W. Michigan Street, SL 280
Indianapolis, Indiana 46202

Earth Sciences

Ph.D. in Applied Earth Sciences

The Ph.D. program prepares students for academic positions or research and leadership positions in local, state, national, or private environmental organizations. The goal of the program is to prepare future researchers and leaders who assess complex environmental systems and assist in providing sound options and solutions for optimizing human-environment interactions.

To apply, fill out the Online Application Form provided by the IUPUI Graduate Office.

NOTE: The suggested application submission date is January 15th. Submission in mid-January maximizes the prospective student's opportunity to receive financial aid.

Master of Science in Geology

The IUPUI graduate program in Geology leads to a Master of Science degree from Indiana University. We offer a thesis and non-thesis option; however, typically only thesis-option students are considered for funding. Our thesis option requires 21 - 24 credit hours of graduate level courses and 6 - 9 credit hours of a research thesis. Our non-thesis option requires 33 credit hours of graduate level coursework and 3 credit hours of a research project. See Requirements of MS Degree for more details.

To apply, fill out the Online Application Form provided by the IUPUI Graduate Office.

NOTE: The suggested application submission date is January 15th. Submission in mid-January maximizes the prospective student's opportunity to receive financial aid. However, the Department of Earth Sciences will consider applications for admission throughout the year.

Forensic and Investigative Sciences, MS

The M.S. Program in Forensic Science, which awards a Purdue University degree, requires 30 credit hours of study beyond the baccalaureate level. It is designed for students seeking careers as professional forensic scientists who desire employment in the criminal justice field or a related area. There are two ways to complete the MS, the thesis MS or the non-thesis, accelerated MS. The MS Thesis Program is FEPAC-accredited.

The **admission requirements** are as follows:

- A Bachelor's degree from an accredited institution in the physical or life sciences including chemistry, biology, forensic science, pharmacology/toxicology, or a related science
- A minimum GPA of 3.00 for all undergraduate work

The program will serve full time students who meet the above requirements as well as students who are presently employed full time in a forensic science laboratory or other analytical laboratory.

The M.S. Program in Forensic Science, which awards a Purdue University degree, requires 30 credit hour of study beyond the baccalaureate level. It is designed for students seeking careers as professional forensic scientists who desire employment in the criminal justice field or a related area.

Students must apply in one of the following concentrations; forensic chemistry or forensic biology. All students take a core of required courses which include a professional issues course, a law course and a clinical law course. Each concentration contains specific required courses taken by students in that concentration.

Both thesis and non-thesis options are available. The full-time thesis M.S. program consists of 30 semester credit hours. It is anticipated that the program is competed within two years. The thesis program requires 17 credit hours of course work and 13 credit hour of thesis completion and defense (research). Students who desire a non-thesis M.S. degree (full or part-time) must complete 30 credit hours of coursework approved by the department and it is expected the program is completed within 12 calendar months. This may include up to six credits of internship.

How to Apply for the Full-Time Thesis MS

Application to the program can be done completely online. The online application is called the "Indiana University Graduate Centralized Application System (CAS)"

You will be directed to create an account to begin your application. The application can be filled out in stages and saved along the way so you can return to it later. The eApp has provisions for uploading your personal statement, supplemental questions, and listing contact names for two letters of recommendation.

These people will automatically be emailed and asked to input their letters of recommendation.

Please arrange for your previous academic institutions to send official, sealed transcripts to FIS Graduate Admissions, 402 N. Blackford St., LD 326, Indianapolis, IN 46202. International applicants will need to provide transcripts in both native language and English, as well as a certificate of diploma.

The Forensic and Investigative Sciences Program accepts applications once a year for beginning matriculation in the Fall semester. The deadline for applying to the program is **January 15** of the year you wish to start. Applications must be complete by **January 15** or they will not be considered. Applicants must submit the following:

1. The completed application which will also require
   - Two letters of recommendation. These would normally be from professors who can evaluate your ability to successfully complete graduate work in forensic science
   - A personal statement that discusses your educational and work background, interest and experience (if any) in forensic science, and research interests if you are full time. Supplemental questions requests information about which degree (thesis or non-thesis) and track (forensic biology or chemistry) is applied for along with requiring a list of relevant coursework.
2. Official final transcripts from all higher education institutions that you attended.

Applications are not normally considered on a rolling basis. They are generally considered en masse after the January 15th deadline. You will be notified within a few weeks after the decision is made. If your application is not successful for the thesis program, it will be automatically considered for the non-thesis program.

How to Apply for the Non-Thesis MS

Application to the program can be done completely online. The online application is called the "eApp Online Admissions Application."

You will be directed to create an account to begin your application. The application can be filled out in stages and saved along the way so you can return to it later. The CAS system has provisions for uploading your personal statement, supplemental questions for, and listing contact names for two letters of recommendation. These people will automatically be emailed and asked to input their letters of recommendation.

The Forensic and Investigative Sciences Program review of applications will begin in late February and will continue on a rolling basis until the **March 15** deadline. Applications will also be considered for the Spring term if there is availability (completed applications by December 1).

Applicants must submit the following:

1. The completed application which will also require
   - Two letters of recommendation. These would normally be from professors who can evaluate your ability to successfully complete graduate work in forensic science
   - A personal statement that discusses your educational and work background, interest and experience (if any) in forensic science, and research interests if you are full time. Supplemental questions requests information about which degree (thesis or non-thesis) and track (forensic biology or chemistry) is applied for along with requiring a list of relevant coursework.
2. Official final transcripts from all higher education institutions that you attended.

Mathematics

Master of Science in Mathematics (M.S.)
Master of Science in Computational Data Science (M.S.)

Doctor of Philosophy in Biostatistics (Ph.D.)
Doctor of Philosophy in Mathematics (Ph.D.)

MS in Mathematics
Application Process

1. IUPUI online application
2. A statement of personal and professional goals (300-500 words). This can be submitted as part of the online application or sent directly to the department.
3. A resume or CV. This can be submitted as part of the online application or sent directly to the department.
4. Three letters of recommendation. These are submitted through the online application.
5. Official transcripts and evidence of degrees awarded from each post-secondary school attended. If the original documents are not in English, you must submit a certified translation of each official

transcript and degree certificate. Notarized copies are NOT acceptable.

6. Demonstration of English proficiency*: Students whose native language is not English must demonstrate English proficiency through one of the following options:
    1. Official TOEFL score report not more than two years old with the following minimum scores: **550** (paper), or **79** (internet)
    2. Official IELTS (International English Language Testing System) score of at least **6.5**.
    3. Complete approved university-level coursework from U.S. or other English-speaking country.
    4. Graduate from an approved ELS Language Center (Level 112 or higher)
    5. Complete post-secondary education and hold designated exempt country citizenship.
7. Non-waiveable, non-refundable application fee for domestic and international applicants.
8. International Student Financial Information Form (For international students only)
9. GRE (optional) Required for applicants who wish to be considered for financial support.
10. Supplemental Question Form. This can be submitted as part of the online application or sent directly to the department.

*If you are a native speaker of English, you are not required to demonstrate English proficiency. An exception will be granted for non-native speakers of English who have completed a post-secondary degree at a college or university in a native-English speaking country within two years of the anticipated enrollment semester and for non-native speakers of English who are U.S. citizens or permanent residents.

NOTE: All documents submitted become the property of IUPUI. After one year of **no** enrollment, hard copies will be discarded.

Send application materials the following address.

Graduate Admissions Committee
IUPUI Department of Mathematical Sciences
402 N. Blackford Street, LD 270
Indianapolis IN 46202-3216

Email: mathgrad@iupui.edu
Phone: 1-317-274-6918
Fax: 1-317-274-3460

Admission Deadlines

Fall Semester

- Assistantship consideration: March 1
- All international applicants: March 1
- All other applicants: May 1*

Spring Semester

- All international applicants: October 1
- All domestic applicants: November 1*

Due to schedule of course offerings, it is not always feasible to begin the program in the Spring semester. Email mathgrad@iupui.edu for more information before applying for Spring admission.

Summer Semester

- April 1**

*If you cannot provide all application materials by the date indicated above, we encourage you to apply to the Graduate Non-Degree program through the IUPUI Graduate School Office. This program will allow you to take courses towards your intended degree program, and you may transfer up to 12 credit hours into the M.S. program, subject to graduate committee approval. Email mathgrad@iupui.edu for more information.

**This deadline applies for an M.S. Math Education major only. Due to schedule of course offerings, it is not always feasible to begin the program in the Summer semester (with the exception of math education). Email mathgrad@iupui.edu for more information before applying for Summer admission (unless you are math education).

MS in Computational Data Science

Qualified graduate students are those that meet the MS admission criteria of the Computer & Information Science Department or Mathematical Sciences Department. Students will be admitted according to the department to which they applied (Computer & Information Science or Mathematical Sciences). The Graduate Committee of each department will be responsible for evaluating the case-by-case applications.

Prerequisite coursework and/or degrees:

4-year Bachelor's degree in Computer Science, Engineering, Mathematics, Statistics or related fields. 4-year Bachelor's degree in any other area of study will be considered on a case-by-case basis, based on the coursework and correspoonding grades in the applicant's transcripts, as well as on the overall potential of successfully completing this program.

GPA: Entering students are expected to have a minium cumulative grade point average (GPA) equivalent to at least 3.00 on a 4.00 scale.

GRE: Scores on the Graduate Record Exam (GRE) must be submitted for admission consideration.

Application Process

1. IUPUI online application
2. A statement of personal and professional goals (300-500 words). This can be submitted as part of the online application or sent directly to the department.
3. A resume or CV. This can be submitted as part of the online application or sent directly to the department.
4. Three letters of recommendation. These are submitted through the online application.
5. Official transcripts and evidence of degrees awarded from each post-secondary school attended. If the original documents are not in English, you must submit a certified translation of each official transcript and degree certificate. Notarized copies are NOT acceptable.
6. 4-year Bachelor's degree in Mathematics, Computer Science, Engineering, Statistics or related fields. 4-year Bachelor's degree in any other area of study will be considered on a case-by-case basis, based

on the coursework and corresponding grades in the applicant's transcripts, as well as on the overall potential of successfully completing this program.

7. GPA - Entering students are expected to have aminimum cumulative GPA equivalent to at least 3.00 on a 4.00 scale.
8. Demonstration of English proficiency*: Students whose native language is not English must demonstrate English proficiency through one of the following options:
    1. Official TOEFL score report not more than two years old with the following minimum scores: **80** (TOEFL), Section minimum requirements in addtion to the minimum Total requirement: 18 Writing, 18 Speaking, 14 Listening, 19 Reading.
    2. Official IELTS (International English Language Testing System) score of at least **6.5**.
    3. Complete approved university-level coursework from U.S. or other English-speaking country.
    4. Graduate from an approved ELS Language Center (Level 112 or higher)
    5. Complete post-secondary education and hold designated exempt country citizenship.
9. Non-waiveable, non-refundable application fee for domestic and international applicants.
10. International Student Financial Information Form (For international students only)
11. GRE (optional) Required for applicants who wish to be considered for financial support.
12. Supplemental Question Form. This can be submitted as part of the online application or sent directly to the department.

*If you are a native speaker of English, you are not required to demonstrate English proficiency. An exception will be granted for non-native speakers of English who have completed a post-secondary degree at a college or university in a native-English speaking country within two years of the anticipated enrollment semester and for non-native speakers of English who are U.S. citizens or permanent residents.

NOTE: All documents submitted become the property of IUPUI. After one year of **no** enrollment, hard copies will be discarded.

Send application materials the following address.

Graduate Admissions Committee
IUPUI Department of Mathematical Sciences
402 N. Blackford Street, LD 270
Indianapolis IN 46202-3216

Email: mathgrad@iupui.edu
Phone: 1-317-274-6918
Fax: 1-317-274-3460

Admission Deadlines

Fall Semester

- Assistantship consideration: March 1
- All international applicants: March 1
- All other applicants: May 1*

Spring Semester

- All international applicants: October 1
- All domestic applicants: November 1*

Due to schedule of course offerings, it is not always feasible to begin the program in the Spring semester. Email mathgrad@iupui.edu for more information before applying for Spring admission.

Summer Semester

- April 1**

*If you cannot provide all application materials by the date indicated above, we encourage you to apply to the Graduate Non-Degree program through the IUPUI Graduate School Office. This program will allow you to take courses towards your intended degree program, and you may transfer up to 12 credit hours into the M.S. program, subject to graduate committee approval. Email mathgrad@iupui.edu for more information.

**This deadline applies for an M.S. Math Education major only. Due to schedule of course offerings, it is not always feasible to begin the program in the Summer semester (with the exception of math education). Email mathgrad@iupui.edu for more information before applying for Summer admission (unless you are math education).

PhD in Biostatistics

The Ph.D. in Biostatistics is offered jointly with the Department of Biostatistics in the Indiana University School of Medicine and the Indiana University Fairbanks School of Public Health.

Admission Requirements

Applications are invited from individuals with strong quantitative and analytical skills and a strong interest in biological, medical and/or health related sciences. This program requires completion of at least 90 credit hours of graduate work. A maximum of 30 credit hours completed in either a previous degree program, or in graduate non-degree status, may contribute towards this requirement, subject to program approval. However, transfer of credit hours completed in graduate non-degree status is limited to no more than 12. All course grades must be a B or higher in order to be considered for transfer into the program.

Application Process

1. IUPUI online application
2. A statement of personal and professional goals (approximately 750 words). This can be submitted as part of the online application or sent directly to the department.
3. A resume or CV. This can be submitted as part of the online application or sent directly to the department.
4. Three letters of recommendation. These are submitted through the online application.
5. Official transcripts and evidence of degrees awarded from each post-secondary school attended. If the original documents are in not in English, you must submit a certified translation of each official transcript and degree certificate. Notarized copies are NOT acceptable.
6. Non-native speakers of English must provide proof of English proficiency. See the IUPUI Office of International Affairs English Language Requirements for details.

1. Non-waiveable, non-refundable application fee of $60 for domestic applicants and $60 for international applicants.
2. International Student Financial Information Form (For international students only; download and print the form).
3. ALL applicants must submit official general GRE test scores.

7. See http://biostatgradprograms.iupui.edu/admissions/ for additional information
8.

NOTE: All documents submitted become property of IUPUI. After one year of **no** enrollment, hard copies will be discarded.

Admission Deadlines

Fall Semester

- All applicants: December 15

Applications are considered for Fall entry only; application entries for Spring (January) and Summer (June) will not be considered. However, any prospective applicant who would like to start taking classes during a Spring or Summer session is welcome to do so as a graduate non-degree student. A separate application is required.

PhD in Mathematics

Admission Requirements

Applications are invited from individuals with a strong background in mathematics who either have an M.S. in mathematics or else have been admitted to our combined M.S.- Ph.D. program. This program requires completion of at least 90 credit hours of graduate work. An M.S. degree from an accredited university may contribute up to 30 credit hours toward this requirement, subject to approval.

Application Process

1. IUPUI online application
2. A statement of personal and professional goals (300-500 words). This can be submitted as part of the online application or sent directly to the department.
3. A resume or CV. This can be submitted as part of the online application or sent directly to the department.
4. Three letters of recommendation. These are submitted through the online application.
5. Official transcripts and evidence of degrees awarded from each post-secondary school attended. If the original documents are not in English, you must submit a certified translation of each official transcript and degree certificate. Notarized copies are NOT acceptable.
6. Demonstration of English proficiency*: Students whose native language is not English must demonstrate English proficiency through one of the following options:
    1. Official TOEFL score report not more than two years old with the following minimum scores:
    570 (paper),
    230 (computer),
    or **80** (internet: writing 18, speaking 18, listening 14, reading 19)
    2. Official IELTS (International English Language Testing System) score of at least **6.5**.
    3. Official PTE (Pearson Test of English) score of at least **58**.
7. Non-waiveable, non-refundable application fee for domestic and international applicants.
8. International Student Financial Information Form (For international students only; download and print the form).
9. The GRE general test scores are required and the GRE Math Subject Test is recommended. Score reports should be submitted directly from the testing service (ETS).
10. Supplemental Question Form. This can be submitted as part of the online application or sent directly to the department.

*If you are a native speaker of English, you are not required to demonstrate English proficiency. An exception will be granted for non-native speakers of English who have completed a post-secondary degree at a college or university in a native-English speaking country within two years of the anticipated enrollment semester and for non-native speakers of English who are U.S. citizens or permanent residents.

NOTE: All documents submitted become the property of IUPUI. After one year of **no** enrollment, hard copies will be discarded.

Send application materials the following address.

Graduate Admissions Committee
IUPUI Department of Mathematical Sciences
402 N. Blackford Street, LD 270
Indianapolis IN 46202-3216

Email: mathgrad@iupui.edu
Phone: 1-317-274-6918
Fax: 1-317-274-3460

Admission Deadlines

Fall Semester

- Fellowship consideration: February 1
- Assistantship consideration: March 1
- All international applicants: March 1
- All other applicants: May 1

Spring Semester

- All international applicants: October 1
- All domestic applicants: October 1

Due to schedule of course offerings, it is not always feasible to begin the program in the Spring semester. Email mathgrad@iupui.edu for more information before applying for Spring admission.

Physics, MS & PhD

Students seeking to enroll in the physics graduate programs should have a background in the usual undergraduate courses in physics, mathematics and other sciences. Graduates from related fields of study in pure and applied sciences, and engineering, may be accepted on a probationary basis until they have completed any necessary undergraduate courses in physics.

Letters of Recommendation: We require three letters of recommendation from people familiar with you and your

student and/or professional career. (See recommended letter format.)

Transcripts: One original copy of the official transcript(s) of all previous university work is required. All degrees awarded should be documented. A list of university courses and their titles that do not appear on the transcript(s) should also be sent to us.

GRE: You are required to take the Graduate Record Examination general test. The subject test in physics is not required, but is strongly encouraged. Please have the documentation of your score mailed directly to us from Educational Testing Service.

TOEFL: Foreign students must take the TOEFL or IELTS. The minimum scores required for admission are 79 (TOEFL internet-based test, (with partial minima of 18 in speaking, 18 in writing, 14 in listening, and 19 in reading)); 213 (TOEFL computer-based test); or 6.5 (IELTS).

Physics Qualifying Exam: The Qualifying Exam must be taken, at the latest, after completing the first semester of graduate work. Two consecutive attempts are permitted to obtain a passing grade. A free attempt is granted to the student upon first enrolling in the Department.

Online Application: Please be sure to complete the Statement of Purpose regarding your goals and plans for your professional career in the on-line application. Also note the specific area of Physics that interests you. Apply now.

Application Fee: An application fee will be charged which may be paid by credit or debit card.

Fellowships & Assistantship: If you are interested in applying for a fellowship, please download and mail to us the form: "Release of Confidential Information to the University Fellowship Subcommittee ." Note: Fall semester deadline to be considered for a Fellowship or a Teaching Assistantship is March 15th. In addition University Fellowships are available. Those have an earlier deadline of January 15th.

Letters of recommendation, transcripts and exam scores should be mailed to:

Director of Graduate Programs

Department of Physics

IUPUI School of Science

402 N. Blackford St., LD 154
Indianapolis IN 46202-3273

Psychology

All applicants must have a bachelor's degree from an accredited institution. A master's degree is not required for admission into the Ph.D. programs.

Applicants must

- take the Graduate Record Examination (GRE),
- submit three (3) letters of recommendation (including the recommendation form),
- a personal statement, and
- provide official transcripts (2 copies) of past academic work.

Admission Deadlines

- December 1 (Clinical Psychology Ph.D.)
- December 1 (Addiction Neuroscience Ph.D.)
- December 15 (Applied Social and Organizational Psychology, Ph.D.)
- February 1 (Industrial/Organizational Psychology M.S.)

Online Applications

Applications are completed online and additional information is available on the Department of Psychology website (https://science.iupui.edu/psychology/).
Call **317-274-6945** or email gradpsy@iupui.edu for additional information.

Apply to the Graduate Program

Addiction Neuroscience Ph.D.

Admission Requirements

Addiction Neuroscience Ph.D.
All admission materials must be submitted by December 1.

Admitted Students enter the program beginning in the Fall semester. The Addiction Neuroscience (AN) program is designed for full-time students only.

Admission Materials

1. Apply online
2. A minimum undergraduate GPA (grade point average) of 3.20*
3. A personal statement expressing interest in addiction neuroscience and detailing any relevant research experience.
4. Three (3) letters of recommendation (including the recommendation form) ideally from faculty or others who can speak to the applicant's preparation for graduate level work in addiction neuroscience..
5. Two (2) official transcripts of all undergraduate and graduate coursework.
6. International students must submit TOEFL (Test of English as a Foreign Language) scores unless the student has a bachelor's degree from a predominantly English-speaking country (check here for the official list).
7. Verbal and quantitative Graduate Record Examination (GRE) scores are optional.

*Majors in the life sciences (psychology, biology, or chemistry) are particularly encouraged to apply, but other degrees will be given full consideration with appropriate course work. Academic preparation and performance in the life sciences (e.g., experimental psychology and behavioral neuroscience; cell and systems biology; chemistry) are given high priority in considering candidates for admission. Note that the candidate's entire application package will be reviewed as a comprehensive and holistic representation of the likelihood for success in graduate studies; no one part of the application materials is deemed "most important".

Women and minorities are strongly encouraged to apply.

Financial support is typically provided to all students in good standing.

For more information about the program, contact Dr. Cristine Czachowski (cczachow@iupui.edu@.

Applied Social and Organizational Psychology Ph.D. (Ph.D.)

Admission Requirements

Applied Social and Organizational Psychology Ph.D.

Admitted students enter the program beginning in the Fall Semester. The Applied Social and Organizational Psychology (ASOP) program is designed for full-time students only.

All admission materials must be submitted by December 15.

Admission Materials

1. A graduate school application that can be electronically submitted
2. A full set of undergraduate and graduate transcripts
3. Three (3) letters of recommendation
4. Verbal and quantitative GRE (Graduate Record Examination) scores
5. International students must submit TOEFL (Test of English as a Foreign Language) scores *unless* the student has a bachelor's degree from a predominantly English-speaking country (check here for the official list).
6. A personal statement
7. Departmental Questions

Admission Requirements

- A bachelor's degree in psychology from an accredited institution is highly desirable, but applicants with a bachelor's degree in a similar area with coursework in social science statistics and research methods will be considered. Applicants with graduate degrees (preferably in psychology or a related social science field) will also be considered.
- An undergraduate and graduate GPA (grade point average) of 3.20 or higher on a 4-point scale.
- Competitive GRE General Test scores with subtest percentile ranks at or above the 50th percentile.
- Three (3) favorable letters of recommendation, ideally from faculty or others who can speak to the applicant's preparation for graduate level work in psychology. The recommendation form must be attached to all reference letters and may be submitted by the recommenders through the online application or mail. Download the Recommendation form if you plan to submit your letters by mail.
- A personal statement expressing an interest in applied social and organizational psychology.
- Relevant research experience, preferably in psychology or a related social science.

Clinical Psychology Ph.D.

Students will be admitted to the program only at the beginning of the Fall Semester. The Clinical Psychology (CP) program is designed for full#time students only.

All admission materials must be submitted by December 1.

Admission Materials

1. A graduate school application that can be electronically submitted
2. A full set of undergraduate and graduate transcripts
3. Three (3) letters of recommendation
4. Verbal and quantitative GRE (Graduate Record Examination) scores.
5. Foreign students must submit TOEFL scores (Test of English as a Foreign Language) *unless* student has a bachelor's degree from a predominantly English-speaking country (check here for the official list).
6. A personal statement.
7. Departmental Questions.

Admission Requirements

- An undergraduate and graduate GPA (grade point average) of 3.20 or higher on a 4-point scale.
- Three (3) favorable letters of recommendation. The recommendation form must be attached to all reference letters and may be submitted by the recommenders through the online application or mail. Download the Recommendation form if you plan to submit your letters by mail.
- A personal statement displaying an interest in the field of clinical psychology with a focus in clinical health psychology, severe mental illness/psychiatric rehabilitation, or substance use.
- Prior research experience is strongly recommended, but not required, for admission.

Undergraduate Prerequisites

Except in unusual circumstances, students admitted to the program are expected to have completed at least 15 credit hours in psychology.

Although there are no specific undergraduate course prerequisites for program entry, students without coursework in the following areas will likely be at a disadvantage when taking some of the required courses:

1. Tests and Measurement
2. Statistics
3. Human Physiology or Physiological Psychology (Behavioral Neuroscience)
4. Abnormal Psychology

Students without preparation in these areas may be asked by their instructors to complete some remedial activity prior to enrolling in the graduate course (e.g., reading an undergraduate text or taking an undergraduate course).

Industrial/Organizational Psychology M.S.

Admission Requirements

All applicants must have a bachelor's degree from an accredited institution. Admitted students enter the program beginning in the Fall semester. The Industrial/ Organizational (I/O) Psychology program is designed for full-time students only.

All admission materials must be submitted by February 1.

1. Apply online
2. Competitive GRE (Graduate Record Examination) verbal and quantitative scores (the psychology subtest is not required)**.**
3. Students must have an undergraduate GPA (grade point average) of at least 3.00 on a 4-point scale
4. Three (3) strong letters of recommendation (including the recommendation Form) ideally from faculty or others who can speak to the applicant's preparation for graduate level work in psychology.

5. A personal statement expressing an interest in industrial/organizational psychology.
6. Two (2) official transcripts of all undergraduate and graduate coursework.
7. International students must submit TOEFL (Test of English as a Foreign Language) scores unless the student has a bachelor's degree from a predominantly English-speaking country (check here for the official list).
8. A program prerequisite is a course in statistics.

Student Learning Outcomes

- Addiction Neuroscience
- Applied Social and Organizational Psychology
- Biology
- Chemistry
- Clinical Psychology
- Computer and Information Science
- Forensic and Investigative Sciences
- Geology
- Industrial Organizational Psychology
- Mathematics
- Physics

Biology

Master of Science in Biology (M.S.)

Students pursuing the Biology Pre-Professional M.S. will be able to:

1. Integrate biological knowledge and information incorporating cellular, molecular, genetic, physiological, and biochemical approaches.
2. Use critical thinking to access, analyze and evaluate information relevant to the study of biological sciences.
3. Develop proficiency in reading, interpreting, and evaluating primary scientific literature.
4. Summarize and present scientific ideas and biological information in a formal setting, in writing and orally, to faculty or fellow students.

Students pursuing the Biology Thesis M.S. will be able to:

1. Conduct independent research under the supervision of a research advisor to design, test, and analyze original laboratory and/or field experiments.
2. Demonstrate the ability to read, interpret, and incorporate the results of primary literature into the research design.
3. Employ rigorous approaches to data collection, replication of experimental results, set up of experimental controls and sampling design, and organization of raw data.
4. Summarize, describe and analyze patterns in data, interpret results and draw conclusions from data to defend an argument.
5. Present and communicate research results to peers through a poster presentation, research seminar and/or publication of results.
6. Write and defend a thesis that demonstrates mastery in at least one discipline of biological sciences.

Doctor of Philosophy in Biology (Ph.D.)

In addition to the above outcomes, students completing the Ph.D. in Biology will be able to:

1. Demonstrate a comprehensive knowledge in biological sciences through successful completion of a qualifying and preliminary examination.
2. Document an original contribution to biology through independent experimental design, peer-reviewed publication of results, and presentation and defense of a thesis.

Chemistry

Master of Science in Chemistry (M.S.)

In addition to the stated SLOs for B.A. and B.S. students, those who graduate with a M.S. in Chemistry will be expected to:

1. Demonstrate increased depth of understanding in most sub-disciplines of chemistry.
2. Integrate sub-disciplines of chemistry and other disciplines as applicable in problem solving and research.
3. Read and understand peer-reviewed chemical literature, and apply in field of study.
4. Present and communicate results to peers through poster, seminar, and/or publishing.
5. Identify chemical problems and design experiments to solve these problems.
6. Teach effectively in labs or recitations in lower-level undergraduate chemistry courses.
7. For thesis MS, propose major area of research and conduct independent research under the mentoring of a research advisor.
8. For thesis MS, write and defend the thesis.

Doctor of Philosophy in Chemistry (Ph.D.)

In addition to the above learning outcomes for the M.S. degree, Chemistry Ph.D. students upon graduation will be expected to:

1. Think critically and creatively.
2. Propose original research project and conduct this research independently, including project design, analysis, and conclusion.
3. Demonstrate mastery of chemistry in at least one discipline of chemistry.
4. Communicate and defend scholarly works.

Computer and Information Science

Graduate Certificates

The CIS department offers graduate certificates in Biocomputing, Computer Security, Software Engineering, Databases and Data Mining, and Biometrics. After graduation, a student should be able to:

1. Demonstrate a sound understanding of computing principles in the chosen area of study (Biocomputing, Biometrics, Computer Security, Databases and Data Mining, Software Engineering).
    1. As evident from appropriate grades earned to satisfy the core course requirement for a specific certificate program

2. Demonstrate an ability to work in a group.
    1. As evident from successfully developing moderately intense collaborative projects (e.g., semester projects in courses)
3. Demonstrate an ability to solve moderately complex problems in the chosen area of study.
    1. As evident from successful completion of elective courses in Computer Science or related fields, as required by the Certificate program(s)

Master of Science in Computer and Information Science (M.S.)

After graduation, a student should be able to:

1. Demonstrate a sound understanding of general fundamental computing concepts (e.g., algorithms, programming languages, operating systems, etc.).
    1. As evident from appropriate grades earned to satisfy the core course requirements
2. Demonstrate a relatively in-depth understanding of a subarea.
    1. As evident from successfully completing a series of courses in a sub-area (e.g., databases)
3. Demonstrate an ability to successfully work in a group and/or demonstrate an ability to successfully carry out moderately complex software projects.
    1. As evident from successfully developing moderately intense collaborative projects (e.g., semester projects in courses) and/or
    2. As evident from software development assignments/projects in courses (e.g., projects in networking course)

Additional Expectation from M.S. students choosing Thesis or Project Option:

1. Demonstrate an ability to systematically carry out scientific research (empirical and/or theoretical) on a moderately complex problem.

Master of Science in Computational Data Science (M.S.)

After graduation, a student should be able to:

1. Synthesize data analysis principles across the statistical and computer sciences in topics such as pattern analysis, prediction, and big data processing.
2. Construct data science algorithms, including derivation and programming implementation in a variety of languages and platforms (C++, Python, Java, SAS, R, Matlab).
3. Be able to assess new programming language trends in industry, by gaining solid background in computing and algorithmic thinking.
4. Differentiate the processes from "raw data to outcome", which spans from considering the domain-specific constraints and charactertistics (e.g., static vs. sequence, sparsity, dimensionality, etc.) to efficient method implementation, as software with desired specifications.
5. Integrate advanced knowledge in a broad range of related topics, such as survival analysis in Computer Science.
6. Assess different solutions to specific data-specific problems.
7. Summarize state-of-the-art data science methods and applications in scientific project reports and software documentation.

Doctor of Philosophy in Computer and Information Science (Ph.D.)

In addition to the above M.S. outcomes, Ph.D. students will:

1. Demonstrate an ability to develop original solutions and their validation that extend the state-of-art in a chosen specialization to significant research problem(s) as evident from publications in highly-ranked conferences/journals.

Forensic and Investigative Sciences

Master of Science in Forensic and Investigative Sciences (M.S.)

- Understand and describe the development of forensic science in the world and US and how we arrived at the present system.
- Describe the judicial system and the role of forensic science within it.
- Explain the development of the rules of evidence that pertain to the introduction of scientific evidence.
- Describe the major ethical issues facing forensic scientists today.
- Summarize the methods of collection and preservation of physical evidence and maintenance of the chain of custody.
- Describe the various schemes of classification of evidence and their importance.
- Compare the methods and strategies of the presentation of scientific evidence in court.
- Understand types of impression evidence including fingerprints, footwear, tire treads, toolmarks, and bullets and cartridge casings.
- Apply understanding of impression to analyze fingerprints, footwear, tire treads, toolmarks, and bullets and cartridge casings.
- Understand applications of light microscopy such as: stereomicroscopy, compound light microscopy, and polarizing light microscopy.
- Demonstrate common techniques used with light microscopy.
- Integrate instrumental microscopy techniques in the examination of trace evidence.
- Apply knowledge of the rules of evidence to promote effectiveness in the collection of evidence, examination/analysis of the evidence, and in the preparation of scientific reports and testimony.
- Describe the kinds of evidence that require a scientific foundation for admission.
- Demonstrate the ability to conduct accurate comprehensive and focused scientific investigations and apply appropriate rules of evidence.
- Interpret and implement standards of forensic practice as established by the rules of evidence.

- Apply knowledge of forensic science to case scenarios, and will exhibit increased mastery of the written and verbal presentation of scientific evidence generally.
- Demonstrate an overall knowledge of the legal system and more specifically, the criminal justice system in the courts of the United States and Indiana.
- Summarize the basic practical and legal aspects of some forensic techniques.
- Conduct a critical evaluation of the limitations and capabilities of some techniques for the purposes of writing reports and testifying in court.
- Demonstrate proper techniques for courtroom testimony and the use of exhibits.

Specialized Outcomes for Students Completing the Thesis Track:

- Conduct a literature search on a forensic science research topic.
- Participate in the design of a research project.
- Carry out experiments to properly collect data.
- Ability to document research data.
- Ability to evaluate and interpret research data.
- Effectively communicate research results through written, oral and visual presentations.

Specialized Outcomes for Students Completing the Non-Thesis Track:

- Conduct a literature search relevant to an area of research or laboratory procedure.
- Understand and describe an appropriate experimental design for laboratory projects.
- Generate a complete proposal for an independent laboratory project.
- Summarize the transition from a scientist to a manager/leader, including leadership assessment, time management, communication and effective delegation.
- Analyze the key components of quality assurance, including implementation of ISO 17025 and the essential national conversation about the accreditation of forensic science laboratories.
- Compare and contrast the best practices with regards to staff motivation, employee evaluation, conflict resolution, effective negotiations, creative problem-solving, collaborative decision-making and teambuilding.
- Integrate the concepts of revenue, expenses, assets, liability, appropriation and fiscal year within the context and resource constraints of a forensic science laboratory.
- Differentiate the processes of budgeting, forecasting and financial reporting in a forensic science laboratory.

Specialized Outcomes for Students Completing the Forensic Biology Concentration:

- Explain the principles, instrumentation and forensic applications of the following to biological evidence analysis:
  - Collection and preservation of evidence
  - Presumptive and confirmatory tests
  - Introduction to DNA typing
  - Single source DNA profiling
- Describe the biological composition, origins, significance for the most commonly encountered types of biological evidence such as blood, semen, and hair.
- Determine the appropriate scheme to be used on biological evidence as it were to be found at a crime scene.
- Demonstrate an understanding of the general concepts of population genetics.
- Differentiate between the main theories.
- Apply knowledge to generate a break-down of several examples through individual presentations of research articles.
- Describe practical examples of population genetics usage
- Recognize and explain the techniques used such as GWAS and Forensic DNA profiling statistics.
- Formulating results using several different Population Genetics computer software on sample data.

Specialized Outcomes for Students Completing the Forensic Chemistry Concentration:

- Describe the major effects of alcohol and drugs on the human body.
- Describe the main legal issues surrounding alcohol and illicit drugs.
- Provide detailed information regarding the analytical methods for alcohol and drugs.
- Identify major areas of research focused on alcohol and drug analysis.
- Explain the principles, instrumentation and forensic applications of the following to trace evidence analysis:
  - Chromatography Techniques: TLC, HPLC, and GC
  - Energy-Induced Methods: EDS, XRF and XRPD
  - Spectroscopy Techniques: UV/vis/ fluorescence, FTIR and Raman
  - Mass Spectrometry using EI, CI and ESI
- Describe the chemical composition, origins, significance and instrumental methods for the most commonly encountered types of trace evidence such as ink, paint, fibers, explosives, and ignitable liquids.
- Determine the appropriate analytical scheme to be used on trace evidence.

Geology

Broad Earth Sciences Graduate Program Goals

Upon graduating, students with a graduate degree (MS in Geology or PhD in Applied Earth Sciences) will:

- Broadly understand and explain the significance of major research questions in one or more areas of earth sciences.
- Formulate testable scientific hypotheses.
- Carry out independent research in one or more subfields of earth sciences, using appropriate field, experimental, analytical, and/or computational methods.

- Describe, synthesize, and interpret the results of a scientific investigation orally and in writing.

Student Learning Outcomes for the M.S. Degree Program

Students who graduate with an MS degree* will achieve the following objectives:

1. Demonstrate the ability to synthesize current research questions and approaches in one or more subfields of Earth Sciences by critical evaluation of primary scientific literature.
2. Write a research proposal that presents a testable hypothesis, outlines the types of data needed to test the hypothesis, and describes how the collected data will be used to test the hypothesis.
3. Devise and implement a field, experimental, analytical, and/or computational plan aimed at collecting and analyzing the data necessary to address a specific scientific question.
4. Communicate research results to peers via poster or oral presentation, or publication in peer-reviewed journals, meeting abstracts, and/or technical reports.
5. Write and defend their research results (orally or in poster format) to demonstrate mastery of the material and an ability to communicate the results and significance of their work.

**numbers 1-5 apply to thesis-option MS graduates. Number 1 applies to non-thesis option MS graduates.*

Student Learning Outcomes for the PhD in Applied Earth Sciences

Students who graduate with a Ph.D. in Applied Earth Science will achieve the following objectives:

1. Conduct independent research under the supervision of a research advisor to design, test, and analyze the results of original laboratory and/or field experiments.
2. Demonstrate the ability to read, interpret, and incorporate the results of primary literature into the research design.
3. Employ rigorous approaches to sampling design and data collection, replication of experimental results, set up of experimental controls, and organization of raw data.
4. Summarize, describe and analyze patterns in data, interpret results and draw conclusions from data to defend or refute a hypothesis.
5. Demonstrate a comprehensive knowledge of applied earth sciences through successful completion of preliminary and qualifying examinations.
6. Document an original contribution to applied earth sciences through publication of peer-reviewed results, and presentation and defense of an original dissertation.

Mathematics

Master of Science in Mathematics (M.S.)

Degree concentrations include: Applied Mathematics, Pure Mathematics, Applied Statistics, and Math Education. In addition to the Student Learning Outcomes for the B.S. degree, those who graduate with a M.S. degree in Mathematics will be able to:

1. Demonstrate increased depth of understanding in most sub-disciplines of mathematics.
2. Integrate sub-disciplines of mathematics and other disciplines as applicable in problem solving.
3. Read and understand peer-reviewed mathematical literature.
4. Identify mathematical problems and design solutions to solve these problems.

Doctor of Philosophy in Mathematics (Ph.D.)

In addition to the Student Learning Outcomes for the M.S. degree, those who graduate with a Ph.D. degree in Mathematics will be able to:

1. Demonstrate a basic understanding of the fundamental ideas underlying the basic mathematical disciplines.
2. Demonstrate the ability to recognize significant research problems.
3. Demonstrate the ability to analyze problems, reach research solutions, and transmit the fundamental ideas to others.
4. Demonstrate a comprehensive knowledge in mathematical sciences through successful completion of a qualifying and preliminary examination.
5. Document an original contribution to mathematics through independent experimental design, peer-reviewed publication of results, and presentation and defense of an original thesis.

Doctor of Philosophy in Biostatistics (Ph.D.)

In addition to the Student Learning Outcomes for the M.S. degree, those who graduate with a Ph.D. degree in Biostatistics will be able to:

1. Demonstrate a basic understanding of the fundamental ideas underlying the basic mathematical disciplines.
2. Demonstrate the ability to recognize significant research problems.
3. Demonstrate the ability to analyze problems, reach research solutions, and transmit the fundamental ideas to others.
4. Demonstrate a comprehensive knowledge in biostatistics through successful completion of a qualifying and preliminary examination.
5. Document an original contribution to biostatistics through independent experimental design, peer-reviewed publication of results, and presentation and defense of an original thesis.

Physics

Master of Science in Physics (M.S.)

Student will demonstrate the following learning outcomes:

1. Students demonstrate proficiency in the core areas of physics (Classical Mechanics, Electromagnetism, Thermal Physics and Quantum Physics), and have knowledge of math sufficient to perform the calculations needed to apply their knowledge (Linear

Algebra, Ordinary and Partial Differential Equations, Vector Calculus).
2. The most important outcome of their Masters is an ability to carry out a research project under the supervision of a faculty member. Research includes written and verbal communication. The written portion is demonstrated in a thesis or report. The ability to communicate verbally is demonstrated during the first part of the defense, which is open to the public. It is not required but expected that students will present their research at scientific conferences.

The students' progress towards their MS degree is evaluated by their advisors and advisory committee.

Doctor of Philosophy in Physics (Ph.D.)

Students will demonstrate the following learning outcomes:

1. Students demonstrate expertise in core areas of physics (Electromagnetism, Thermal Physics and Quantum Physics), as well as in other areas associated specifically with their research.
2. They demonstrate proficiency in widely used areas of mathematics (Linear Algebra, Ordinary and Partial Differential Equations, Vector Calculus) and in the use of advanced mathematical tools needed in their physics courses and their research.
3. The most important outcome of their PhD is an ability to perform independent research in collaboration with a faculty member. Their research culminates in an original project, written as a Thesis and defended in an examination, which has a public part and a meeting with the examination committee.
4. Communication skills are emphasized throughout the PhD. The Thesis and examination establish the student’s ability to communicate verbally and in scientific writing at a high level. Students also write reports in their courses, they have to present their research results at conferences, and it is expected that they will publish their results in scientific journals.
5. Their ability to plan and design a research plan is evaluated at a Preliminary exam when, if successful, they are fully admitted into the PhD program. Students in the PhD program meet at least once a year with their advisory committee to report on their progress.

Doctor of Philosophy in Addiction Neuroscience (Ph.D.)

Graduate students earning a Purdue University Ph.D. in Addiction Neuroscience on the IUPUI campus will demonstrate the following abilities related to the research focus of the degree:

1. Demonstrate knowledge of key concepts in the psychological and brain sciences, including the methods, history, and theoretical and empirical foundations, with special emphasis on the neuroscience of addiction.
2. Demonstrate the knowledge and skills necessary to conduct, analyze, interpret, and communicate original research and scholarship in behavioral neuroscience, particularly in addiction neuroscience.
3. Demonstrate understanding of the neural mechanisms and processes associated with the causes and consequences of substance abuse, including integration across genetic, neurobiological, developmental, and behavioral levels.
4. Think critically and creatively to solve problems and generate new knowledge in behavioral neuroscience in general, with focus on and application to problems of drug abuse and addiction.
5. Conduct research in the behavioral and addiction neurosciences in an ethical and responsible manner.

Doctor of Philosophy in Applied Social and Organizational Psychology (Ph.D.)

Students graduating with a Ph.D. in Applied Social and Organizational Psychology will be able to:

1. Demonstrate mastery of knowledge of the core content areas of *organizational psychology* (e.g., staffing, human resources and organizational development, work motivation, leadership, and group/team performance) and *applied social psychology* (e.g., attitudes and social cognition, social stigma, and managing a diverse workforce).
2. Apply the theory, methodologies, and data analytic procedures to conduct research on topics relevant to organizations and society.
3. Synthesize and critically evaluate psychological theory and research as they relate to human cognition, emotion, and behavior in social and organizational settings.
4. Apply skills related to the conceptualization, implementation, and evaluation of scientifically-based interventions intended to improve organizational functioning and provide evidence-based solutions to societal problems.
5. Communicate effectively to members of the field and to the general public.
6. Demonstrate awareness of, appreciation for, and interpersonal skills regarding human diversity.
7. Behave ethically and professionally in accordance with the American Psychological Association's Ethics Code in the conduct of research and in personal and professional settings.

Clinical Psychology

Doctor of Philosophy in Clinical Psychology (Ph.D.)

Graduate students earning a Purdue University Ph.D. in Clinical Psychology on the IUPUI campus will demonstrate the following abilities:

1. Students will demonstrate knowledge in the breadth of scientific psychology, including historical perspectives of its foundations and development.
2. Students will demonstrate knowledge in the theory, methodology, and data analytic skills related to psychological research.
3. Students will demonstrate the ability to generate new scientific knowledge and theory related to the field of psychology.
4. Students will acquire knowledge and skills in the assessment of individual strengths and weaknesses,

as well as the diagnosis of psychological problems and disorders.
5. Students will acquire knowledge and skills in the conceptualization, design, implementation, delivery, supervision, consultation, and evaluation of empirically-supported psychosocial interventions for psychological problems and disorders.
6. Students will demonstrate sensitivity, knowledge, and skills in regard to the role of human diversity in the research and practice of clinical psychology.
7. Students will demonstrate a working knowledge of the APA Ethics Code and will demonstrate their ability to apply ethical principles in practical contexts.

Master of Science in Industrial/ Organizational Psychology (M.S.)

Students graduating with a M.S. in Industrial/ Organizational (I/O) Psychology will be able to:

1. Demonstrate mastery of knowledge of the historical foundations of I/O psychology and its core content areas: *personnel psychology* (e.g., selection, training, and performance management) and *organizational psychology* (e.g., motivation, leadership, job attitudes, and group/team performance).
2. Apply the theory, methodologies, and data analytic procedures to conduct research in organizational settings or on topics relevant to organizations.
3. Synthesize and critically evaluate psychological theory and research as they relate to human cognition, emotion, and behavior in organizations.
4. Apply skills related to the conceptualization, implementation, and evaluation of scientifically-based interventions intended to improve organizational functioning.
5. Communicate effectively to members of the field and to the general public.
6. Demonstrate awareness of, appreciation for, and interpersonal skills regarding human diversity.
7. Behave ethically and professionally in accordance with the American Psychological Association's Ethics Code in the conduct of research and in personal and professional settings.

Admission

All students entering the School of Science must have been officially admitted to the university by the IUPUI Undergraduate Admissions Center, Campus Center, Room 255, 420 University Blvd., Indianapolis, IN 46202. Further information and application forms may be obtained at this address, by calling (317) 274-4591, or on the Web at www.enroll.iupui.edu.

Applicants should be aware that, under Indiana law, criminal convictions might result in ineligibility for admission to certain programs at IUPUI. For the School of Science, criminal convictions may also result in ineligibility for enrollment in certain courses or participation in certain projects. Questions regarding school policy on such matters should be addressed to the Executive Director of Academic and Student Affairs or the Associate Dean for Academic Affairs.

International Students

International students seeking admission to the School of Science at IUPUI must submit the international application for admission, which is available online from the IUPUI Office of International Affairs. Additional information can be obtained at IUPUI Office of International Affairs, 902 W. New York St., ES 2126 46202; phone (317) 274-7000; fax (317) 278-2213; email: @.

Undergraduate Requirements

Beginning Students

Students entering IUPUI directly from high school should file their applications for admission early in their senior year.

Acceptance to the university as a new student is influenced by several factors. The Undergraduate Admissions Center is guided by the following:

- The applicant should be a high school graduate or be scheduled to graduate before enrolling at IUPUI.
- The extent to which the student meets or exceeds the minimum subject requirements indicated below is considered. For admission to the School of Science, the student's record should include the following course work:

Subjects	Semesters
English	8
History and Social Science	6
Algebra	4
Geometry	2
Trigonometry	1-2
Laboratory Science	6 (including chemistry and biology)
Combination of foreign language, additional mathematics, laboratory science, social science, or computer science courses	6-7

Applicants to the School of Science are strongly encouraged to complete AP science and mathematics courses if available at their high school. Applicants considering majors in physics or chemistry are encouraged to complete a calculus course in high school.

In planning high school electives, the curricula of the various departments of the School of Science contained in this bulletin should be reviewed. Departmental advisors will be glad to help with planning for admission.

- All applicants are required to take the Scholastic Aptitude Test (SAT) or the American College Test (ACT). IUPUI requires that the writing section of the test also be completed. It is recommended that these tests be taken in the spring of the junior year in high school or fall of the senior year.

The Undergraduate Admissions Center will examine the applicant's high school transcript and standardized test scores to determine both admission to the university and acceptance to the School of Science.

Students should declare a major when applying for admission so a departmental advisor can be assigned.

Transfer Students

From IUPUI Schools, Indiana University Campuses, and Purdue University Campuses

Prospective transfer students should have a minimum grade point average of 2.00 on a 4.00 scale, meet the requirements of the department or program they wish to enter, and be in good disciplinary standing. In order to be accepted for admission to the School of Science, students must first provide the materials indicated below.

- An IUPUI campus student should file a record change online form. The form and information about the process may be found at: science.iupui.edu/undergraduate/admissions.
- A Purdue University campus student must make an official application through the IUPUI Undergraduate Admissions Center at https://admissions.iupui.edu.
- A student from another Indiana University campus, must make an official application through the IUPUI Undergraduate Admissions Center using the Intercampus Transfer Application. Additional information is available at https://admissions.iupui.edu.

From Other Colleges and Universities

Students who have earned transfer credit for 12 credit hours and have a minimum cumulative grade point average of 2.00 on a 4.00 scale from other institutions may be considered for admission to the School of Science. Admittance to the school is contingent upon acceptance into a departmental program. Students should submit the following with their application for admission to the IUPUI Undergraduate Admissions Center:

- a copy of their high school record showing satisfactory completion of entrance requirements; students with less than 26 hours of transfer work must present SAT or ACT scores.
- an official transcript of work completed in all institutions previously attended
- evidence of good academic and disciplinary standing at the institution last attended

The Undergraduate Admissions Center evaluates credit from other institutions, and the major department and the School of Science determine its applicability toward degree requirements in the School of Science.

A marginal applicant may be granted admission, admitted on probation, or have admission denied.

From IUPUI to Other Indiana University and Purdue University Campuses

Students transferring from IUPUI to other Indiana University and Purdue University campuses should consult the appropriate departments at those campuses about equivalence of courses.

Transfer Credit Evaluation

The student's major department and the School of Science determine acceptability of transfer credits from another college or university to the School of Science. In some cases, a course description and/or a course syllabus may need to be reviewed by the corresponding IUPUI department for consideration of applicability to a degree requirement.

Graduate and Doctoral Requirements

For Admission requirements please refer to the IUPUI University Graduate Office.

Non-Degree Students

Undergraduate Non-Degree Program

Students who hold a bachelor's degree from IUPUI or another university may register at IUPUI as Undergraduate Non-Degree students. This enrollment status is desirable for students who need to take a small number of undergraduate courses in order to apply for medical school or other professional programs in, for example, dentistry, occupational therapy, optometry, pharmacy, physical therapy, and veterinary medicine. Students enrolled as undergraduate non-degree pay undergraduate tuition and fees, but may only register for undergraduate courses.

Undergraduate non-degree students who enroll in graduate courses may be administratively withdrawn from these courses and may forfeit tuition and associated fees. Undergraduate non-degree students may seek academic advising through the School of Science. Students enrolled as undergraduate non-degree are eligible for Stafford loans only, provided they have not used up their undergraduate financial aid eligibility. They may also seek loans or support through banks or other financial institutions. Students enrolled as undergraduate non-degree are not eligible for other forms of financial aid through IUPUI.

Graduate Non-Degree Program

The students who normally select the graduate non-degree classification are those whose intent is to take course work for personal improvement. A student who wishes to become a candidate for an advanced degree should consult with the chosen major department at the time of application for admission as a graduate non-degree student. The major department will advise applicants of the procedure for obtaining status as a degree-seeking student. An application to become a graduate non-degree student is obtained through the IUPUI Graduate Office at the following Web site: http://graduate.iupui.edu/admissions/non-degree.shtml. Additional information can be obtained at the IUPUI Graduate Office, University Library, Room UL 1170, 755 W. Michigan Street, Indianapolis, IN 46202; telephone (317) 274-1577.

No more than 12 hours of credit earned under this classification may be used on a plan of study for a Purdue University degree program without approval of the major department and the Purdue University Graduate School. Similarly, no more than 9 hours of credit earned under this classification may be used in a plan of study for an Indiana University degree program without approval of the major department.

Departments & Programs

- Biology
- Biotechnology
- Chemistry and Chemical Biology

- Computer and Information Science
- Earth Sciences
- Environmental Science
- Forensic and Investigative Sciences
- Interdisciplinary Studies
- Mathematical Sciences
- Neuroscience
- Physics
- Psychology
- Special Programs

Department of Biology

723 W. Michigan Street, SL 306
Indianapolis, IN 46202-5132
Phone: (317) 274-0577; fax: (317) 274-2846
https://science.iupui.edu/biology/

Department Chair: Theodore R. Cummins, Ph.D.

Department Advisors:

- Graduate Programs: James Marrs, Ph.D.
- Undergraduate Programs:
  - Jane Alexander (student last names A - K)
  - M. Jane Parr (student last names L, N - Z)
  - Krista Swisher (Student last names M, transfer students)

The Department of Biology offers undergraduate instructional programs leading to the Bachelor of Arts (B.A.), Bachelor of Science (B.S.) and Biotechnology B.S. degrees. These programs are designed to prepare students for a variety of careers in the biological sciences and allow sufficient flexibility to accommodate the needs and interests of students. Postgraduate activities frequently selected by biology majors include graduate schools, medical and dental schools, other health care professions, agricultural schools, industrial positions in research and technology, and secondary teaching.

The selection of a particular degree program in biology should be made in consultation with a departmental advisor.

The Department of Biology offers graduate study leading to the Master of Science (M.S.) degree. The M.S. degree program may be completed with a thesis option or with a non-thesis option. Among the non-thesis options is the M.S. degree in the teaching of biology, which is designed primarily for secondary school teachers, and a one-year preprofessional option for those seeking admission to medical or dental schools. The Doctor of Philosophy (Ph.D.) degree can be pursued in a variety of areas through the Purdue University Graduate School and through several programs and departments in the Indiana University School of Medicine.

The Department of Biology regards research as an important component of its programs at both the undergraduate and graduate levels. Students may work in such specific areas as microbial genetics, neurobiology, plant cell and molecular biology, recombinant DNA, cell biology, developmental biology, regenerative biology, microbiology, oncology, plant and animal tissue culture, and forensic biology.

- Bachelor of Arts Degree Requirements
- Bachelor of Science Degree Requirements
- Minor in Biology
- Biology Plans of Study
- Master of Science
- Doctor of Philosophy

Bachelor of Arts Degree Requirements

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I English Composition and Communication Competency

See the School of Science requirements under “Undergraduate Programs” in this bulletin.

Written Communication (6 cr.)

ENG-W131 Reading, Writing and Inquiry (3 cr.)

A second writing course with ENG-W131 as a prerequisite, e.g. ENG-W270, ENG-W150, ENG-W230, ENG-W231, ENG-W320, ENG-W350, TCM 22000, or TCM 32000.

Oral communication

COMM-R110 Fundamentals of Speech Communication (3 cr.)

Area II World Language Competency

See School of Science requirements under “Undergraduate Programs.” Students must have first-year proficiency in a world language (first year sequence (131 & 132) or a 200-level world language course or 200 level world language proficiency).

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.)

- List H course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.
- List S course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.
- One additional course from either List H or List S
- List C course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

Physics Two semesters of basic physics (PHYS-P201 / PHYS-P202 or PHYS 15200 / PHYS 25100).

Chemistry Two semesters of Principles of Chemistry with laboratories (CHEM-C105/CHEM-C125 3/2 cr.; CHEM-C106/CHEM-C126 3/2 cr.), two semesters of organic chemistry lecture and one semester of laboratory (CHEM-C341/CHEM-C343, CHEM-C342), plus prerequisite basic sequence or background to enter sequence above. The second laboratory in organic chemistry (CHEM-C344) is required for admission to some medical schools and is strongly recommended for students in most other programs. Consult a PREPs or departmental advisor.

Area IIID Analytical Reasoning Competency

MATH 15900 or MATH 15300 / MATH 15400. (Starting point for mathematics courses should be worked out with a departmental advisor based on the math placement test and/or background of the student.) The computer programming requirement may be satisfied with CSCI-N200, CSCI-N201, CSCI-N207, or CSCI-N211 (other 300+ level courses may be used with permission).

Note: Computer Science CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as general electives.

Area IV Biology Major Requirements

Required Core Sequence

- BIOL-K101 / BIOL-K103 Concepts of Biology I and II (BIOL-K102/BIOL-K104 Honors)
- BIOL-K322 Genetics and Molecular Biology
- BIOL-K324 Cell Biology
- BIOL-K341 Principles of Ecology and Evolution

Upper-Level Courses

- At least one lecture course from each of areas I-II listed below.
- Three laboratory courses beyond BIOL-K101 / BIOL-K103 selected from areas below. To receive credit for a laboratory, an accompanying pre- or co-requisite lecture must be completed with a minimum grade of C-. BIOL-K493 will count as one laboratory course only if BIOL-K490 is also taken.
- Capstone Experience. This requirement is met by taking either BIOL-K493 Independent Research (1 cr.) or BIOL-K490 Capstone (1 cr.) in the senior year. BIOL-K493 cannot be used as both a third laboratory and as a capstone. BIOL-K490 addresses the integration of knowledge in the principles of undergraduate education as well as values and ethics as they relate to the student's major. The capstone is an independent, creative effort by the student that is integrative and builds on the student's previous work in the major; it may include research projects, independent study and projects, a practicum, a seminar, and/or a field experience.
- Electives consisting of sufficient lecture and laboratory course work to total 30 credit hours (including core sequence credit hours). These credits may be selected from any of the areas listed below.
- Residency Credits. In order to graduate students must have a minimum of 32 credit hours at the 300-level or above at IUPUI. B.A. students usually need at least one 300-level course in addition to their required biology and chemistry courses to meet this requirement.

A maximum of 15 credit hours of biology earned previously at other institutions is applicable toward the major for the B.A. degree.

Unless approved as part of the major, note that all courses taken outside the Schools of Science and Liberal Arts must receive approval from the student's major department and the School of Science Academic Dean's Office. Consult with your major department advisor for information and additional course restrictions.

A minimum 2.00 GPA must be earned in BIOL-K courses; No grade lower than a C-.

Once admitted, students are expected to fulfill their course requirements within the major at IUPUI.

Areas/Electives

I. Molecular/Cellular Area

- Undergraduate Level
  - BIOL-K338 Introductory Immunology
  - BIOL-K384 Biochemistry
  - BIOL-K416 Cellular and Molecular Neuroscience
  - BIOL-K451 Neuropharmacology
  - BIOL-K484 Cellular Biochemistry
  - BIOL-K488 Endocrinology in Health and Disease

- Undergraduate and Graduate Level
  - BIOL 50700 Principles of Molecular Biology
  - BIOL 51600 Molecular Biology of Cancer
  - BIOL 54410 Sensory Systems
  - BIOL 55000 Plant Molecular Biology
  - BIOL 55900 Endocrinology
  - BIOL 56010 Neurodegenerative Diseases
  - BIOL 56100 Immunology
  - BIOL 56400 Molecular Genetics of Development
  - BIOL 57410 Molecular and Cell Bone Biology

II. Organismal Area

- Undergraduate Level
  - BIOL-K331 Developmental Biology
  - BIOL-K350 Comparative Animal Physiology
  - BIOL-K356 Microbiology
  - BIOL-K411 Global Change Biology
  - FIS 43000 Population Genetics (P: STAT 30100)

- Undergraduate and Graduate Level
  - BIOL 55600 Physiology I
  - BIOL 55700 Physiology II

Laboratory Courses (select 3)

- BIOL-K323 Genetics (BIOL-S323 Honors)
- BIOL-K325 Cell Biology (BIOL-S325 Honors)
- BIOL-K333 Developmental Biology
- BIOL-K339 Immunology
- BIOL-K342 Principles of Ecology and Evolution
- BIOL-K357 Microbiology (BIOL-S357 Honors)
- BIOL-K461 Cadaveric Human Anatomy (2 cr. count towards degree requirements)

Bachelor of Science Degree Requirements

Degree Requirements

First-Year Experience Course

Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area Requirements

Area I English Composition and Communication Competency

See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Written Communication (6 cr.)

ENG-W131 or ENG-W140 Reading, Writing and Inquiry (3 cr.)

The second semester of English composition may be satisfied with ENG-W231, ENG-W270 (or ENG-W150), ENG-W230, ENG-W320, ENG-W350, TCM 22000, or TCM 32000.

Oral Communication (3 cr.)

COMM-R110 Fundamentals of Speech Communication (3 cr.)

Area II World Language Competency

No world language proficiency is required for a Bachelor of Science degree. However, knowledge of a world language is strongly recommended for any student planning to attend graduate school.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.)

- List H course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements "Undergraduate Programs" in this bulletin.
- List S course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements "Undergraduate Programs" in this bulletin.
- One additional course from either List H or List S.
- List C course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements "Undergraduate Programs" in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

Physics Two semesters of basic physics (PHYS-P201 / PHYS-P202 or PHYS 15200 / PHYS 25100).

Chemistry Two semesters of Principles of Chemistry with laboratories (CHEM-C105/CHEM-C125 3/2 cr.; CHEM-C106/CHEM-C126 3/2 cr.), two semesters of organic chemistry with laboratories (CHEM-C341/CHEM-C343 3/2 cr.; CHEM-C342/CHEM-C344 3/2 cr.), plus prerequisite basic sequence or background to enter sequence above. (A course in analytical chemistry or biochemistry is also strongly recommended; determination should be made in consultation with a PREPs or departmental advisor.)

Area IIID Analytical Reasoning Competency

Course work through two semesters of calculus (MATH 23100 / MATH 23200 or MATH 22100 / MATH 22200 or MATH 16500 / MATH 16600). Starting point to be worked out with departmental advisor based on the math placement test and/or background of the student. The computer programming requirement may be satisfied with CSCI-N200, CSCI-N201, CSCI-N207, or CSCI-N211 (other 300+ level courses may be used with permission).

Note: Computer Science CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as general electives.

Area IV Biology Requirements

Required Core Sequence

- BIOL-K101 / BIOL-K103 Concepts of Biology I and II (BIOL-K102/BIOL-K104 Honors)
- BIOL-K322 Genetics and Molecular Biology
- BIOL-K324 Cell Biology
- BIOL-K341 Principles of Ecology and Evolution

Upper-Level Courses

- At least one lecture course from each of areas I and II listed below.
- Four laboratory courses beyond BIOL-K101 / BIOL-K103 selected from areas listed below. To receive credit for a laboratory course, an accompanying pre- or co-requisite lecture course must be completed with a minimum grade of C-. BIOL-K493 will count as one laboratory course only if BIOL-K490 is also taken.
- Capstone for the BS may be met with BIOL-K493 Independent Research (2 to 3 credit hours) and BIOL-K494 Senior Research Thesis (1 credit hour) or by taking the BIOL-K490 Capstone (1 credit hour). The BIOL-K493 / BIOL-K494 option will consist of the completion BIOL-K493 (research) and the preparation of a written report (BIOL-K494) on the results of the research project. The title and nature of the BIOL-K493 / BIOL-K494 sequence is to be determined in consultation with the department research sponsor. A student may complete BIOL-K493 in lieu of one of the required labs. If the student uses BIOL-K493 for a lab, they must complete BIOL-K490 for the capstone requirement.
- Electives consisting of sufficient BIOL-K lecture and laboratory course work to total 40 credit hours (including core sequence credit hours). These credits may be selected from any of the areas listed below.
- Residency Credits. In order to graduate students must have a minimum of 32 credit hours at the 300-level or above at IUPUI. B.S. students usually fulfill the requirement with required biology and chemistry courses. Transfer students may need additional 300-level hours.

A maximum of 20 credit hours of biology earned previously at other institutions is applicable toward the major for the B.S. degree.

Unless approved as part of the major, note that all courses taken outside the Schools of Science and Liberal

Arts must receive approval from the student's major department and the School of Science Academic Dean's Office. Consult with your major department advisor for information and additional course restrictions.

A minimum 2.00 GPA must be earned in BIOL-K courses; No grade lower than a C- allowed.

Once admitted, students are expected to complete their course requirements within the major at IUPUI.

Areas/Electives

I. Molecular/Cellular Area

- Undergraduate Level
  - BIOL-K338 Introductory Immunology
  - BIOL-K384 Biochemistry
  - BIOL-K416 Cellular and Molecular Neuroscience
  - BIOL-K451 Neuropharmacology
  - BIOL-K484 Cellular Biochemistry
  - BIOL-K488 Endocrinology in Health and Disease
- Undergraduate and Graduate Level
  - BIOL 50700 Principles of Molecular Biology
  - BIOL 51600 Molecular Biology of Cancer
  - BIOL 54410 Sensory Systems
  - BIOL 55000 Plant Molecular Biology
  - BIOL 55900 Endocrinology
  - BIOL 56010 Neurodegenerative Diseases
  - BIOL 56100 Immunology
  - BIOL 56400 Molecular Genetics of Development
  - BIOL 57410 Molecular and Cell Bone Biology

II. Organismal Area

- Undergraduate Level
  - BIOL-K331 Developmental Biology
  - BIOL-K350 Comparative Animal Physiology
  - BIOL-K356 Microbiology
  - BIOL-K411 Global Change Biology
  - FIS 43000 Population Genetics
- Undergraduate and Graduate Level
  - BIOL 55600 Physiology I
  - BIOL 55700 Physiology II

Laboratory Courses (select 4)

- BIOL-K323 Genetics (BIOL-S323 Honors)
- BIOL-K325 Cell Biology (BIOL-S325 Honors)
- BIOL-K333 Developmental Biology
- BIOL-K339 Immunology
- BIOL-K342 Ecology
- BIOL-K357 Microbiology (BIOL-S357 Honors)
- BIOL-N461 Caderveric Human Anatomy (2 cr. count towards degree requirements)

Minor in Biology

The Department of Biology offers an undergraduate minor in biology with the following requirements:

- BIOL-K101 Concepts of Biology I (5 cr.)
- BIOL-K103 Concepts of Biology II (5 cr.)
- BIOL-K322 Genetics and Molecular Biology (3 cr.)
- BIOL-K324 Cell Biology (3 cr.)
- BIOL-K341 Principles of Ecology and Evolution (3 cr.)

At least half of the minimum 19 credit hours required to minor in biology must be completed at IUPUI. The minor requires a minimum grade point average of 2.00, and all grades must be C- or higher. Correspondence courses may not be used to fulfill requirements for the minor.

Biology Plans of Study

No single semester-by-semester plan of study will guide all students through the degree options because of the flexibility encouraged within the programs. However, one possible sequence of courses for each option is given below; variations from these examples of plans of study should be made in consultation with a departmental advisor.

Bachelor of Arts Sample Program (120 cr. required)

Freshman Year

First Semester	
SCI-I120 Windows on Science	1
BIOL-K101 Concepts of Biology I	5
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 15300 Algebra and Trigonometry I	3
Total	**14**
Second Semester	
BIOL-K103 Concepts of Biology II	5
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 15400 Algebra and Trigonometry II	3
ENG-W131 Reading, Writing and Inquiry	3
Total	**16**

Sophomore Year

Third Semester	
BIOL-K322 Genetics and Molecular Biology	3
BIOL-K323 Genetics and Molecular Biology Lab	2
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
World Language Course (Cultural Understanding)	4
Elective Course	1

Total	**15**
Fourth Semester	
BIOL-K324 Cell Biology	3
BIOL-K325 Cell Biology Laboratory	2
CHEM-C342 Organic Chemistry II	3
2nd written communication course	3
World Language Course	4
Total	**15**

Junior Year

Fifth Semester	
Molecular/Cellular Biology Lecture	3
PHYS-P201 General Physics I	5
Arts and Humanities/Social Sciences (choose from list)	3
Computer Programming Course (approved)	3
Total	**14**
Sixth Semester	
Organismal Biology Lecture/ Lab	5
PHYS-P202 General Physics II	5
Social Sciences (choose from list)	3
Elective Course	3
Total	**16**

Senior Year

Seventh Semester	
BIOL-K341 Principles of Ecology/Evolution	3
Arts and Humanities (choose from list)	3
Elective/Minor Course 300-level	3
Elective/Minor Course	6
Total	**15**
Eighth Semester	
BIOL-K490 Capstone in Biology (or BIOL-K493 Independent Research)	1
COMM-R110 Fundamentals of Speech Comm	3
Elective/Minor Courses	11
Total	**15**

Bachelor of Science Sample Program (120 cr. required)

Freshman Year

First Semester	
SCI-I120 Windows on Science	1
BIOL-K101 Concepts of Biology I	5
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 23100 Calculus for the Life Sciences I	3
Total	**14**
Second Semester	
BIOL-K103 Concepts of Biology II	5
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 23200 Calculus for the Life Sciences II	3
ENG-W131 Reading, Writing and Inquiry	3
Total	**16**

Sophomore Year

Third Semester	
BIOL-K322 Genetics and Molecular Biology	3
BIOL-K323 Genetics and Molecular Biology Laboratory	2
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
Computer Programming (approved elective)	3
COMM-R110 Fundamentals of Speech Comm	3
Total	**16**
Fourth Semester	
BIOL-K324 Cell Biology	3
BIOL-K325 Cell Biology Laboratory	2
CHEM-C342 Organic Chemistry II	3
CHEM-C344 Organic Chemistry Laboratory II	2
2nd written communication course	3
Elective Course	1
Total	**14**

Junior Year

Fifth Semester	
Molecular/Cellular Biology Lecture/Lab	5
PHYS-P201 General Physics I	5

Social Sciences (choose from list)	3
Arts and Humanities (choose from list)	3
Total	**16**
Sixth Semester	
Organismal Biology Lecture/ Lab	5
PHYS-P202 General Physics II	5
Arts and Humanities/Social Sciences (choose from list)	3
BIOL-K493 Independent Research	1
Total	**14**

Senior Year

Seventh Semester	
BIOL-K341 Principles of Ecology/Evolution	3
BIOL-K493 Independent Research	1
Cultural Understanding (choose from list)	3
Elective/Minor Courses	9
Total	**16**
Eighth Semester	
BIOL-K493 Independent Research	1
BIOL-K494 Capstone in Biology	1
Biology Major Courses	3
Elective/Minor Courses	9
Total	**14**

Master of Science

Degree Options

M.S. non-thesis in Interdisciplinary Biology. This program requires a minimum of 30 credit hours of registration, at least 21 of which must be in biology. For students who wish to combine biology training with work in a secondary area as a mechanism to meet career objectives, up to 9 credit hours can be taken in the secondary area. Advanced-level undergraduate course work hours are limited to 6. Examples of secondary areas include, but are not limited to, chemistry, mathematics, public affairs, business, statistics, law, computer science, administration, and, for those interested in teaching, education. For those students with no secondary area of interest, all 30 credit hours may be taken in biology. The program requires registrations in BIOL 59500 Special Assignments and BIOL 69600 Seminar. The former consists of an independent, creative project done in association with a faculty member. Typical examples include a limited laboratory research experience or a library research assignment. The results of the project are reported both in writing and orally in BIOL 69600.

M.S. Pre-professional Non-thesis

This program also consists of a minimum of 30 credit hours, all of which must be taken over two semesters. This challenging program is highly intensified and is open only to those students who meet a high admission standard based on undergraduate GPA and GRE scores. The program is available to those students planning careers in medicine, dentistry, optometry, or other health-related fields and differs from the interdisciplinary non-thesis M.S. by having no requirement for the BIOL 59500 and BIOL 69600 registrations.

M.S. with Thesis

This 30 credit hour program requires a minimum of 9 credit hours of 500-level and 600-level course work in biology chosen in consultation with the student's graduate advisory committee, and intensive research leading to a thesis. Most full-time students should expect to spend at least two full years to complete this program. Areas in which research opportunities are available include: physiology, neuroscience, eye regeneration, biochemistry, plant hormones, developmental genetics, cell biology, membrane biochemistry and biophysics, plant physiological ecology, plant and animal molecular biology, and regenerative biology. The overall emphasis of the department's research program focuses on questions at the cellular, biochemical, and molecular levels. Many of the projects provide a foundation in biotechnology and an excellent preparation for biomedical and industrial applications.

Admission Requirements

- Students must hold a bachelor's degree from an accredited institution of higher learning and demonstrate good preparation in biological sciences, organic chemistry, physics, and mathematics.
- The GRE and/or subject tests are not required for Ph.D. and Thesis M.S. applicants; however, if submitted, the results are added to the applicant's file for consideration. Only non-thesis M.S. applicants are required to take the GRE General Test. In place of the GRE, non-thesis MS applicants can use MCAT or DAT test scores.
- Three letters of recommendation are required.
- A minimum graduation grade point average of 3.0 or its equivalent is required for unconditional admission.

Transfer of Credit

Transfer credit to be used in the non-thesis option may be given for up to 9 credit hours of graduate work completed elsewhere with a grade of B or higher. Such credit may be used only in the secondary area and will be accepted only after one semester of satisfactory work is completed in residence at IUPUI. Transfer credit is not accepted in the thesis option. Up to 12 hours of biology graduate credit taken at IUPUI under graduate non-degree status may be transferred to the thesis or non-thesis options.

Requirements

Grades

Only grades of A, B, or C are acceptable, although performance higher than C may be required. Pass/Fail grades are unacceptable.

Residence Requirements

Thirty (30) credit hours of registration are required for the M.S. degree. Students entering with advanced standing from another graduate school are given residence credit commensurate with the graduate work accomplished.

Final Examination

A comprehensive written or oral examination in the individual's primary area may be required of non-thesis students unless their cumulative GPA is 3.0 or higher. The final examination for thesis students will consist of a thesis defense, which will be done in conjunction with BIOL 69600 Seminar.

All students are required to take BIOL 69600 Seminar. The creative project required of all non-thesis students will provide the basis for the public presentation.

Financial Assistance

The Department of Biology has financial support available in the form of tuition-refund assistantships, associate faculty positions, fellowships, and stipends from local industry on a limited basis.

Doctor of Philosophy

Doctor of Philosophy—Purdue University

The degree of Doctor of Philosophy (Ph.D.), the highest earned degree conferred by Purdue University, can be pursued in the Department of Biology at IUPUI. The doctoral degree is restricted to those scholars who have demonstrated superior ability in a recognized academic discipline. The Ph.D. degree is not awarded on the basis of time spent in residence or following the completion of any specific number of formal courses, nor is the degree granted on the basis of miscellaneous course studies and research effort. The entire Ph.D. program must be rationally related, should be highly research oriented, and should culminate in a thesis of scholarly merit indicative of the candidate's ability to conduct original research in a recognized field of specialization.

Ph.D. programs are directed by professors who work in close association with selected graduate students. In practice, doctoral programs are composed of formal courses, guided individual study in a chosen field or discipline, study in such cognate subjects as may be required by the candidate's advisory committee, and original research that serves as the basis of a scholarly thesis.

As part of their graduate training, all Ph.D. candidates are expected to teach at least quarter time for one year.

Ninety (90) credit hours of registration are required for the Ph.D. degree. Students entering with advanced standing from another graduate school are given residence credit commensurate with the graduate work accomplished.

Fields of Study

Ph.D. degrees are offered in most of the fields described for the M.S. degree. Until a major professor is named, a student is counseled by a temporary advisor. In order to help familiarize students with the department and to assist the student in the selection of a major professor, a series of laboratory rotations is available.

Admission and First Year Review

To enter the Ph.D. program, a student must satisfy the admission requirements for the M.S. with thesis option and also take a qualifying examination at the end of the first year of graduate study. In their second semester students write a review paper detailing a problem/knowledge gap in their area of research, along with an assessment of this literature to propose a specific answer to this problem. In the fall of their second year the students present the review to their graduate committee. For this first committee meeting, the student will prepare a presentation to recap the review for the committee. In addition, they may incorporate some of their preliminary data from the laboratory either linked to, or separate from, the review. As with other committee meetings, the committee will vote to pass or fail. If the student fails the committee meeting, the student will have to re-write the critical review and pass a committee meeting prior to taking the preliminary examination.

Plan of Study

Each prospective candidate for the doctoral degree, with the approval of the head of the Department of Biology, shall select a major professor from the department who will act as the chairperson of the student's advisory committee and who will direct the research. The student, in consultation with the major professor, will arrange an advisory committee of at least four faculty members (including the major professor) who have been approved to guide graduate students.

The plan of study shall include a primary area and related area or areas. The plan will be appropriate to meet the needs of the student in a chosen field as determined by the advisory committee. The Graduate School of Purdue University does not impose any minimum number of required course credit hours, but the plan shall specify the area or field of interest in which the student proposes to study and to conduct research. The plan will include the specific courses that the student is expected to complete, all specific course and language (if any) requirements, and 2 credit hours of BIOL 69600 Seminar.

The department or school head, the school dean, and the associate dean of the Graduate School at Purdue University, West Lafayette, must approve the plan of study. The graduate school dean reserves the right to refer any or all plans of study to the Purdue Graduate Council for review and approval when deemed advisable. The Graduate Council has the final authority to supervise the quality of all graduate programs.

Preliminary Examination

After the student has completed most of the formal study to the satisfaction of the advisory committee and met any language requirement(s), the student becomes eligible to take the preliminary examination in order to advance to candidacy. The preliminary examination must be taken within one year of, and at least six months after passing the first committee meeting. The examination requires a research proposal to be written by the student in consultation with their major professor. The results of these written and oral examinations will be reported to the graduate school by the examining committee with an appropriate recommendation for the student's

admission to candidacy, continued preparatory study, or discontinuation. The graduate school associate dean reserves the right to appoint additional members to the preliminary examining committee. The dean must be informed of the date and place of the examination and the membership of the examining committee at least two weeks before the examination. No examining committee shall have fewer than three faculty members.

If the student does not pass the preliminary examinations, a second meeting must be convened within 6 months. Should the preliminary examinations be failed twice, the student may not be given a third examination, except upon the recommendation of the examining committee and with special approval of the Graduate Council.

Ph.D. Dissertation

After admission to candidacy, the candidate must devote at least two semesters to research before the final examination.

The special research carried on as part of the doctoral work is expected to make a definite contribution to the candidate's chosen field of knowledge–a contribution of sufficient importance to merit publication. Each candidate must, therefore, prepare a dissertation showing the research results.

After the research has been completed and the dissertation written, the candidate shall be given a final examination in which the candidate defends the dissertation and demonstrates to the examining committee all of the capabilities for which the Doctor of Philosophy degree is awarded. The examining committee shall consist of no fewer than four members. The dean of the graduate school reserves the right to appoint additional committee members and must be informed of the place and time of the final examination at least two weeks in advance.

Doctor of Philosophy—Indiana University

The Ph.D. degree conferred by Indiana University can be pursued under the direction of faculty in the Department of Biology who hold adjunct appointments with departments or programs in the Indiana University School of Medicine. All Indiana University doctoral degrees require 90 credit hours of registration; specific course and examination requirements vary with the department or program in which the student is enrolled. Contact the graduate program director in the Department of Biology for additional information.

Biotechnology Program

IUPUI
723 W. Michigan Street, SL 306
Indianapolis, IN 46202-5132
Phone: (317) 274-0577; fax: (317) 274-2846

- **Department Chair:** Theodore R. Cummins, Ph.D.
- **Program Advisors:**
  - Jane Alexander (student last names A - K)
  - M. Jane Parr (student last names L - Z)

This program is available only to students who have an earned Associate degree in Biotechnology from Ivy Tech Community College (ITCC).

What has become known as the biotechnology industry has been going through some transforming changes that mandate more sophisticated workforce training at many levels. In order to place central Indiana at the forefront in the preparation of a suitable workforce for existing industry as well as a flexible training program that may be attractive to biotechnology industries considering a move to Indiana, IUPUI has partnered with ITCC in central Indiana to provide an integrated training and theoretical framework for future biotechnology industry requirements.

The curriculum of the bachelor's degree also allows sufficient flexibility within the major and with electives to meet basic requirements for application to most graduate and professional programs.

No more than 64 applicable credits may transfer from a two-year or community college.

Degree Characteristics

Bachelor of Science in Biotechnology (BSB)

- 120 credit hour Purdue degree
- additional courses in the major and flexibility to add areas of specialization
- full general-education course work in the humanities and social sciences
- flexibility to become eligible for most graduate and professional degree programs

Bachelor of Science in Biotechnology (B.S.)

Degree Requirements

(ITCC: indicates course completed at Ivy Tech Indianapolis)

Area I English Composition and Communication Competency See the School of Science requirements under "Undergraduate Programs" in this bulletin.

Written Communication (6 cr.)

- ENG-W131 Reading, Writing and Inquiry (3 cr.) *(ENG 111 ITCC)*
- TCM 32000 Written Communication in Science and Industry (3 cr.)

Speech Communication (3 cr.)

- COMM-R110 Fundamentals of Speech Communication (3 cr.) *(COMM 101 ITCC)*

Area II World Language Competency No world language is required for a Bachelor of Science degree. However, knowledge of a world language is strongly recommended for any student planning to attend graduate school.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Compentencies

- List H course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements "Undergraduate Programs" in this bulletin.
- List S course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements "Undergraduate Programs" in this bulletin.

- One additional course from either List H or List S.
- List C course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

Chemistry

Two semesters of Principles of Chemistry with laboratory:

- CHEM-C105 / CHEM-C125 Principles of Chemistry I with lab *(CHEM-C105 ITCC)*
- CHEM-C106 / CHEM-C126 Principles of Chemistry II with lab *CHEM-C106 ITCC)*

Two semesters of organic chemistry lecture:

- CHEM-C341/CHEM-C343 Organic Chemistry Lecture/Lab I
- CHEM-C342 Organic Chemistry Lecture II

Physics One semester of basic physics

- PHYS 101, ITCC **or** PHYS 21800, IUPUI

Area IIID Analytical Reasoning Competency

Course work through two semesters of calculus:

- MATH 23100 / MATH 23200 **or**
- MATH 22100 / MATH 22200 **or**
- MATH 16500 / MATH 16600

NOTE: Students may need to complete MATH 136 (Algebra & Trigonometry I) and MATH 137 (Algebra and Trigonometry II) at ITCC

The starting point for mathematics courses should be worked out with a departmental advisor based on the math placement test and/or background of the student.

The computer programming requirement may be satisfied with CSCI-N200, CSCI-N201, CSCI-N207 or CSCI-N211. A statistics course is required: STAT 30100.

Area IV Biotechnology Requirements

Required courses

- BIOL-K101 Concepts of Biology I (5 cr.)
- BIOL-K384 Biological Chemistry (3 cr.) **or** CHEM-C384 Biological Chemistry (3 cr.) **or** BIOL-K484 Cellular Biochemistry (3 cr.)
- BIOL-K322, BIOL-K323, BIOL-K324, BIOL-K356, BIOL-K338
- BIOL-K357 or BIOL-K339

Specialized courses in biotechnology, including the internship, are to be taken at Ivy Tech Community College, Indianapolis. This program is available only to students who have an earned Associate Degree in Biotechnology from Ivy Tech Community College. See departmental advisor for additional information.

Elective courses in area of specialization

Electives chosen with advisor to total at least 40 credits

No grade below a C- will be accepted toward the degree program in any biology, biotechnology and chemistry course.

To receive credit for a laboratory for which there is an accompanying pre- or corequisite lecture, the lecture must be completed with a minimum grade of C-.

Department of Chemistry and Chemical Biology

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Science Building, LD 326
402 N. Blackford Street
Indianapolis, IN 46202-3274
Phone: (317) 274-6872, fax: (317) 274-4701
https://science.iupui.edu/chemistry/

Department Chair: Partha Basu, Ph.D.

Department Advisors:

- Graduate Programs:
  - Eric Long, Ph.D.
- Undergraduate Programs:
  - Marie Nguyen (last names A - G)
  - Tamiko Porter (last names H - M)
  - Lin Zhu, Ph.D. (last names N - Z)

Chemistry is the science that studies substances, both natural and synthetic, and their compositions, properties, transformations, and interactions with external forces.

The Department of Chemistry and Chemical Biology offers the Bachelor of Arts (B.A.) degree, the Bachelor of Science in Chemistry (B.S.) degree with a chemistry option, a biological chemistry option, and a medicinal chemistry option and the Master of Science (M.S.) degree. All degrees carry the general requirements of the School of Science, which are described elsewhere in this bulletin. An undergraduate minor in chemistry is also offered. The Bachelor of Science degree carries certification by the American Chemical Society (ACS) Committee on Professional Training. The Master of Science degree has both a thesis and nonthesis option. An Industrial Co-op Program is also offered for the Master of Science degree. Qualified students may be authorized to pursue the Doctor of Philosophy (Ph.D.) degree in chemistry in the areas of analytical, biological, inorganic, organic, or physical chemistry. Contact the Department for details or visit the Web site chem.iupui.edu.

To enter the undergraduate curriculum in chemistry, a student should have completed a minimum of two years of algebra, one semester of trigonometry, one year each of chemistry and physics, and two years of a modern foreign language. The choice of a particular degree program in chemistry and the selection of courses for that degree must be made in consultation with a departmental advisor.

Courses for Nonmajors

Students in programs that require only one semester of chemistry should take CHEM-C100, CHEM-C101, or CHEM-C110, depending on their specific degree program. CHEM-C100 and CHEM-C110 are both nonmathematical introductions to chemistry, while CHEM-C101 requires one

semester of high school algebra. Students in programs that require two semesters of chemistry take either CHEM-C101 / CHEM-C121 with CHEM-C110 / CHEM-C115 or the CHEM-C105 / CHEM-C125 with CHEM-C106 / CHEM-C126 sequence. (See specific program for degree major.) The CHEM-C105 / CHEM-C125 with CHEM-C106 / CHEM-C126 sequence is designed for students pursuing advanced work in scientific fields (e.g., biology, chemistry, geology, medicine, and physics). Students with an insufficient background in high school chemistry for CHEM-C105 should take CHEM-C101 as a preparatory course. Credit for CHEM-C101 cannot count toward the total credit hours needed for graduation if either of the following courses is taken: CHEM-C105 or CHEM-C106. Completion of CHEM-C101 does not qualify a student for admission to CHEM-C106.

Academic Advising in Chemistry

Academic success requires frequent and regular interaction between students and faculty in the classroom as well as outside it. In keeping with this departmental philosophy, chemistry majors are required to meet with their advisor at least once a year, preferably in the first half of the fall semester. Students who do not meet with their advisor by October 21 will not be permitted to register for the following spring semester until their advisor approves their registration.

Course Prerequisites

The Department enforces all prerequisites for chemistry courses as indicated in the course listing of this bulletin. For course equivalency of prerequisites, consult the instructor.

- Bachelor of Arts Preprofessional Chemistry Major
- Bachelor of Science in Chemistry, Professional Chemistry Major, A.C.S. Certified
- Graduate Programs (M.S. and Ph.D. Degrees)
- Minor

Bachelor of Arts Preprofessional Chemistry Major

For students who require a knowledge of chemistry as a basis for work in other fields such as business, dentistry, environmental science and policy, law, medicine, or other allied health fields. Recommended for pre-medical and pre-dentistry students.

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied only by ENG-W270, ENG-W230, ENG-W231, ENG-W233, ENG-W320, ENG-W350, TCM 22000, or TCM 32000.

Area II World Language Competency See the School of Science requirements under “Undergraduate Programs” in this bulletin.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies See the School of Science requirements under "Undergraduate Programs" in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency PHYS-P201 and PHYS-P202 (recommended PHYS 15200 and PHYS 25100). Also, at least two additional courses outside chemistry having a laboratory component, which may be chosen from, for example, biology, geology, or physics.

Area IIID Analytical Reasoning Competency MATH 22100 and MATH 22200 or MATH 23100 and MATH 23200 (recommended MATH 16500 and MATH 16600). One computer programming course is also required.

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for any credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as general electives.

Area IV Chemistry Concentration Requirements CHEM-C105, CHEM-C125, CHEM-C106, CHEM-C126, CHEM-C294, CHEM-C310, CHEM-C311, CHEM-C325, CHEM-C341, CHEM-C342, CHEM-C343, CHEM-C344, CHEM-C360 (recommended CHEM-C361), and CHEM-C495. Recommended CHEM-C384 or CHEM-C484. A total of 34 credit hours of chemistry courses are required. The Department requires a minimum grade of C in all chemistry courses (C- grades are unacceptable).

Bachelor of Arts Preprofessional Chemistry Major Sample Program (120 cr. required):

Freshman Year

First Semester	
SCI-I120 Windows on Science	1
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 22100 Calculus for Technology I or MATH 23100 Calculus for the Life Sciences I	3
ENG-W131 Reading, Writing and Inquiry	3
World Language	4
Total	**16**
Second Semester	
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 22200 Calculus for Technology II or MATH	3

23200 Calculus for the Life Sciences II	
World Language	4
2nd Written communication course	3
Total	**15**

Sophomore Year

Third Semester	
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
Life and Physical Science with lab (approved elective)	5
COMM-R110 Fundamentals of Speech Communication	3
Arts and Humanities/Social Science (choose from list)	3
Total	**16**
Fourth Semester	
CHEM-C342 Organic Chemistry II	3
CHEM-C344 Organic Chemistry Laboratory II	2
CHEM-C294 Cornerstone in Chemistry	1
Life and Physical Science (approved elective)	5
Arts and Humanities/Social Sciences (choose from list)	3
Total	**14**

Junior Year

Fifth Semester	
CHEM-C310 Analytical Chemistry Lecture	3
CHEM-C310 Analytical Chemistry Lab	1
PHYS-P201 General Physics I	5
Arts & Humanities or Social Sciences (choose from list)	3
Elective	3
Total	**15**
Sixth Semester	
CHEM-C325 Intro to Instrumental Analysis	5
Computer Programming (approved course)	3
PHYS-P202 General Physics 2	5
Electives	3
Total	**16**

Senior Year

Seventh Semester	
Electives	15
Total	**15**
Eighth Semester	
CHEM-C360 Elementary Physical Chemistry	3
CHEM-C495 Capstone in Chemistry	1
Electives	9
Total	**13**

Bachelor of Science in Chemistry, Professional Chemistry Major, A.C.S. Certified

This degree is for students who plan to be professional chemists or who plan to pursue graduate studies in chemistry. It carries certification by the Committee on Professional Training of the American Chemical Society. Three options are available: a Chemistry option, a Biochemistry option and a Medicinal Chemistry option.

Degree Requirements (Chemistry Option)

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied only by ENG-W270 (or ENG-W150), ENG-W230, ENG-W231, ENG-W233, ENG-W320, ENG-W350, TCM 22000, or TCM 32000.

Area II World Language Competency No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies See the School of Science requirements under "Undergraduate Programs" in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency PHYS 15200, PHYS 25100, and at least two additional courses outside chemistry, which may be chosen from, for example, biology, geology, or physics.

Area IIID Analytical Reasoning Competency MATH 16500, MATH 16600, MATH 17100, and MATH 26100. One computer programming course is also required.

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for any credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as general electives.

Area IV Chemistry Concentration Requirements CHEM-C105, CHEM-C125, CHEM-C106, CHEM-C126, CHEM-C294, CHEM-C310, CHEM-C311, CHEM-C341, CHEM-C342, CHEM-C343, CHEM-C344, CHEM-C361, CHEM-C362, CHEM-C363, CHEM-C410, CHEM-C411, CHEM-C430, CHEM-C435, CHEM-C484 and CHEM-

C495. A total of 47 credit hours of chemistry courses are required. The Department of Chemistry requires a minimum grade of C in all chemistry courses (C- grades are unacceptable).

In addition to the above requirements, a minimum of 6 additional credit hours of advanced chemical elective courses is required. Courses may be chosen from the following: CHEM-C409 (3 cr. min.), CHEM-C309, CHEM-C371, CHEM-C372, CHEM-C475, CHEM-C485, CHEM-C488, CHEM-C489, certain CHEM-C496 topics courses (permission required) or any graduate-level chemistry course (permission required).

Degree Requirements (Biochemistry Option)

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied only by ENG-W270 (or ENG-W150), ENG-W230, ENG-W231, ENG-W233, ENG-W290, TCM 22000, or TCM 32000.

Area II World Language Competency No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies See the School of Science requirements under “Undergraduate Programs” in this bulletin.

Area IIIC Life and Physical and Sciences Competency PHYS 15200, PHYS 25100, BIOL-K101, and BIOL-K103. Beyond the introductory level, an additional 3 credit hours of biology should be chosen from one of the following: BIOL-K324 Cell Biology, BIOL-K356 Microbiology, or BIOL-K322 Genetics and Molecular Biology.

Area IIID Analytical Reasoning Competency MATH 16500, MATH 16600, MATH 17100, and MATH 26100. One computer programming course is also required.

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for any credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as general electives.

Area IV Chemistry Concentration Requirements CHEM-C105, CHEM-C125, CHEM-C106, CHEM-C126, CHEM-C294, CHEM-C310, CHEM-C311, CHEM-C341, CHEM-C342, CHEM-C343, CHEM-C344, CHEM-C361, CHEM-C362, CHEM-C363, CHEM-C410, CHEM-C411, CHEM-C430, CHEM-C435, CHEM-C484, CHEM-C485, CHEM-C486, and CHEM-C495. A total of 52 credit hours of chemistry courses are required. The Department requires a minimum grade of C in all chemistry courses (C- grades are unacceptable).

In addition to the above requirements, a minimum of 3 additional credit hours of advanced chemical elective courses is required. Courses may be chosen from the following: CHEM-C409 (3 cr. min.), CHEM-C309, CHEM-C371, CHEM-C372, CHEM-C475, CHEM-C488, CHEM-C489, certain CHEM-C496 topics courses (permission required), any graduate-level chemistry course (permission required), BIOL 54000 (permission required), or BIOL 54800 (permission required).

Degree Requirements (Medicinal Chemistry Option)

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied only by ENG-W270 (or ENG-W150), ENG-W230, ENG-W231, ENG-W233, ENG-W290, TCM 22000, or TCM 32000.

Area II World Language Competency No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies See the School of Science requirements under “Undergraduate Programs” in this bulletin.

Area IIIC Life and Physical Sciences Competency PHYS 15200, PHYS 25100, BIOL-K101, and BIOL-K103. Beyond the introductory level, an additional 3 credit hours of biology should be chosen from one of the following: BIOL-K324 Cell Biology, BIOL-K356 Microbiology, or BIOL-K322 Genetics and Molecular Biology.

Area IIID Analytical Reasoning Competency MATH 16500, MATH 16600, MATH 17100, and MATH 26100. One computer programming course is also required.

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for any credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as general electives.

Area IV Chemistry Concentration Requirements CHEM-C105, CHEM-C125, CHEM-C106, CHEM-C126, CHEM-C294, CHEM-C310, CHEM-C311, CHEM-C341, CHEM-C342, CHEM-C343, CHEM-C344, CHEM-C361, CHEM-C362, CHEM-C363, CHEM-C410, CHEM-C411, CHEM-C430, CHEM-C435, CHEM-C484, CHEM-C486, CHEM-C488, CHEM-C489, and CHEM-C495. A total of 55 credit hours of chemistry courses are required. The Department requires a minimum grade of C in all chemistry courses (C- grades are unacceptable).

Bachelor of Science: Sample Program, Chemistry Option- Professional Chemistry Major- A.C.S. Certified (120 cr. required)

Freshman Year

First Semester	
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 16500 Analytic Geometry and Calculus I	4

Arts and Humanities/Social Sciences (choose from list)	3
ENG-W131 Reading, Writing and Inquiry	3
SCI-I120 Windows on Science	1
Total	**16**
Second Semester	
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4
PHYS 15200 Mechanics	4
2nd Written Communication Course	3
Total	**16**

Sophomore Year

Third Semester	
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
MATH 17100 Multidimensional Mathematics	3
Life and Physical Science (approved elective)	3
Arts & Humanities/Social Science (choose from list)	3
COMM-R110 Fundamentals of Speech Communication	3
Total	**17**
Fourth Semester	
CHEM-C342 Organic Chemistry II	3
CHEM-C344 Organic Chemistry Laboratory II	2
CHEM-C294 Cornerstone in Chemistry	1
PHYS 25100 Heat, Electricity and Optics	5
MATH 26100 Multivariate Calculus	4
Total	**15**

Junior Year

Fifth Semester	
CHEM-C362 Physical Chemistry of Molecules	4
CHEM-C310 Analytical Chemistry Lecture	3
CHEM-C311 Analytical Chemistry Lab	1
Arts & Humanities/Social Science (choose from list)	3
Cultural Understanding (choose from list)	3
Total	**14**
Sixth Semester	
CHEM-C361 Physical Chemistry of Bulk Matter	3
CHEM-C363 Experimental Physical Chemistry	2
CHEM-C484 Biomolecules and Catabolism	3
Computer Programming (approved course)	3
Elective	3
Total	**14**

Senior Year

Seventh Semester	
CHEM-C410 Principles of Chemical Instrumentation	3
CHEM-C411 Principles of Chemical Instrumentation Laboratory	2
Life and Physical Science (approved elective)	3
Advanced Chemical Elective	3
Electives	3
Total	**14**
Eighth Semester	
CHEM-C430 Inorganic Chemistry	3
CHEM-C435 Inorganic Chemistry Laboratory	1
CHEM-C495 Capstone in Chemistry	1
Advanced Chemical Elective	3
Electives	6
Total	**14**

Bachelor of Science: Sample Program Biochemistry Option-Professional Chemistry Major-A.C.S. Certified (120 cr. required)

Freshman Year

First Semester	
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
BIOL-K101 Concepts of Biology I	5
MATH 16500 Analytic Geometry and Calculus I	4
SCI-I120 Windows on Science	1
Total	**15**
Second Semester	
CHEM-C106 Principles of Chemistry II	3

CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4
BIOL-K103 Concepts of Biology II	5
ENG-W131 Reading, Writing and Inquiry	3
Total	**17**

Sophomore Year

Third Semester	
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
MATH 17100 Multidimensional Mathematics	3
PHYS 15200 Mechanics	4
2nd written communication course	3
Total	**15**
Fourth Semester	
CHEM-C342 Organic Chemistry II	3
CHEM-C344 Organic Chemistry Laboratory II	2
CHEM-C294 Cornerstone in Chemistry	1
PHYS 25100 Heat, Electricity and Optics	5
MATH 26100 Multivariate Calculus	4
Total	**15**

Junior Year

Fifth Semester	
CHEM-C362 Physical Chemistry of Molecules	4
CHEM-C310 Analytical Chemistry Lecture	3
CHEM-C311 Analytical Chemistry Lab	1
COMM-R 110 Fundamentals of Speech Communication	3
Arts and Humanities (choose from list)	3
Total	**14**
Sixth Semester	
CHEM-C361 Physical Chemistry of Bulk Matter	3
CHEM-C363 Experimental Physical Chemistry	2
CHEM-C484 Biomolecules and Catabolism	3
Arts and Humanities/Social Sciences (choose from list)	3
Arts and Humanities/Social Sciences (choose from list)	3
Total	**14**

Senior Year

Seventh Semester	
CHEM-C410 Principles of Chemical Instrumentation	3
CHEM-C411 Principles of Chemical Instrumentation Lab	2
CHEM-C485 Biosynthesis and Physiology	3
CHEM-C486 Biological Chemistry Lab	2
Computer Programming (approved course)	3
Biology (approved elective)	3
Total	**16**
Eighth Semester	
CHEM-C430 Inorganic Chemistry	3
CHEM-C435 Inorganic Chemistry Laboratory	1
Advanced Chemistry Elective	3
Cultural Understanding (choose from list)	3
Elective	3
CHEM-C495 Capstone in Chemistry	1
Total	**14**

Bachelor of Science: Sample Program Medicinal Chemistry Option-Professional Chemistry Major-A.C.S. Certified (120 cr. required)

Freshman Year

First Semester	
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
BIOL-K101 Concepts of Biology I	5
MATH 16500 Analytic Geometry and Calculus I	4
SCI-I120 Windows on Science	1
Total	**15**
Second Semester	
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4

BIOL-K103 Concepts of Biology II	5
ENG-W131 Reading, Writing and Inquiry	3
Total	**17**

Sophomore Year

Third Semester	
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
MATH 17100 Multidimensional Mathematics	3
PHYS 15200 Mechanics	4
2nd written communication course	3
Total	**15**
Fourth Semester	
CHEM-C342 Organic Chemistry II	3
CHEM-C344 Organic Chemistry Laboratory II	2
CHEM-C294 Cornerstone in Chemistry	1
PHYS 25100 Heat, Electricity and Optics	5
MATH 26100 Multivariate Calculus	4
Total	**15**

Junior Year

Fifth Semester	
CHEM-C310 Analytical Chemistry Lecture	3
CHEM-C311 Analytical Chemistry Lab	1
CHEM-C362 Physical Chemistry of Molecules	4
COMM-R110 Fundamentals of Speech Communication	3
Arts and Humanities/Social Sciences (choose from list)	3
Total	**14**
Sixth Semester	
CHEM-C361 Physical Chemistry of Bulk Matter	3
CHEM-C363 Experimental Physical Chemistry	2
CHEM-C484 Biomolecules and Catabolism	3
Arts and Humanities/Social Sciences (choose from list)	3
Arts and Humanities/Social Sciences (choose from list)	3
Total	**14**

Senior Year

Seventh Semester	
CHEM-C410 Principles of Chemical Instrumentation	3
CHEM-C411 Principles of Chemical Instrumentation Laboratory	2
CHEM-C486 Biological Chemistry Laboratory	2
CHEM-C488 Introduction to Medicinal and Agricultural Chemistry	3
Computer Programming (approved course)	3
Biology (approved elective)	3
Total	**16**
Eighth Semester	
CHEM-C430 Inorganic Chemistry	3
CHEM-C435 Inorganic Chemistry Laboratory	1
CHEM-C489 The Practice of Medicinal Chemistry	3
CHEM-C495 Capstone in Chemistry	1
Cultural Understanding (choose from list)	3
Elective Course	3
Total	**14**

The Department will not grant credit for a course when considerable duplication of course content may occur with another course taken. In general, credit will be allowed for the higher-level course, but not for the lower-level course. The following listings are considered to be duplications (lower-level courses listed first):

- CHEM-C360 and CHEM-C361
- MATH 22100 / MATH 22200 or MATH 23100 / MATH 23200 and MATH 16500 / MATH 16600
- PHYS-P201 / PHYS-P202 or PHYS 21800 / PHYS 21900 and PHYS 15200 / PHYS 25100
- PHYS 10000 or PHYS 20000 and PHYS-P201, PHYS 21800, or PHYS 15200

For example, if a student has earned credit in MATH 16500 / MATH 16600, the student will receive no credit for MATH 22100 / MATH 22200, even if earned previously.

On occasion, a student who initially enrolled in the preprofessional B.A. in chemistry program decides to transfer to the B.S. in Chemistry program, having already taken one or more of the above-listed lower-level courses. The following policies will apply:

- If a student has a minimum grade of B (B- or lower is unacceptable) in CHEM-C360 and approval of the departmental chairperson, credit will be granted for CHEM-C361 and the student may proceed to CHEM-C362.
- If a student has earned credit for the MATH 22100 / MATH 22200 sequence, the student will be placed in MATH 16600. If the student passes MATH 16600, the MATH 16500 / MATH 16600 requirement will be

considered fulfilled. Credit will be granted for MATH 22100 and MATH 16600 only (7 credit hours). If the student does not pass MATH 16600, the student must start with MATH 16500.

- If a student has earned credit for MATH 22100 only, the student must take the MATH 16500 / MATH 16600 sequence, and no credit will be allowed for MATH 22100.
- If a student has earned credit for the PHYS-P201 / PHYS-P202 or PHYS 21800 / PHYS 21900 sequence, the student will be placed in PHYS 25100. If the student passes PHYS 25100, the PHYS 15200 / PHYS 25100 requirement will be considered fulfilled. Credit will be granted for PHYS-P201 and PHYS 25100 only (10 credit hours). If the student does not pass PHYS 25100, the student must start with PHYS 15200.
- If a student has earned credit for PHYS-P201 or PHYS 21800 only, the student must take the PHYS 15200 / PHYS 25100 sequence, and no credit will be allowed for PHYS-P201 or PHYS 21800.

On occasion, a student who initially enrolled in the B.S. in Chemistry program decides to transfer to the pre-professional B.A. in Chemistry program, having already taken one or more of the above-listed higher-level courses. A higher-level course will always substitute for a lower-level course to satisfy the requirement.

Minor in Chemistry

The undergraduate minor in chemistry requires a minimum of 21 credit hours of chemistry courses. The following courses are required: CHEM-C105, CHEM-C125, CHEM-C106, CHEM-C126, CHEM-C341, CHEM-C342, CHEM-C343, and CHEM-C310, CHEM-C360 or CHEM-C484. MATH 22200 or MATH 23200 and PHYS-P202 or PHYS 25100 are prerequisites for CHEM-C360. A grade of C or better must be earned in each chemistry course. (A grade of C minus does not count). For other requirements see the School of Science requirements under "Undergraduate Programs, Minors" elsewhere in the bulletin.

Graduate Programs (M.S. and Ph.D. Degrees)

Admission Requirements

The prospective student should have a bachelor's degree from an accredited institution, show promise of ability to engage in advanced work, and have adequate preparation, at least 35 credit hours of chemistry, broadly representative of the fields of the discipline, in a chemistry curriculum.

Incoming students with an undergraduate grade point average (GPA) of 3.0 or higher (on a 4.0 scale) will be considered for admission as regular graduate students. Those with a GPA below 3.0 could be considered for admission.

Application for Admission

Inquiries concerning the application process can be made directly to the Department by writing to Graduate Admissions; Department of Chemistry and Chemical Biology, IUPUI, 402 N. Blackford Street, Indianapolis, IN 46202-3272; phone (317) 274-6876; https://chemistry.iupui.edu. Applications for full-time study should be completed by January 15th for the following Fall semester to ensure complete consideration for fellowships and other financial support (see "Graduate Program Financial Aid" in this section). Applications for part-time graduate admission may be submitted at any time.

Non-degree seeking graduate students who wish to enroll in courses, though not necessarily in a degree program, should contact the IUPUI Graduate Office, University Library, UL 1170, 755 W. Michigan Street, Indianapolis, IN 46202; phone (317) 274-1577. Students should be aware that no more than 12 credit hours earned as a non-degree student may be counted toward a degree program. Please contact the graduate administrator in the Department of Chemistry and Chemical Biology for guidelines.

Transfer Credit

The Department will accept by transfer a maximum of 6 hours of graduate credit, in excess of undergraduate degree requirements, from approved institutions subject to approval by the graduate director in the Department of Chemistry and Chemical Biology.

Graduate Program Financial Aid

All full-time Ph.D. graduate students receive support stipends through teaching assistantships, research assistantships, departmental fellowships, university fellowships, or through the Industrial Co-op Program. Full-time students receive fee remissions; students with assistantships and fellowships are also eligible for health insurance. Consult the graduate advisor for current funding levels.

Master of Science Program

The M.S. program in chemistry, culminates in a Purdue University degree and requires 30 credit hours of study beyond the baccalaureate level. It is designed for students seeking careers as professional chemists. Graduates of the program often choose industrial positions, but others enter Ph.D. programs in chemistry or related areas. Graduates have been placed in positions throughout the United States and abroad.

General Degree Options and Requirements

Specific area requirements (core courses) apply for course work. Courses from three of the following areas must be taken: analytical, biological, inorganic, organic, and physical. Typically, students take three courses in their primary area and two courses outside of it to meet these requirements.

The M.S. degree can be earned through any of three different options: the thesis option, the Industrial Co-op Program, and the nonthesis option.

Thesis Option This traditional full-time program requires 20 hours of course work and 10 hours of thesis research. The research activity culminates in the completion and defense of a thesis. This option is available to full- or part-time students.

Nonthesis Option The nonthesis option requires 30 hours of course work alone. Because actual research experience is essential in an advanced chemistry program, this option is recommended for part-time

students only. Students in this option are usually employed full time and are already engaged in research activity as part of their employment. However, nonthesis students may still enroll in a limited amount of research study that applies to the degree requirements (usually through CHEM 59900).

Ph.D. Program

The Ph.D. program is a full-time, thesis-based research program that culminates in a Purdue University degree. This program provides a substantially larger research component than that of the M.S. degree and requires original and significant research contributions by the student. As a result, the Ph.D. student is qualified for employment where the ability to design, develop, and complete a research program is expected.

To establish candidacy, students must pass five written 'cumulative' examination questions within their first four semesters and an oral examination before the end of their fifth semester of graduate study. The oral examination will include a discussion of the student's research and defense of an original research proposal that is different from the student's thesis research.

Course requirements include a core of three courses in the student's major division plus three additional courses outside the major division. A number of additional courses may be recommended that cover material appropriate to the written part of the preliminary examination.

Department of Computer and Information Science

IUPUI
Engineering, Science and Technology Building, SL 280
723 W. Michigan Street
Indianapolis, IN 46202-5132
Phone: (317) 274-9727; fax: (317) 274-9742
https://science.iupui.edu/cs/

Department Chair Shiaofen Fang, Ph.D.

Department Advisors:

- Graduate Programs: contact Nicole Wittlief
- Undergraduate Programs: Tenille Bullock

The department offers Purdue University Bachelor of Science (B.S.) in Computer Science, Bachelor of Science (B.S.) in Computer Science - Biocomputing Track, Bachelor of Science (B.S.) in Artificial Intelligence - Data and Computational Science Concentration, Bachelor of Arts (B.A.) in Applied Computer Science, Graduate Certificates, and Master of Science (M.S.) degrees. It also offer a Certificate in Applied Computer Science and a Certificate in Fundamentals of Data Analytics. Students interested in research may arrange to pursue a Doctor of Philosophy (Ph.D.) degree through the Purdue University Graduate School. The programs of study emphasize the basic principles of computing and information processing, which include the creation, representation, display, storage, transformation, and transmission of information, as well as the software to accomplish these tasks. Because computers are used in all segments of society, the theory and practice of computer and information science are pervasive and the field is, therefore, interdisciplinary. It is also young and dynamic, as evidenced by the growth of the computer industry, so the curriculum itself evolves rapidly.

- Bachelor of Science
- Bachelor of Science, Biocomputing Concentration
- Bachelor of Science, Artificial Intelligence - Data and Computational Science Concentration
- Bachelor of Arts
- Certificate in Applied Computer Science
- Certificate in Fundamentals of Data Analytics
- Graduate programs
- Minor in Computer and Information Science and Minor in Applied Computer Science

Bachelor of Arts

The B.A. in Applied Computer Science offers a balance of theoretical and applied computing coursework to prepare a student for multiple pathways into the information technology workforce. The student's additional coursework in the liberal arts and social sciences further enhances communication skills and understanding of issues in other sectors of the economy. The program requires 120 credit hours including core courses in computer science that are supplemented by applied electives and rounded out with courses in algebra and statistics, world language, communications, liberal arts and social sciences. This program allows students flexibility in pursuing a minor or undergraduate certificate in a program of their choice.

Degree Requirements

NOTE: These degree requirements are effective for students admitted beginning in the Fall of 2021.

See the School of Science requirements under "Undergraduate Programs" in this bulletin for the general and area degree requirements. The School of Science will not accept certain university courses for the computer science degree program. The Bachelor of Arts degree program in computer science requires a minimum of 120 credit hours.

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take CSCI 12000 Windows on Computer Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency (9 cr.) See the School of Science requirements under "Undergraduate Programs" in this bulletin for details.

- ENG-W131 Reading, Writing and Inquiry
- COMM-R110 Fundamentals of Speech Communication

The second semester of English composition must be satisfied with:

- TCM 32000 Written Communication in Science and Industry

Area II World Language Competency Students must demonstrate world language first-year proficiency in one of three ways:

- First year proficiency via test
- Successful completion of a world language courses 131 and 132.
- Successful completion of a 200-level or higher world language courses with a C or above

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.) The information about the IIIA requirements in the School of Science "Undergraduate Programs" section of this bulletin lists courses that may be used to satisfy the requirements below. Students should consult a departmental advisor before registering for these courses.

- List H Arts and Humanities Competency: Choose one course from this list. (3 cr.). The list of course choices is located with the School of Science Area requirements under "Undergraduate Programs" in this bulletin.
- List S Social Sciences Competency: Choose one course from this list (3 cr.). The list of course choices is located with the School of Science Area requirements under "Undergraduate Programs" in this bulletin.
- One additional course from either List H or List S (3 cr.)
- List C Cultural Understanding Competency: Choose one course from this list (3 cr.). The list of course choices is located with the School of Science Area requirements under "Undergraduate Programs" in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency The Department of Computer and Information Science requires all computer science majors to take four science courses chosen from the areas of biology, chemistry, geology, and physics, or from certain courses in engineering. A single grade of D or D+ is acceptable in this Area. Otherwise, all courses must be completed with a C- or higher. Each course that counts as one of the physical science required courses must have a lecture component and be at least 3 credit hours. One course must be at least 4 credit hours with a lab component. Courses that may not be used to fulfill Area IIIC requirements include: BIOL-N100, BIOL-N120, BIOL-N200; CHEM-C100, CHEM-C102; PHYS 01000, PHYS 10000, PHYS 14000, PHYS 20000; AST-A130; GEOL-G 103, GEOL-G130, GEOL-G132; and all agriculture and geography courses. Consult a departmental academic advisor concerning the acceptability of other courses. The following engineering courses may be applied toward Area IIIC requirements: ECE 20100, ECE 20200, and ECE 27000. Laboratory courses without a lecture component may be taken for credit, but do not count toward the four-course requirement.

Area IIID Analytical Reasoning Competency Applied Computer Science majors are required a minimum of 9 credit hours of mathematical sciences. A single grade of D or D+ is acceptable in this Area. Otherwise, all courses must be completed with a C- or higher. The three course requirements are MATH 15300, MATH 15400, and STAT 30100.

Area IV Major Requirements Minimum requirements include 17 credit hours of core computer science courses, 12 credit hours of core applied computer science courses, and at least 27 additional hours of computer science and supporting course electives. Core CSCI courses are: CSCI 23000, CSCI 24000, CSCI 34000, CSCI 36200, and CSCI 49500. Applied computer science core courses are: CSCI-N211 or CIT 21400, CSCI-N241 or CIT21200, CSCI-N361 or INFO-I402, and INFO-I300. All major courses must be completed with a grade of C- or better. Students must maintain a GPA of 2.0 or above in major courses.

Computer and Information Science Electives Applied Computer Science majors take 9 major elective courses. Four courses must be from the list of approved applied computer science electives. No more than two applied courses can be chosen from the list of electives outside of computer science. Five courses must be from the list of traditional computer science electives.

CSCI-N-Series and applied electives—Choose no more than four total and no more than two outside of computer science

- CSCI-N300 Mobile Computing Fundamentals
- CSCI-N305 C Language Programming
- CSCI-N311 Advanced Database Programming, Oracle
- CSCI-N317 Computation for Scientific Applications
- CSCI-N321 System and Network Administration
- CSCI-N335 Advanced Programming, Visual Basic
- CSCI-N341 Client Side Web Programming
- CSCI-N342 Server Side Web Development
- CSCI-N343 Object-Oriented Programming for the Web
- CSCI-N345 Advanced Programming, Java
- CSCI-N351 Introduction to Multimedia Programming
- CSCI-N355 Introduction to Virtual Reality
- CSCI-N361 Fundamentals of Software Project Management
- CSCI-N410 Mobile Computing Application Development
- CSCI-N420 Mobile Computing Cross Platform Development
- CSCI-N430 Mobile Computing and Interactive Applications
- CSCI-N431 E-Commerce with ASP.NET
- CSCI-N435 Data Management Best Practices with ADO.NET
- CSCI-N443 XML Programming
- CSCI-N450 Mobile Computing with Web Services
- CSCI-N451 Web Game Development
- CSCI-N452 3D Game Programming (Pending)
- CSCI-N461 Software Engineering for Applied Computer Science
- CSCI-N499 Topics in Applied Computing (topic varies)
- INFO-I202 Social Informatics
- INFO-I270 Intro HCI Principles and Practices
- INFO-I275 Intro to HCI Theory

- INFO-I310 Multimedia Arts: History, Criticism & Technology
- INFO-I480 Experience Design & Evaluation of Ubiquitous Computing
- NEWM-N220 Intro to Media Application Development
- NEWM-N230 Intro to Game Design & Development
- NEWM-N241 Stop Motion Animation
- NEWM-N255 Intro to Digital Sound
- NEWM-N285 Interactive Design
- NEWM-N320 Intermediate Media Application Development
- NEWM-N330 Game Design, Development, and Production
- NEWM-N335 Character Modeling and Animation
- NEWM-N431 Game On
- NEWM-N450 Usability Practices for New Media Interfaces
- CIT 20200 Network Fundamentals
- CIT 31200 Advanced Web Design
- CIT 31300 Commercial Web Site Development
- CIT 32900 Java Server Programming
- CIT 34700 Advanced ASP.NET Programming
- CIT 35600 Network Operating System Administration
- CIT 40200 Design and Implementation of Local Area Networks
- CIT 40600 Advanced Network Security
- CIT 41200 XML-Based Web Applications
- CIT 42000 Digital Forensics
- CIT 43600 Advanced E-Commerce Development
- CIT 44000 Computer Network Design
- HER-L210 Visual Design for the Web
- HER-A261 Intro to Computer Imagery
- BUS-S302 Management Information Systems
- BUS-L203 Commercial Law I
- BUS-L303 Commercial Law II
- ECE 20400 Intro to Electrical & Electron Circuits
- ECE 27000 Intro to Digital System Design
- ECE 36200 Microprocessor Systems & Interfacing
- ECE 47100 Embedded Systems
- STAT 51400 Design of Experiments
- MATH 16500 Analytic Geometry & Calculus I
- MATH 16600 Analytic Geometry & Calculus II
- MATH 26100 Multivariate Calculus
- MATH 26600 Ordinary Differential Equations
- MATH 35300 Linear Algebra II with Applications

Please note that the courses above may require pre-requisites. Be sure to plan accordingly

CSCI 300, 400, and 500 level Electives—Choose at least five courses

- CSCI 30000 Systems Programming
- CSCI 35500 Introduction to Programming Languages
- CSCI 36300 Principles of Software Design
- CSCI 40200 Computer Architecture
- CSCI 40300 Operating Systems
- CSCI 41400 Numerical Methods
- CSCI 43200 Security in Computing
- CSCI 43300 Introduction to Internet of Things
- CSCI 43500 Multimedia Information Systems
- CSCI 43600 Principles of Computer Networking
- CSCI 43700 Introduction to 3D Game Graphics
- CSCI 43800 Advanced Game Development
- CSCI 44300 Database Systems
- CSCI 44800 Biometric Computing
- CSCI 45000 Principles of Software Engineering
- CSCI 45200 Object-Oriented Analysis and Design
- CSCI 46300 Analysis of Algorithms
- CSCI 47000 Automata and Formal Languages
- CSCI 47500 Scientific Computing I
- CSCI 47600 Scientific Computing II
- CSCI 47700 High Performance Computing
- CSCI 48100 Data Mining
- CSCI 48400 Theory of Computation
- CSCI 48500 Expert System Design
- CSCI 48700 Artificial Intelligence
- CSCI 48900 Data Science
- CSCI 49000 Variable Title
- CSCI 500-level electives per approval

Bachelor of Arts Sample Program (120 cr. required)

Freshman Year

First Semester	
CSCI 12000 First Year Seminar	1
CSCI 23000 Computing I	4
MATH 15300 Algebra & Trigonometry I	3
ENG W131 Reading, Writing and Inquiry	3
Arts & Humanities/Social Sciences (choose from list)	3
Total	**14**
Second Semester	
CSCI 24000 Computing II	4
CSCI 34000 Discrete Computational Structures	3
MATH 15400 Algebra & Trigonometry II	3
CSCI-N211 Intro. to Databases	3
COMM-R110 Fundamentals of Speech Communication	3
Total	**16**

Sophomore Year

Third Semester	
CSCI 36200 Data Structures	3
CSCI-N241 Fundamentals of Web Development	3
STAT 30100 Elem. Statistical Methods I	3
Life and Physical Science (approved elective)	3
Arts & Humanities/Social Sciences (choose from list)	3
Total	**15**

Fourth Semester	
CSCI-N361 Fund. of Software Project Mgmt.	3
CSCI elective	3
CSCI elective	3
Life and Physical Science (approved elective)	3
Arts & Humanities/Social Sciences (choose from list)	3
Total	**15**

Junior Year

Fifth Semester	
CSCI Elective	3
World Language	4
Life and Physical Science (approved elective)	4
TCM 32000 Written Comm. in Science & Industry	3
Elective	3
Total	**17**
Sixth Semester	
CSCI Elective	3
CSCI Elective	3
Life and Physical Science (approved elective)	3
World Language	4
Elective	3
Total	**16**

Senior Year

Seventh Semester	
CSCI Elective	3
CSCI Elective	3
CSCI Elective	3
INFO-I300 Human Computer Interaction	3
Total	**12**
Eighth Semester	
CSCI 49500 Explorations in Applied Computing (Capstone)	3
CSCI Elective	3
Elective	6
Elective	3
Total	**15**

Bachelor of Science

Students completing the undergraduate degree in computer and information science will have acquired a fundamental understanding of computing, information processing, and information communication. The department's graduates serve in a variety of programming, software engineering, database administration, systems analysis, management, and research positions.

Degree Requirements

NOTE: These degree requirements are effective for students admitted beginning in the Fall of 2021.

See the School of Science requirements under "Undergraduate Programs" in this bulletin for the general and area degree requirements. Computer science majors are admitted only provisionally to the program until they have completed MATH 16500 and CSCI 23000 and 24000 with a grade point average of 2.7 or higher for the three courses. Please note that computer and information science courses below CSCI 23000 or CSCI-N305 with certain exceptions, mathematics courses below MATH 16500, and statistics courses below STAT 35000 are not credited toward the degree. Furthermore, the School of Science will not accept certain university courses for the computer science degree program. The Bachelor of Science degree program in computer science requires a minimum of 120 credit hours.

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take CSCI 12000 Windows on Computer Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency (9 cr.) See the School of Science requirements under "Undergraduate Programs" in this bulletin for details.

- ENG-W131 Reading, Writing and Inquiry
- COMM-R110 Fundamentals of Speech Communication

The second semester of English composition must be satisfied with:

- TCM 32000 Written Communication in Science and Industry

Area II World Language Competency No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.) The information about the IIIA requirements in the School of Science "Undergraduate Programs" section of this bulletin lists courses that may be used to satisfy the requirements below. Students should consult a departmental advisor before registering for these courses.

- List H One course from Arts and Humanities List (3 cr.).
- List S One course from Social Sciences List (3 cr.)
- One additional course from either Arts/Humanities or Social Sciences List (3 cr.)
- List C One course from Cultural Understanding List (3 cr.).

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency The Department of Computer and Information Science requires all computer science majors to take PHYS 15200

and three other physical science courses chosen from the areas of biology, chemistry, geology, and physics, or from certain courses in engineering. A single grade of D or D+ is acceptable in this Area. Otherwise, all courses must be completed with a C- or higher. Each course that counts as one of the physical science required courses must have a lecture component and be at least 3 credit hours. Courses that may not be used to fulfill Area IIIC requirements include: BIOL-N100, BIOL-N120, BIOL-N200; CHEM-C100, CHEM-C101, CHEM-C102; PHYS 01000, PHYS 10000, PHYS 14000, PHYS 20000, PHYS 21800, PHYS 21900, PHYS-P201, PHYS-P202; AST-A130; GEOL-G 103, GEOL-G130, GEOL-G132; and all agriculture and geography courses. Consult a departmental academic advisor concerning the acceptability of other courses. The following engineering courses may be applied toward Area IIIC requirements: ECE 20100, ECE 20200, and ECE 27000. Laboratory courses without a lecture component may be taken for credit, but do not count toward the four-course requirement.

Area IIID Analytical Reasoning Competency Computer Science majors are required a minimum of 17 credit hours of mathematical sciences. A single grade of D or D+ is acceptable in this Area. Otherwise, all courses must be completed with a C- or higher. Five course requirements are MATH 16500, MATH 16600, MATH 17100, MATH 35100 or MATH 51100, STAT 35000 or STAT 41600 or STAT 51100.

Area IV Major Requirements Minimum requirements include 26 credit hours of core computer science courses and at least 33 additional hours of computer science and supporting course electives. Core courses are: CSCI 23000, CSCI 24000, CSCI 34000, CSCI 36200, CSCI 40200, CSCI 40300, CSCI 48400, and CSCI 49500. Students who do not maintain a minimum GPA of 2.50 in MATH 17100, and in CSCI 23000, CSCI 24000, CSCI 34000, and CSCI 36200 will not be permitted to continue as departmental majors. All major courses must be completed with a grade of C- or better. Students must maintain a GPA of 2.0 or above in major courses.

Computer and Information Science Electives

Students are encouraged to focus their required electives in such areas as databases and data mining, software engineering, game and graphics, networking, and security. Students choose a minimum of 11 courses from among the list of computer science and supporting course electives. No more than 3 courses can be chosen from the select list of N-series courses; a minimum of 6 courses must be CSCI 40000-level or above, and no more than 2 courses can be chosen from an approved list of supporting electives outside of computer science.

CSCI-N-Series — Choose no more than three

- CSCI 30000 Systems Programming
- CSCI 35500 Introduction to Programming Languages
- CSCI 36300 Principles of Software Design
- CSCI-N300 Mobile Computing Fundamentals
- CSCI-N305 C Language Programming
- CSCI-N311 Advanced Database Programming, Oracle
- CSCI-N317 Computation for Scientific Applications
- CSCI-N321 System and Network Administration
- CSCI-N335 Advanced Programming, Visual Basic
- CSCI-N341 Client Side Web Programming
- CSCI-N342 Server Side Web Development
- CSCI-N343 Object-Oriented Programming for the Web
- CSCI-N345 Advanced Programming, Java
- CSCI-N351 Introduction to Multimedia Programming
- CSCI-N355 Introduction to Virtual Reality
- CSCI-N361 Fundamentals of Software Project Management
- CSCI-N410 Mobile Computing Application Development
- CSCI-N420 Mobile Computing Cross Platform Development
- CSCI-N430 Mobile Computing and Interactive Applications
- CSCI-N431 E-Commerce with ASP.NET
- CSCI-N435 Data Management Best Practices with ADO.NET
- CSCI-N443 XLM Programming
- CSCI-N450 Mobile Computing with Web Services
- CSCI-N451 Web Game Development (Pending)
- CSCI-N452 3D Game Programming
- CSCI-N461 Software Engineering for Applied Computer Science
- CSCI-N499 Topics in Applied Computing (topic varies)

CSCI 300-Level Electives

- CSCI 30000 Systems Programming
- CSCI 35500 Introduction to Programming Languages
- CSCI 36300 Principles of Software Design

CSCI 400 and 500 level Electives—Choose at least six courses

- CSCI 41400 Numerical Methods
- CSCI 43200 Security in Computing
- CSCI 43300 Introduction to Internet of Things
- CSCI 43500 Multimedia Information Systems
- CSCI 43600 Principles of Computer Networking
- CSCI 43700 Introduction to 3D Game Graphics
- CSCI 43800 Advanced Game Development
- CSCI 44300 Database Systems
- CSCI 44800 Biometric Computing
- CSCI 45000 Principles of Software Engineering
- CSCI 45200 Object-Oriented Analysis and Design
- CSCI 46300 Analysis of Algorithms
- CSCI 47000 Automata and Formal Languages
- CSCI 47500 Scientific Computing I
- CSCI 47600 Scientific Computing II
- CSCI 47700 High Performance Computing
- CSCI 48100 Data Mining
- CSCI 48500 Expert System Design
- CSCI 48700 Artificial Intelligence
- CSCI 48900 Data Science
- CSCI 49000 Variable Title
- CSCI 500-level Electives per Approval

Computer Science Supporting Electives

Choose no more than 2 courses. Note that this list of courses is not all-inclusive. Other courses outside of

computer science can be considered and can be counted with prior written approval of a computer science faculty advisor.

- NEWM-N220 Intro to Media Application Development
- NEWM-N230 Introduction to Game Design & Development
- NEWM-N255 Intro to Digital Sound
- NEWM-N285 Interactive Design
- NEWM-N320 Intermediate Media Application Development
- NEWM-N330 Game Design, Development, and Production
- NEWM-N335 Character Modeling and Animation
- CIT 40200 Design and Implementation of Local Area Networks
- CIT 40600 Advanced Network Security
- CIT 42000 Digital Forensics
- CIT 44000 Computer Network Design
- HER-L210 Visual Design for the Web
- HER-A261 Intro to Computer Imagery
- INFO-I300 Human Computer Interaction
- INFO-I310 Multimedia Arts: History, Criticism, and Technology
- INFO-I320 Distributed Systems and Collaborative Comp
- BUS-S302 Management Information Systems
- BUS-L203 Commercial Law I
- BUS-L303 Commercial Law II
- ECE 20400 Introduction Electrical and Electron Circuits
- ECE 27000 Introduction to Digital System Design
- ECE 36200 Microprocessor Systems and Interfacing
- ECE 47100 Embedded Systems
- MATH 26100 Multivariate Calculus
- MATH 26600 Ordinary Differential Equations
- MATH 35300 Linear Algebra II with Applications
- STAT 51400 Design of Experiments

Bachelor of Science Sample Program (120 cr. required)

Freshman Year

First Semester	
CSCI 12000 Windows on Computer Science	1
CSCI 23000 Computing I	4
ENG W131 Reading, Writing and Inquiry	3
MATH 16500 Analytic Geometry and Calculus I	4
Arts & Humanities/Social Sciences (choose from list)	3
Total	**15**
Second Semester	
CSCI 24000 Computing II	4
CSCI 34000 Discrete Computational Structures	3
MATH 16600 Analytic Geometry and Calculus II	4
COMM-R110 Fundamentals of Speech Communication	3
Social Sciences (choose from list)	3
Total	**17**

Sophomore Year

Third Semester	
CSCI 36200 Data Structures	3
CSCI Elective	3
MATH 17100 Multidimensional Mathematics	3
Life and Physical Science (approved elective)	3
Arts & Humanities/Social Sciences (choose from list)	3
Total	**15**
Fourth Semester	
CSCI 40200 Architecture of Computers	3
CSCI elective	3
MATH 35100 Elementary Linear Algebra	3
Life and Physical Science (approved elective)	3
Cultural Understanding (choose from list)	3
Total	**15**

Junior Year

Fifth Semester	
CSCI 40300 Intro. to Operating Systems	3
CSCI elective	3
CSCI elective	3
Statistics (approved elective)	3
TCM 32000 Written Comm. in Science & Industry	3
Total	**15**
Sixth Semester	
CSCI elective	3
CSCI elective	3
CSCI elective	3
PHYS 15200 Mechanics	4
General elective	3
Total	**16**

Senior Year

Seventh Semester	
CSCI 48400 Theory of Computation	3
CSCI elective	3
CSCI elective	3
CSCI elective	3
General elective	3

Total	**15**
Eighth Semester	
CSCI 49500 Explorations in Applied Computing (Capstone)	3
CSCI elective	3
Science elective	3
General elective	3
Total	**12**

Bachelor of Science, Biocomputing Concentration

Students completing the undergraduate degree in computer and information science will have acquired a fundamental understanding of computing, information processing, and information communication. The Biocomputing concentration prepares graduates for medical school admission application requirements. The option also combines the study of computer science with coursework in the life sciences. The department's graduates serve in a variety of programming, software engineering, database administration, systems analysis, management, and research positions.

Degree Requirements

NOTE: These degree requirements are effective for students admitted beginning in the Fall of 2021.

See the School of Science requirements under "Undergraduate Programs" in this bulletin for the general and area degree requirements. Computer science majors are admitted only provisionally to the program until they have completed MATH 16500 and CSCI 23000 and 24000 with a grade point average of 2.7 or higher for the three courses. Please note that computer and information science courses below CSCI 23000 or CSCI-N305 with certain exceptions, mathematics courses below MATH 16500, and statistics courses below STAT 35000 are not credited toward the degree. Furthermore, the School of Science will not accept certain university courses for the computer science degree program. The Bachelor of Science degree program in computer science, Biocomputing concentration requires a minimum of 120 credit hours.

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take CSCI 12000 Windows on Computer Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency (9 cr.) See the School of Science requirements under "Undergraduate Programs" in this bulletin for details.

- ENG-W131 Reading, Writing and Inquiry
- COMM-R110 Fundamentals of Speech Communication

The second semester of English composition must be satisfied with:

- TCM 32000 Written Communication in Science and Industry

Area II World Language Competency No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.) The information about the IIIA requirements in the School of Science "Undergraduate Programs" section of this bulletin lists courses that may be used to satisfy the requirements below. Students should consult a departmental advisor before registering for these courses.

- List H One course from Arts & Humanities List (3 cr.).
- List S Social Science - PSY-B110 (3 cr.)
- One additional course - SOC-R100 (3 cr.)
- List C One course from Cultural Understanding List (3 cr.).

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

Life and physical science courses required for the BS in computer science, Biocomputing concentration are:

- BIOL-K101 Concepts of Biology I
- BIOL-K103 Concepts of Biology II
- CHEM-C105 Principles of Chemistry I
- CHEM-C125 Experimental Chemistry I
- CHEM-C106 Principles of Chemistry II
- CHEM-C126 Experimental Chemistry II
- CHEM-C341 Organic Chemistry I
- CHEM-C343 Organic Chemistry I Lab
- CHEM-C342 Organic Chemistry II
- CHEM-C344 Organic Chemistry II Lab
- PHYS-P201 General Physics I
- PHYS-P202 General Physics II
- BIOL-K384 or CHEM-C384 Biochemistry

Area IIID Analytical Reasoning Competency BS in Computer Science, Biocomputing concentration majors are required to complete a minimum of 14 credit hours of mathematical sciences. A single grade of D or D+ is acceptable in this Area. Otherwise, all courses must be completed with a C- or higher. Four course requirements are MATH 16500, MATH 16600, MATH 17100, STAT 35000 or STAT 41600 or STAT 51100.

Area IV Major Requirements Minimum requirements include 23 credit hours of core computer science courses and at least 18 additional hours of computer science course electives. Core courses are: CSCI 23000, CSCI 24000, CSCI 34000, CSCI 36200, CSCI 40200, CSCI 40300, and CSCI 49500. Students who do not maintain a minimum GPA of 2.50 in MATH 17100, and in CSCI 23000, CSCI 24000, CSCI 34000, and CSCI 36200 will not be permitted to continue as departmental majors. All major courses must be completed with a grade of C- or better. Students must maintain a GPA of 2.0 or above in all major courses.

Computer and Information Science Electives

Students choose a minimum of 6 courses from among the list of computer science course electives. No more than 3 courses can be chosen from the select list of N-series and 300-level courses.

CSCI-N-Series and 300-Level - Choose no more than three:

- CSCI 30000 Systems Programming
- CSCI 35500 Introduction to Programming Languages
- CSCI 36300 Principles of Software Design
- CSCI-N300 Mobile Computing Fundamentals
- CSCI-N305 C Language Programming
- CSCI-N311 Advanced Database Programming, Oracle
- CSCI-N317 Computation for Scientific Applications
- CSCI-N321 System and Network Administration
- CSCI-N335 Advanced Programming, Visual Basic
- CSCI-N341 Client Side Web Programming
- CSCI-N342 Server Side Web Development
- CSCI-N343 Object-Oriented Programming for the Web
- CSCI-N345 Advanced Programming, Java
- CSCI-N351 Introduction to Multimedia Programming
- CSCI-N355 Introduction to Virtual Reality
- CSCI-N361 Fundamentals of Software Project Management
- CSCI-N410 Mobile Computing Application Development
- CSCI-N420 Mobile Computing Cross Platform Development
- CSCI-N430 Mobile Computing and Interactive Applications
- CSCI-N431 E-Commerce with ASP.NET
- CSCI-N435 Data Management Best Practices with ADO.NET
- CSCI-N443 XLM Programming
- CSCI-N450 Mobile Computing with Web Services
- CSCI-N451 Web Game Development (Pending)
- CSCI-N452 3D Game Programming
- CSCI-N461 Software Engineering for Applied Computer Science
- CSCI-N499 Topics in Applied Computing (topic varies)

CSCI 400 and 500 level Electives—Choose at least three courses

- CSCI 41400 Numerical Methods
- CSCI 43200 Security in Computing
- CSCI 43300 Introduction to Internet of Things
- CSCI 43500 Multimedia Information Systems
- CSCI 43600 Principles of Computer Networking
- CSCI 43700 Introduction to 3D Game Graphics
- CSCI 43800 Advanced Game Development
- CSCI 44300 Database Systems
- CSCI 44800 Biometric Computing
- CSCI 45000 Principles of Software Engineering
- CSCI 45200 Object-Oriented Analysis and Design
- CSCI 46300 Analysis of Algorithms
- CSCI 47000 Automata and Formal Languages
- CSCI 47500 Scientific Computing I
- CSCI 47600 Scientific Computing II
- CSCI 47700 High Performance Computing
- CSCI 48100 Data Mining
- CSCI 48500 Expert System Design
- CSCI 48700 Artificial Intelligence
- CSCI 48900 Data Science
- CSCI 49000 Variable Title
- CSCI 500-level Electives per Approval

Bachelor of Science, Biocomputing Concentration Sample Program (120 cr. required)

Freshman Year

First Semester	
CSCI 12000 Windows on Computer Science	1
CSCI 23000 Computing I	4
MATH 16500 Analytic Geometry and Calculus I	4
BIOL-K101 Concepts in Biology I	5
Total	**14**
Second Semester	
CSCI 24000 Computing II	4
MATH 16600 Analytic Geometry and Calculus II	4
ENG-W131 Reading, Writing and Inquiry	3
BIOL-K103 Concepts of Biology II	5
Total	**16**

Sophomore Year

Third Semester	
CSCI 34000 Discrete Computational Structures	3
MATH 17100 Multidimensional Mathematics	3
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
COMM-R110 Fundamentals of Speech Communication	3
PSY-B110 Introduction to Psychology	3
Total	**17**
Fourth Semester	
CSCI 36200 Data Structures	3
Statistics (approved elective)	3
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
SOC-R100 Introduction to Sociology	3
Total	**14**

Junior Year

Fifth Semester	
CSCI 40200 Architecture of Computers	3
CSCI elective	3
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry I Lab	2
Arts and Humanities (choose from list)	3
Cultural Understanding (choose from list)	3
Total	**17**
Sixth Semester	
CSCI 40300 Introduction to Operating Systems	3
TCM 32000 Written Comm. in Science/Industry	3
CSCI elective	3
CHEM-C342 Organic Chemistry II	3
CHEM-C344 Organic Chemistry II Lab	2
Total	**14**

Senior Year

Seventh Semester	
CSCI elective	3
CSCI elective	3
PHYS-P 201 General Physics I	5
BIOL-K384 or CHEM-C384 Biochemistry	3
Total	**14**
Eighth Semester	
CSCI 49500 Explorations in Applied Computing (Capstone)	3
CSCI elective	3
CSCI elective	3
PHYS-P202 General Physics II	5
Total	**14**

Bachelor of Science Artificial Intelligence

The B.S. in AI degree program will provide a solid foundational, as well as comprehensive, education on AI and related technologies. Students graduating from this program will be able to develop intelligent agents that are part of autonomous systems mimicking human behavior capable of performing tasks autonomously, and intelligently. Students completing the undergraduate degree in artificial intelligence will have studied artificial intelligence theory, methodologies, and applications throughout the program. Students will be able to apply this knowledge to artificial intelligence technologies, such as robotics, autonomous systems, intelligent control and smart systems and devices.

Degree Requirements

NOTE: These degree requirements are effective for students admitted beginning in the Fall of 2021.

See the School of Science requirements under "Undergraduate Programs" in this bulletin for the general and area degree requirements. Please note that omputer and information science courses below CSCI 23000 or CSCI-N305 with certain exceptions, mathematics courses below MATH 16500, and statistics courses below STAT 35000 are not credited toward the degree. Furthermore, School of Science will not accept certain university courses for the computer science degree program. The Bachelor of Science degree program in artificial intelligence requires a minimum of 120 credit hours.

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take CSCI 12000 Windows on Computer Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency (9 cr.) See the School of Science requirements under "Undergraduate Programs" in this bulletin for details.

- ENG-W131 Reading, Writing and Inquiry
- COMM-R110 Fundamentals of Speech Communication

The second semester of English composition must be satisfied with:

- TCM 32000 Written Communication in Science and Industry

Area II World Language Competency No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.) The information about the IIIA requirements in the School of Science "Undergraduate Programs" section of this bulletin lists courses that may be used to satisfy the requirements below. Students should consult a departmental advisor before registering for these courses.

- List H Arts and Humanities Competency: One course from Arts and Humanities list (3 cr.)
- List S Social Sciences Competency: One course from Social Science list - PSY-B110 Intro to Psychology (3 cr.)
- One additional course from either Arts/Humanities or Social Science list (3 cr.)
- List C Cultural Understanding Competency: One course from Cultural Understanding list (3 cr.)

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency The Department of Computer and Information Science

requires four life and physical science lecture courses; one of those courses must also have a lab component. A single grade of D or D+ is acceptable in this Area. Otherwise, all courses must be completed with a C- or higher. Each course that counts as one of the physical science required courses must have a lecture component and be at least 3 credit hours. Courses that may not be used to fulfill Area IIIC requirements include: BIOL-N100, BIOL-N120, BIOL-N200; CHEM-C100, CHEM-C101, CHEM-C102; PHYS 01000, PHYS 10000, PHYS 14000, PHYS 20000, AST-A130; GEOL-G 103, GEOL-G130, GEOL-G132; and all agriculture and geography courses. Consult a departmental academic advisor concerning the acceptability of other courses. The following engineering courses may be applied toward Area IIIC requirements: ECE 20100, ECE 20200, and ECE 27000. Laboratory courses without a lecture component may be taken for credit, but do not count toward the four-course requirement.

Area IIID Analytical Reasoning Competency Artificial Intelligence majors are required to complete a minimum of 21 credit hours of mathematical science courses. A single grade of D or D+ is acceptable in this Area. Otherwise, all courses must be completed with a C- or higher. Six course requirements are MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 35100 and STAT 41600.

Area IV Major Requirements Minimum requirements include 47 credit hours of computer science courses. Core courses are: CSCI 23000, CSCI 24000, CSCI 34000, CSCI 36200, CSCI 48100, CSCI 41400, CSCI-N 317, CSCI 44300, CSCI 48700, CSCI 46300 or ECE 49500 Algorithms, CSCI 49500 Robotics, CSCI 49500 and CSCI 49000 Deep Learning, Computer Vision and Natural Language Processing courses. All major courses must be completed with a grade of C- or better. Students must maintain a GPA of 2.0 or above in major courses.

Focus Area Electives:

- CSCI 43500 Multimedia Information Systems
- CSCI 44800 Biometric Computing
- CSCI 45000 Principles of Software Engineering
- CSCI 48900 Data Science
- CSCI 58000 Algorithm Design, Analysis, and Implementation

Bachelor of Science Sample Program (120 cr. required)

Freshman Year

First Semester	
CSCI 12000 Windows on Computer Science	1
CSCI 23000 Computing I	4
MATH 16500 Analytical Geometry and Calculus I	4
ENG W131 Reading, Writing and Inquiry	3
AI-IUPUI 1XX Intro to AI	3
Total	**15**
Second Semester	
CSCI 34000 Discrete Computational Structures	3
MATH 16600 Analytical Geometry and Calculus II	4
MATH 17100 Multidimensional Math	3
PSY-B110 Intro to Psychology (Social Sciences)	3
COMM-R110 Fundamentals of Speech Communication	3
Total	**16**

Sophomore Year

Third Semester	
MATH 26100 Multivariate Calculus	4
AI-IUPUI 2XX Introductory Data Science	3
MATH 35100 Linear Algebra	3
Life/Physical Science Elective	3
CSCI 24000 Computing II	4
Total	**17**
Fourth Semester	
CSCI-N317 Computation for Scientific Applications	3
STAT 41600 Probability	3
CSCI 36200 Data Structures	3
PSY-B201 Foundations of Neuroscience (life/physical science)	3
CSCI 48100 Data Mining	3
Total	**15**

Junior Year

Fifth Semester	
CSCI 41400/MATH 41400 Numerical Methods	3
AI-IUPUI 3XX Artificial Intelligence	3
CSCI 44300 Database Systems	3
Life/Physical Science Elective	3
CSCI 49000 topic - Deep Learning	3
Total	**15**
Sixth Semester	
CSCI 48700 Artificial Intelligence	3
AI Core- CSCI 46300 or ECE 49500 Algorithms	3
Cultural Understanding elective	3
Life/Physical Science Elective + lab requirement	4
Focus Area Elective	3
Total	**16**

Senior Year

Seventh Semester	
TCM 32000 Written Communication in Science and Industry	3
AI-IUPUI Recent Trends in AI	3
AI-IUPUI 4XX AI Ethics	1
AI Core ECE 49500 Robotics	3
Arts & Humanities Elective	3
Total	**13**
Eighth Semester	
CSCI 49000 topic - Computer Vision	3
CSCI 49500 Computer Science Capstone	3
CSCI 49000 topic - Natural Language Processing	3
Focus Area Elective 2	1
General Education Arts/ Humanities or Social Sciences	3
Total	**13**

Certificate in Applied Computer Science

The certificate program introduces computer science principles, develops practical skills in market-driven software applications, and prepares students to be successful with emerging technologies. The program is designed to supplement and enhance a primary degree program. It serves current IUPUI students and returning adults who are interested in gaining knowledge and skills in computing applications.

Those who earn the certificate will have demonstrated that they have the core competencies necessary for entry-level positions in information technology. They will have the ability to solve complex problems, design and implement algorithms, apply computer science theory to practical problems, adapt to technological change and to develop software solutions.

Admission Requirements

- A cumulative GPA of at least 2.0 and enrollment in or successful completion (no grade below C–) of MATH-M118 Finite Mathematics or higher or PHIL-P162 Logic or PHIL-P265 Introduction to Symbolic Logic

Students must declare their intent to earn this certificate before completing the core requirements (9 credit hours) described below. No more than 9 credit hours earned before admission to the program will be accepted toward the certificate requirements.

Program Requirements

Students are required to successfully complete 18 credit hours (six courses) to earn the certificate. Three courses are core requirements and three courses are advanced electives. Core requirements must be completed before enrolling in the advanced electives. No individual grade below a C– is acceptable. At least 9 credit hours in the certificate program must be taken in the Department of Computer and Information Science. A GPA of at least 2.0 is required for the complete certificate program.

Required Core CSCI Courses (9 credit hours):

- CSCI-N241 Fundamentals of Web Development
- CSCI-N301 Fundamental Computer Science Concepts or CSCI-N 200 Principles of Computer Science or CSCI 23000 Computing I
- CSCI-N361 Fundamentals of Software Project Management

Advanced Electives (9 credit hours):

In addition to the three core courses, students must successfully complete three other approved courses that complete one Tier 1 and two Tier 2 electives.

Tier 1 Electives

- CSCI-N207 Data Analysis Using Spreadsheets
- CSCI-N211 Introduction to Databases
- CSCI-N341 Client Side Web Programming

Tier 2 Electives

- CSCI-N300 Mobile Computing Fundamentals
- CSCI-N311 Advanced Database Programming, Oracle
- CSCI-N317 Computation for Scientific Applications
- CSCI-N342 Server Side Web Development
- CSCI-N410 Mobile Application Development
- CSCI-N431 E-Commerce with ASP.net
- CSCI 36200 Data Structures
- CSCI 48100 Data Mining
- INFO-I300 Human-Computer Interaction

Students should contact the Computer and Information Science Academic Advisor for information about Tier 1 and Tier 2 courses. While the certificate can be completed entirely online, not all electives are offered online or offered every semester.

To enroll in this certificate program, students must be formally admitted by the Office of Undergraduate Admissions on the IUPUI campus. For currently enrolled (admitted) IUPUI students, an online application is available at https://science.iupui.edu/admissions/apply/internal-application.html.

Certificate in Fundamentals of Data Analytics

The certificate in fundamentals of data analytics equips students with the skill set necessary to perform meaningful data analysis in any domain. The curriculum includes theoretical knowledge as well as hands-on training in various major data applications, such as R, MatLab, SPSS, Excel, Access, MySQL, Oracle and more. Students will learn to marshal computational data to solve a variety of real world problems. The certificate is appropriate for students and working professionals in a wide range of areas, including STEM fields, Liberal Arts, Philanthropy, Business and more.

Admission Requirements

- Candidates for this certificate are required to be formally admitted by the IUPUI Office of Admissions.

Current IUPUI students must have a 2.0 IU Cumulative GPA or better for admission.

Program Requirements

Students are required to successfully complete 15 credit hours (five courses) to earn the certificate. No individual grade below a C is acceptable. At least 12 credit hours in the certificate program must be taken at IUPUI. An IU Cumulative GPA of at least 2.0 is required to complete the certificate program

Required Courses (15 credit hours):

- CSCI-N207 Data Analysis Using Spreadsheets
- CSCI-N211 Introduction to Databases
- CSCI-N311 Advanced Database Programming
- CSCI-N317 Computation for Scientific Applications
- STAT 30100 Elementary Statistical Methods (pre-requisite of MATH 11000 or MATH 11100 or equivalent)

Minor in Computer and Information Science

The undergraduate minor in computer and information science requires at least 20 credit hours in computer science courses, including CSCI 23000, 24000, 34000, 36200, and two CSCI elective courses. Students who have requested and received approval for the waiver of CSCI 23000 must replace that course with another CSCI minor course elective; for such students the minimum total computer science credit hour requirement will be relaxed to 19 credits. Course prerequisites must be fulfilled prior to enrollment in CSCI courses.

Approved list of computer and information science minor electives:

- CSCI 30000 Systems Programming
- CSCI 35500 Introduction to Programming Languages
- CSCI 36300 Software Design
- CSCI 40200 Computer Architecture
- CSCI 40300 Operating Systems
- CSCI 43200 Security in Computing
- CSCI 43300 Internet of Things
- CSCI 43500 Multimedia Information Systems
- CSCI 43600 Principles of Computer Networking
- CSCI 43700 Introduction to Game Graphics
- CSCI 43800 Advanced Game Development
- CSCI 44300 Database Systems
- CSCI 44800 Biometric Computing
- CSCI 45000 Principles of Software Engineering
- CSCI 48100 Data Mining
- CSCI 48400 Theory of Computation
- CSCI 48700 Artificial Intelligence
- CSCI 48900 Data Science
- CSCI 49000 Variable Title
- MATH 41400/CSCI 41400 Numerical Methods
- CSCI-N300 Mobile Computing Fundamentals
- CSCI-N311 Advanced Database Prog. Oracle
- CSCI-N317 Comp. for Scientific Applications
- CSCI-N341 Client-Side Web programming
- CSCI-N342 Server-Side Web Development
- CSCI-N361 Software Project Management
- CSCI-N410 Mobile Computing Application Dev.
- CSCI-N431 E-Commerce with ASP.NET

A minimum GPA of 2.50 must be maintained in these courses. At least 9 credit hours of the minor must be taken at IUPUI.

Students who wish to pursue a minor in computer and information science may declare the minor intent by completing this online form. Students should consult an advisor in the department before their final semester regarding minor completion.

Minor in Applied Computer Science

The Minor in Applied Computer Science is available to currently enrolled IUPUI undergraduate students pursuing bachelor's degrees outside computer science. The applied minor requires at least 19 credit hours in computer science courses, including CSCI-N201, CSCI-N207 or CSCI-N211, CSCI-N241, CSCI 23000, and two three-credit electives from the approved list.

Approved list of applied computer science minor electives:

- CSCI 24000 Computing II
- CSCI 30000 Systems Programming
- CSCI 35500 Introduction to Programming Languages
- CSCI 36300 Software Design
- CSCI-N300 Mobile Computing Fundamentals
- CSCI-N311 Adanced Database Prog., Oracle
- CSCI-N317 Comp. for Scientific Applications
- CSCI-N341 Client-Side Web Programming
- CSCI-N342 Server-Side Web Development
- CSCI-N361 Software Project Management
- CSCI-N410 Mobile Computing Application Dev.
- CSCI-N431 E-Commerce with ASP.NET
- CSCI-N499 Topics in Applied Computing

A minimum 2.0 GPA must be maintained in these courses, and no grade below C- is allowed. At least 12 credit hours of the minor must be taken in residence at IUPUI. Students who wish to pursue a minor in Applied Computer Science may declare the minor intent by completing this online form. Students should consult an advisor in the department before their final semester regarding minor completion.

Graduate programs

Master of Science

This program leads to a Master of Science degree from Purdue University.

The Department offers three options for Master of Science students: Thesis, Project, and Course Only. Each option requires 30 completed credit hours. Thesis students complete a research project that counts for 6 or 9 credit hours of the 30 required credits. Project students complete a project, usually of a more practical nature related to their work or academic interests, counting for 3 or 6 of the 30 required credits. Course Only option students take 30 credit hours of course work, and select an area or areas of concentration. No thesis or project work is required.

Application for Admission

Submit applications for admission to the graduate program directly to the Department of Computer and Information Science by April 1 for the following Fall semester and September 15 for the following Spring semester. To be considered for the University Fellowship award for the following Fall semester, all application materials *must* be received by *January 15*.

Students interested in advanced study or students who are required to complete preparatory courses and are waiting on application processing may take courses as graduate nondegree students. However, no more than 12 graduate credit hours earned as a nondegree student may be counted toward a graduate degree program.

See the department's Web site (https://science.iupui.edu/cs/) for additional information on requirements and application deadlines.

General Admission Requirements

The applicant to the graduate program must have a four-year bachelor's degree or equivalent. Students with three-year degrees may be required to complete additional course work in order to be eligible for admission.

The applicant's record should demonstrate strong individual accomplishments, include recommendations from independent references and exhibit outstanding achievement as indicated by the grade point average for each degree over his or her entire academic record. An applicant is expected to have a GPA of at least a 3.0 on a scale of 4.0.

The Graduate Record Exam (GRE) General Test is required for all applicants, however there is no specific minimum score requirement that must be met.

All applicants should have a background in the following core areas of computer science:

- software development experience in a high-level language
- data structures and algorithms
- systems (operating systems, compilers, and programming languages)
- theory (discrete math and theory of computation)
- hardware (computer architecture)

In addition, applicants should have a strong background in mathematics, including calculus, linear algebra, and numerical computations.

All applicants whose native language is not English must submit sufficient proof of English proficiency via either TOEFL or IELTS test. For TOEFL, applicants must have an overall score of at least 80 on the Internet Based Test (iBT) with section minimums of 19 Reading, 14 Listening, and 18 Speaking & Writing. TOEFL scores must be from a single test occurrence; "MyBest" scores are not accepted. For IELTS (Academic test only), applicants must have an overall band score of 6.5, with section minimums of 6.5 Reading, 6.0 Listening & Speaking and 5.5 Writing.

International applicants who have received a degree in the U.S. are exempted from the TOEFL/IELTS requirement only if the degree was awarded within the last 3 years.

Degree Requirements

To receive the Master of Science degree, the applicant must be admitted as a graduate student *without provisions* and complete 30 semester credit hours of study in CSCI courses numbered 500 or above. Of the 30 required hours, students must select 1 course each from 4 different "foundational" categories for a total of 12 credit hours. There are 6 categories from which to select the 4, as listed below:

1. Networking and Security -- CSCI 53600, CSCI 55500
2. Databases and Intelligent Systems -- CSCI 54100, CSCI 54900, CSCI 57300
3. Visualization and Graphics -- CSCI 55000, CSCI 55200, CSCI 55700
4. Software Engineering -- CSCI 50600, CSCI 50700, CSCI 50900
5. Theory -- CSCI 52000, CSCI 56500, CSCI 58000
6. Systems - CSCI 50200, CSCI 50300, CSCI 50400, CSCI 53700

Each student is required to submit to the graduate committee for approval an initial plan of study during the first year in the program. This is prepared in consultation with the faculty advisor. Before the semester of expected graduation, the student's formal plan of study must be submitted to, and accepted by, Purdue University Graduate School. Each student must register in CAND 99100 and at least 1 credit hour of a fee-bearing course during the final semester before graduation.

Credit for Courses from Outside the Department

Credit for graduate courses taken at other institutions may be transferred with the approval of the graduate committee and the Graduate School if the courses have not been used for other degree requirements. Transfer credits are normally limited to 6 credit hours and are restricted to courses in which the grade is B or higher. Non-departmental courses are limited to 3 credits (1 course) for course-only students, selected from a pre-approved list. Up to 3 additional credits (for a total of 6) may be allowed for M.S. Thesis or M.S. Project students for courses related to research area; prior approval of the Advisory and Graduate Committees are required for registration.

Assessment

The student's graduate examination committee will examine the student's project or thesis and general proficiency in computer science. Grades of A and B are expected; up to 6 credit hours of C or C+ may be included, provided an overall GPA of 3.0 (B) is maintained. Other grades are unacceptable.

Programs of Study

The department offers three programs of study within its M.S. program: the Research Program, the Applied Program, and the Course Only option.

Research Program

The objective of the Research Program is to help students develop a general knowledge of computer science, depth in a specific area, and an ability to do independent

research. The student learns research techniques by working in close cooperation with a faculty member while doing the thesis research. In addition to the two core courses and 6 to 9 credit hours of CSCI 69800 M.S. Thesis work, the student completes a sufficient number of electives from the department's graduate level courses to satisfy the requirement of 30 credits hours total.

Applied Program

The objective of the Applied Program is to develop skills and knowledge of the computer science fundamentals and an ability to apply these to practical problems. In addition to the two core courses, it requires at least two courses in a specialization, 3 to 6 credits of work in the M.S. Project course, CSCI 69500, and a sufficient number of electives from the department's graduate courses to complete the requirement of 30 credits hours. The course work is designed to provide breadth of knowledge to the professional as well as specialized knowledge in the areas that the project will require. The project normally involves at least two semesters of intensive work on an application of the course material to a problem of practical importance. This might be a project from the student's work environment, internship, or a faculty member's work. Its objective is generally more immediately practical than the thesis in the Research Program. The student carries out the project under the supervision of a faculty member.

The Applied Program offers a menu of courses from which the individual selects one or more specializations to prepare for the proposed project. To define a specialization, the graduate advisor and student identify in the plan of study two or more courses that provide depth in a cohesive theme.

Course Only Option

The Course Only option is meant for students who desire practical knowledge and skills in a range of specializations in computer science. It offers a menu of courses from which the individual selects one or more specializations to define a concentration area. The program provides both depth and breadth of knowledge in the discipline, and is ideal for students who are not planning careers exclusively in research.

Master of Science in Computational Data Science

This degree program is offered through the Departments of Computer & Information Science and Mathematical Sciences of the IUPUI School of Science. The objective of the program is to prepare students to enter the workforce in the rapidly advancing field of data science, an interdisciplinary domain that cuts across computer science and statistics, by providing a solid, comprehensive background in the related topics of theory and their applications.

This program will provide the skills necessary that will enable students to be flexible and competitive in today's job market by gaining deep understanding of theory, implementation (e.g., algorithms and appropriate computing languages), as well as the inherent "nature" of different data modalities, such as classification and prediction challenges on specific data (e.g., sparse and/or incomplete data).

Curriculum Requirements

The curriculum requires 30 credits in total that can be completed in three semesters. There are 9 credits for core courses in Computer Science, 6 credits for Statistics core courses, 12 credits for elective courses from Computer Science and/or Statistics, and 3 credits for the capstone course. The students must chooe at least two electives from Computer Science and at least two electives from Statistics.

Successful completion of the program requires a minimum plan of study GPA of 3.0, the minimum grade in any course is C and the maximum number of courses with grades of C or C+ is two.

Core Courses:
CSCI 59000 Introduction to Data Science
CSCI 57300 Data Mining
CSCI 57800 Statistical Machine Learning
STAT 51200 Applied Regression Analysis
STAT 52900 Applied Decision Theory and Bayesian Analysis

Capstone Courses:
CSCI 69500 MS Capstone Project
STAT 59800 Topics in Statistical Methods

Elective courses:
CSCI 52000 Computational Methods in Analysis
CSCI 54100 Database Systems
CSCI 55200 Advanced Graphics & Visualization
CSCI 58000 Algorithm Design, Analysis & Implementation
CSCI 59000 Large-Scale Machine Learning
CSCI 59000 High Performance Computing
STAT 51400 Design of Experiments
STAT 52000 Time Series and Applications
STAT 52300 Categorical Data Analysis
STAT 52400 Applied Multivariate Analysis
STAT 52501 Generalized Linear Models
STAT 53600 Introduction to Survival Analysis
The course sequence is crucial for successful completion of this program. Students should consult with the departmental advisor.

General Admission Requirements for MS in Computational Data Science

Prerequisite coursework and/or degrees:

4-year Bachelor's degree in Computer Science, Engineering, Mathematics, Statistics or related fields. 4-year Bachelor's degree in any other area of study will be considered on a case-by-case basis, based on the coursework and corresponding grades in the applicant's transcripts, as well as on the overall potential of successfully completing this program.

GPA: Scores on the Graduate record Exam (GRE) must be submitted for admission consideration.

All applicants whose native language is not English must submit sufficient proof of English proficiency via either TOEFL or IELTS test. For TOEFL, applicants must have an overall score of at least 80 on the Internet Based Test (iBT) with section minimums of 19 Reading, 14 Listening, and 18 Speaking & Writing. TOEFL scores must be from a single test occurrence; "MyBest" scores are not accepted. For IELTS (Academic test only), applicants must have an

overall band score of 6.5, with section minimums of 6.5 Reading, 6.0 Listening & Seaking and 5.5 Writing.

International applicants who have received a degree in the U.S. are exempted from the toeFL/IELTS requirement only if the degree was awarded within the last 3 years.

Doctor of Philosophy

Students interested in research in certain areas and who qualify may be admitted to pursue a Ph.D. degree. Information on the general nature of the program appears in the “Graduate Programs” section of the School of Science part of this bulletin. Consult the department’s Web page (https://science.iupui.edu/cs/) for more specific information on how this might be arranged.

Research Orientation Requirement

Students in their first year must take a 1-credit Pass/Fail seminar course (CSCI-C591) and, as part of this course, they must also complete the "Physical Science Responsible Conduct of Research" course online and provide the certificate of completion.

Core Course Requirement

Students must satisfy this requirement by the end of their fourth semester by passing one theory core course and one systems core course and one course in an area of specialization with an average GPA of at least 3.5. A core course that does not meet the grade and GPA requirements can be taken, at most, a second time. Taking another course (in the same core area or in the same specialization area, or taking a course in another specialization area) would count as the second attempt. The second attempt at satisfying the core course qualifications will be considered a probationary period for the student to remedy the shortcoming. Students must declare the area of specialization ahead of time with the approval of their advisory committee. The students who have not satisfied their core course requirements by the end of their fourth semester according to the conditions described above cannot proceed further in their PhD studies. They will need to contact their advisor and their advisory committee. The students will receive a letter of probation during their second attempt at completing a core course. The students will be informed that they can be dismissed if they fail to be removed from probation.

The core courses and areas of specialization are defined as follows:

- Theory core courses: CSCI 58000 (Algorithms) and CSCI 56500 (Programming Languages)
- Systems core courses: CSCI 50300 (Operating Systems), CSCI 50400 (Computer Architecture)
- Area Specialization courses:
  - Visualization, Image Processing and Machine Vision: CSCI 55000, CSCI 55200, CSCI 55700, CSCI 55800
  - Data Communication and Networking: CSCI 53600, CSCI 59000 (Wireless Sensor Networks)
  - Distributed Computing: CSCI 53700, CSCI 53200
  - AI, Machine Learning, and Data Analysis: CSCI 54900, CSCI 57300, CSCI 57800
  - Databases: CSCI 54100
  - Software Engineering: CSCI 50600, CSCI 50700, CSCI 50900
  - Security: CSCI 55500, CSCI 57500

Students who are admitted into the program with deficiencies in CS background (because their degrees are in another discipline) must prove that the deficiencies are eliminated by the end of their qualifying process. The areas (as described in the admissions requirements) are Data Structures, Computer Architecture, and Operating Systems.

Plan of Study

- Advisory committee: Advisor + 2 or more other faculty. The students must form their advisory committee by the end of their first year.
- Overall course requirement: at least nine graduate level courses (including the two core and one specialization courses) with GPA>= 3.3. Other courses need to be 500 or 600 level courses.
  - A student receiving a grade lower than a B- in a course on the plan of study will have to repeat or replace the course. If a course is repeated, only the most recent grade, even if lower, is used to compute the current GPA.
- Policy for transferring courses from MS degree:
  - The MS courses taken in the department as part of the MS degree within the department count towards Ph.D. course requirements.
  - For students with graduate courses from another institution, the faculty will consider approving the transfer of up to 30 credits of graduate level courses from other institutions upon petition by the student. The faculty will require a copy of the syllabus for each course considered for transfer and decisions will be made on a case-by-case basis. Final approval of the course transfers will be made by the IUPUI Graduate Office. The courses on the plan of study cannot have been used to satisfy requirements for an undergraduate degree nor can they cause the student's doctoral plan of study to include courses from more than one master's program.

Preliminary Exam

- Students must pass a preliminary examination that tests competence in the student's research area and readiness for research on a specific problem. The content of the examination is at the discretion of the examining committee. Typically, the examination includes a proposal of thesis research, the student's preliminary research results, an oral presentation by the student on his/her thesis proposal, and any other relevant material if requested by the examining committee. The form and content of the examination will be determined by the examination committee and will be communicated to the student by the committee chair, which normally is the student's advisor.
- The examining committee consists of the student's Advisory Committee, and of an additional member, who is not on the advisory committee, who is determined by the Graduate Committee Chair.

- The examination must be taken at least two semesters before the final examination of the thesis. It is advised, however, that the student take the preliminary exam by the end of the third semester following the one in which the student completes the qualifying process.

Thesis and Final Exam/Defense

- The thesis must present new results worthy of publication.
- The student must defend the thesis publicly and to the satisfaction of the Examining Committee.
- The Examining Committee consists of the Advisory Committee and one additional faculty member representing an area outside that of the thesis and who is assigned by the Graduate Committee Chair.
- The students can only defend their thesis after at least two semesters following the completion of the preliminary exam. The thesis defense should be completed by the end of the fourth semester following the one in which the student passes the preliminary examination. The Graduate Committee may grant extensions.

Annual Reviews

Each doctoral student's academic and research progress is evaluated annually by their advisory committee. Students receive written feedback and guidance to support their progress.

Computer and Information Science Ph.D. Minor

The objective of this minor is to provide an opportunity for current Indiana University doctoral students in other disciplines at IUPUI to learn and use computer science techniques and tools to solve problems in their academic fields.

Eligibility

If you are enrolled in any Indiana University doctoral program at IUPUI, you may apply for this Ph.D. minor.

You are required to have a background in computer science of at least CSCI 36200 - Data Structures, or an equivalent course. Please contact our graduate advisor for permission to register for courses.

Requirements

The minor will require coursework totaling 12 graduate credit hours at the 500 level or above. These must include one 3-credit hour core course, and three elective computer science courses. Additional courses at the 500 level or above may be substituted for elective courses, with advance approval.

Core courses

- CSCI 50300 - Operating Systems
- CSCI 56500 - Programming Languages
- CSCI 58000 - Algorithm Design, Analysis, and Implementation

Elective courses

- CSCI 50600 - Management of the Software Development Process
- CSCI 54100 - Database Systems
- CSCI 54900 - Intelligent Systems
- CSCI 55000 - Computer Graphics
- CSCI 55200 - Advanced Graphics & Visualization
- CSCI 55500 - Cryptography
- CSCI 57300 - Data Mining

Minimum overall GPA

Successful completion of the minor requires at least a B (3.0) average over all courses counting toward the mior. The minimum grade that will be accepted in any single course is C. If you receive a C- or below, you must repeat the course.

Maximum number of transferable credits

If you have earned credits for one or more of the equivalent courses from another institution, you may request to apply up to a maximum of three credits toward the minor.

Maximum time for completion

All requirements for the minor must be completed within four calendar years.

Allowable credit hours prior to admission

Up to six equivalent credit hours taken prior to admission into the minor program may be applied toward the minor. Up to three of these may be from another institution.

For inquires about the Ph.D. minor, please contact our graduate advisor or email csgrad@iupui.edu.

Department of Earth Sciences

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Interim Department Chair: Andrew Barth, Ph.D.

Department Advisors:

- Graduate Programs: Broxton Bird, Ph.D.
- Undergraduate Programs: Jennifer Nelson

Geology is the study of the planet Earth: the materials of which it is made, the processes that act upon these materials, and the history of the planet and life forms since its origin. Geology considers the physical forces acting on the earth, the chemistry of its constituent materials, and the biology of its past inhabitants. Geology also includes the study of the interrelationships in the modern environment of humans and geological phenomena and focuses on such important concerns as how our global climate is changing and how that change will affect human activities.

The Department of Earth Sciences offers the Bachelor of Arts (B.A.) degree in Geology and Bachelor of Science (B.S.) degrees in Geology and in Environmental Science from Indiana University. These programs prepare students for graduate studies and for a variety of careers with emphasis on investigation of the environment by federal and state agencies, industries, and consulting companies, or earth and space science education. The programs allow flexibility to accommodate the needs and interests of

all students. Selection of a particular program should be made in consultation with a departmental advisor.

Minors in Geochemistry, Geology and Environmental Science are available to supplement other campus, school, and department major programs. Minors allow for in-depth study of concepts to complement another degree program, or to pursue interests.

The Department of Earth Sciences offers graduate study leading to the Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees granted by Indiana University. The M.S. program in Geology offers both thesis and non-thesis options. The Ph.D. program in Applied Earth Sciences is an interdisciplinary research training program involving students and faculty from the IUPUI Schools of Science, Liberal Arts, and Medicine.

Faculty and students of the Department of Earth Sciences are actively engaged in basic and applied research. Specific research areas include biogeochemistry, biomineralization, glacial geology, geochemistry, geomicrobiology, history of geology, hydrology, mineralogy, paleoceanography, paleoclimatology, paleontology, petrology, remote sensing and planetary geology, sedimentology and soil biogeochemistry.

- Bachelor of Arts
- Bachelor of Science
- Graduate Programs
- Minors

Bachelor of Arts in Geology

(Granted by Indiana University)

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with less than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied by ENG-W270, ENG-W231, ENG-W230 or ENG-W350. GEOL-G205 may satisfy the second writing requirement in Area I, but the 3 credit hours cannot then also be counted as part of the geology credit hours required in Area IV.

Area II World Language Competency First-year proficiency in a modern world language is required for the Bachelor of Arts degree program. See the School of Science requirements under “Undergraduate Programs” in this bulletin.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies See the School of Science requirements under “Undergraduate Programs” in this bulletin. For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency See the School of Science requirements under “Undergraduate Programs” in this bulletin, but all four courses must include laboratories; two of the four courses must include CHEM-C105 / CHEM-C125 and CHEM-C106 / CHEM-C126 and at least one of the four courses must be in biological sciences. No grade below C- will be accepted in any of these courses.

Area IIID Analytical Reasoning Competency MATH 15300 / MATH 15400 or MATH 15900 and CSCI-N207 or another CSCI course approved by the Department of Earth Sciences. No grade below C- will be accepted in any of these courses.

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as an elective.

Area IV Geology Concentration Requirements GEOL-G110, GEOL-G120, GEOL-G205 (or 300-level or 400-level GEOL-G course if GEOL-G205 is used as a second composition course), GEOL-G335, GEOL-G221, GEOL-G222, GEOL-G334, three 300-level or higher geology courses, and a capstone course (GEOL-G420, GEOL-G460, or GEOL-G495). Thirty-nine (39) credit hours in GEOL-G course work required. Geology majors cannot earn credit for both GEOL-G221/GEOL-G222 and GEOL-G306. Other 100-level courses and 1 - 2 credit courses do not count toward the geology concentration, but may be applied as electives toward the university-required total of 120 credit hours. No grade below C- will be accepted in any of these courses.

Other Requirements

See the School of Science requirements under Undergraduate Programs, Baccalaureate Degree, General Requirements in this bulletin. Three credit hours of GEOL-G420, GEOL-G460, or GEOL-G495 may be used to satisfy the School of Science capstone requirement, with approval by the Department of Earth Sciences.

Bachelor of Arts Sample Program (120 cr. required)

Freshman Year

First Semester	
SCI-I120 Windows on Science	1
GEOL-G110 Physical Geology	3
GEOL-G120 Physical Geology Laboratory	1
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
ENG-W131 Reading, Writing and Inquiry	3
MATH 15300 Algebra and Trigonometry I	3
Total	**16**
Second Semester	
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 15400 Algebra and Trigonometry II	3

COMM-R110 Fundamentals of Speech Communication	3
CSCI-N207 or other approved computer course	3
Elective (GEOL-G130 course suggested)	1
Total	**15**

Sophomore Year

Third Semester	
Second Composition Course (GEOL-G205 recommended)	3
GEOL-G221 Introductory Mineralogy	5
Approved Biology course with laboratory	5
Arts and Humanities (choose from list)	3
Total	**16**
Fourth Semester	
GEOL-G335 Evolution of the Earth and Life	4
GEOL-G222 Petrology	5
Approved Science course with laboratory	5
Elective (GEOL-G130 recommended)	1
Total	**15**

Junior Year

Fifth Semester	
GEOL-G300/GEOL-G400 elective	3
GEOL-G334 Principles of Sedimentation and Stratigraphy	5
Social Sciences Course (choose from list)	3
World Language Course	4
Total	**15**
Sixth Semester	
GEOL-G300/GEOL-G400 elective	3
Arts & Humanities or Social Sciences (choose from list)	3
World Language Course	4
Electives	5
Total	**15**

Senior Year

Seventh Semester	
GEOL-G300/GEOL-G400 electives	3
World Language Course	4
Elective	3
Elective	3
Elective	3
Total	**16**
Eighth Semester	
GEOL-G300/GEOL-G400 elective	3
Geology Capstone Course	3
Elective	3
Elective	3
Total	**12**

Bachelor of Science in Geology

(Granted by Indiana University)

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with less than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied by ENG-W270, ENG-W231, ENG-W230 or ENG-W350. GEOL-G205 may satisfy the second writing course requirement in Area I, but the 3 credit hours cannot then also be counted as part of the geology credit hours required in Area IV and another GEOL-G course must be taken.

Area II World Language Competency No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies See the School of Science requirements under “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency CHEM-C105 / CHEM-C125, CHEM-C106 / CHEM-C126; PHYS-P201 / PHYS-P202; BIOL-K341 / BIOL-K342; and two Life and Physical Science courses or certain geography courses (see advisor), outside the Department of Earth Sciences at the 300 or 400-level approved by the Department of Earth Sciences. No grade below C- will be accepted in any of these courses.

Area IIID Analytical Reasoning Competency MATH 22100 / MATH 22200; CSCI-N207 or another CSCI course approved by the Department of Earth Sciences; and STAT 30100 or another statistics course approved by the Department of Earth Sciences. No grade below C- will be accepted in any of these courses.

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as an elective.

Area IV Geology Concentration Requirements GEOL-G110, GEOL-G120, GEOL-G205 (or GEOL-G 300 level or GEOL-G400 level course if GEOL-G205 is used as a

second composition course), GEOL-G335, GEOL-G221, GEOL-G222, GEOL-G334, GEOL-G323, 12 credits of 300-level or 400-level geology courses, and GEOL-G420 or another field camp of at least 3 credit hours approved by the Department of Earth Sciences. Forty-six (46) credit hours in GEOL-G course work required. Geology majors cannot earn credit for both GEOL-G221/GEOL-G222 and GEOL-G306. Other 100-level courses, and 1 - 2 credit courses do not count toward the geology concentration requirement, but may be applied as electives toward the university-required total of 120 credit hours. No grade below C- will be accepted in any of these courses.

Other Requirements See the School of Science requirements under Undergraduate Programs, Baccalaureate Degree, General Requirements in this bulletin. GEOL-G420 satisfies the School of Science capstone requirement.

Bachelor of Science Sample Program (120 cr. required)

Freshman Year	
First Semester	
SCI-I120 Windows on Science	1
GEOL-G110 Physical Geology/GEOL-G120 Laboratory	4
ENG-W131 Reading,Writing & Inquiry I	3
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
Arts & Humanities Course (choose from list)	3
Total	**16**
Second Semester	
COMM-R110 Fundamentals of Speech Communication	3
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 22100 Calculus for Technology I	3
CSCI-N207 or other approved computer course	3
Total	**14**

Sophomore Year	
Third Semester	
Second Composition Course (GEOL-G205 recommended)	3
GEOL-G221 Introductory Mineralogy	5
MATH 22200 Calculus for Technology II	3
Social Sciences Course (choose from list)	3
Total	**14**
Fourth Semester	
PHYS-P201 General Physics I	5
GEOL-G222 Introductory Petrology	5
GEOL-G335 Evolution of Earth and Life	4
STAT 30100 Elementary Statistical Methods	3
Total	**17**

Junior Year	
Fifth Semester	
PHYS-P202 General Physics II	5
GEOL-G323 Structural Geology	5
GEOL-G334 Sedimentology and Stratigraphy	5
Total	**15**
Sixth Semester	
BIOL-K341 Ecology and Evolution Lecture/BIOL-K342 Laboratory	5
GEOL-G300/GEOL-G400 elective	3
300-400 level Science or Geography course	3
Elective	3
Total	**14**

Senior Year	
Seventh Semester	
GEOL-G300/GEOL-G400 elective	3
GEOL-G300/GEOL-G400 elective	3
Arts & Humanities or Social Sciences (choose from list)	3
Cultural Understanding Course (choose from list)	3
Elective	3
Total	**15**
Eighth Semester	
GEOL-G300/GEOL-G400 elective	3
GEOL-G300/GEOL-G400 elective	3
300-400 level Science or Geography course	3
Elective	3
GEOL-G420 Regional Geology Field Trip (Summer)	3
Total	**15**

Minors

(Granted by Indiana University)

Minor in Geology

The undergraduate minor in geology requires 18 credit hours, with an overall grade point average of 2.0 (C) and with no grade less than a C-, distributed as follows:

- Students must complete the following four courses that total 12 credit hours: GEOL-G110 (3 cr.), GEOL-G120 (1 cr.), GEOL-G335 (4 cr.), and GEOL-G221 (4 cr.) or GEOL-G306 (4 cr.).
- Students must complete an additional 6 credit hours minimum, including two of the following courses: GEOL-G222 (4 cr.), GEOL-G304 (3 cr.), GEOL-G334 (4 cr.), GEOL-G406 (3 cr.), GEOL-G415 (3 cr.), GEOL-G430 (4 cr.), GEOL-G451 (3 cr.), or another 400-level geology course with departmental approval.

At least 9 credit hours of the minor must be taken at IUPUI. In addition, recommended courses include one year of college chemistry and at least one course in college algebra.

Minor in Geochemistry

The undergraduate minor in geochemistry requires five courses that total 15 credit hours, with an overall grade point average of 2.00 (C) and with no grade less than a C, distributed as follows:

At least three courses (9 credit hours) are geology courses chosen from the following: GEOL-G406, GEOL-G483, GEOL-G486, and GEOL-G488.

A maximum of two courses/course sequences may be chosen from the following: CHEM-C310/CHEM-C311, CHEM-C341, CHEM-C360, CHEM-C361, CHEM-C410/CHEM-C411, BIOL-K411.

At least 9 credit hours of the minor must be taken at IUPUI. Prerequisites to the minor courses are not included but are required in order to complete the minor. This information can be found in the School of Science bulletin. Additional recommended courses include one year of college chemistry and at one course in college algebra.

Minor in Environmental Science

A minor in Environmental Science requires satisfactory completion of 16-17 credit hours distributed as follows, with a minimum grade of C- in each course. At least 9 credits must be completed at IUPUI (this does not include transfer credit, AP, or CLEP credit).

- GEOL-G107 (3 cr.)
- GEOL-G117 (1 cr.)
- GEOL-G115 or GEOL-G132 (3 cr.)
- GEOL-G306 (4 cr.)
- Choose one (3 cr.) SPEA-V222, SPEA-V311, GEOG-G303, PBHL-A435, SPEA-E476
- Choose one (2-3 cr.): GEOL-G436, GEOL-G477, GEOL-G467, GEOL-G415, or GEOL-G420 British Virgin Islands Experiential Field Study

At least 9 credit hours of the minor must be taken at IUPUI. In addition, recommended courses include one year of college chemistry and at least one course in college algebra.

Graduate Programs

Master of Science in Geology

The Department of Earth Sciences graduate program leads to a Master of Science degree from Indiana University. The program is administered by a departmental graduate advisory committee, composed of the graduate advisor and two or more members of the graduate faculty.

Admission Requirements

Prospective students should have a bachelor's degree in geology, including a summer field course, and a minimum of a B (3.0) average in geology courses. One year of chemistry and mathematics through college algebra and trigonometry are required. Individuals with a bachelor's degree in another area of science are also encouraged to apply; the departmental graduate advisory committee will prescribe a plan of study to remove deficiencies. The Graduate Record Examination (GRE) General Test is required. Each student must submit three letters of recommendation.

Financial Aid

Admitted students may be appointed as research assistants or as teaching assistants in introductory geology courses. Several such assistantships are available each year. Assistantships include remission of tuition and fees.

Degree Requirements

Both thesis and non-thesis MSc degree options are available. *The thesis option* requires 30 credit hours of total course work. Of the 30 credit hours, 21 to 24 are comprised of non-research course work and 6 to 9 are comprised of G810 Research credits. 1 credit of colloquium is required. At least 6, but no more than 9 credits of G810 Research credits shall be counted toward the 30 total credit hours for the MSc thesis option, although more may be taken. Of the non-research course work, 15 to 21 credit hours shall be completed within the department. At least 3 credit hours, and up to 6, of non-research course work approved at the graduate level must be taken outside of the department from allied disciplines with the approval of the graduate advisor. Up to 6 credit hours of 400-level courses approved for graduate credit may be counted toward the 15 to 24 credit hours of non-research course work with the approval of the graduate advisor. Up to 6 credit hours of G700 credits may be counted toward the non-research course work requirements. *The non-thesis option* requires a total of 36 credit hours, none of which are to be taken as G810 Research. Of the 36 credit hours, 24 to 33 are to be completed within the department. 3 to 6 of the in-department course work credit hours must be completed as G700 Geologic Problems. At least 3, and up to 12, credit hours of non-research courses approved at the graduate level must be taken outside of the department from allied disciplines with the approval of the graduate advisor. The departmental graduate committee must approve elective credits outside the Department of Earth Sciences for both the thesis and non-thesis options.

MSc Degree Option	In Department Credit Hours	Outside of Department Credit Hours	G810 Research Credit Hours	G700 Geologic Problems Credit Hours	Total Credit Hours
Thesis	15-21	3-6	6-9	0-6	30
Non-Thesis	24-33	3-12	0	3-6	36

Admitted students will be assigned a three-person advisory committee at the beginning of the first year of graduate study. The committee will prescribe a study program based on the interests of the student and the principal graduate advisor. Students must complete all degree requirements within five years of beginning the study program. Students must maintain a B (3.0) average or higher, and no grade below C is acceptable.

Bachelor of Science/Master of Science in Geology

Program Structure and Admission

The B.S./M.S. program blends the undergraduate BS program with the MS program in Geology, leading to a joint award of B.S. and M.S. degrees upon completion of the M.S. thesis. The departmental graduate advisory committee administers the B.S./M.S. program in cooperation with the undergraduate advisor.

Prospective students should have advanced standing in the undergraduate program. Students will apply to the Earth Sciences graduate program in early spring of the junior year under consultation of the undergraduate advisor. Students should submit three letters of recommendation. Application requires a minimum GPA of 3.0 and will be considered by the departmental graduate committee.

Upon acceptance into the program, the student will prepare an M.S. research and course plan in consultation with a B.S./M.S. academic advisor, or will elect to complete a non-thesis (coursework) M.S. degree. Research reading and data collection begins in the summer prior to the senior year of undergraduate study, and will be completed in the following summer. The fifth year of study is devoted to graduate course work and completion of the M.S. thesis research, or M.S. non-thesis coursework.

Degree Requirements

The proposed curriculum includes the core undergraduate courses that are currently required for the B.S. in Geology, and all the graduate courses that are currently required for the M.S. in Geology. The total credit hours for this integrated degree program will be 138 credit hours for a thesis M.S., and 147 credit hours for a non-thesis M.S.

For reference, the B.S. Geology degree requires 120 hours, and the M.S. Geology degree requires 30 hours for a thesis M.S., and 36 hours for a non-thesis M.S. The integrated program utilizes overlap credits, reducing the number of required credit hours by 12 hours for students pursuing a thesis M.S., and by 9 hours for students pursuing a non-thesis (coursework) M.S.

- For thesis M.S.: GEOL-G700 Geologic Problems (3 cr.), is taken in the Summer after the senior year, to develop a research project for the M.S. degree.
- For non-thesis M.S.: GEOL-G690 Advanced Geology Seminar (3 cr.), is taken with a faculty member in the Earth Sciences department to explore a research focus.
- Two 400-level or higher GEOL-G courses (6 cr.) satisfy both the B.S. Geology major course requirements, and 6 credits of the M.S. Geology graduate coursework requirements.
- For a thesis M.S., two 500-level or higher GEOL-G courses (6 cr.) satisfy both the B.S. Geology major concentration requirements, and M.S. Geology graduate coursework requirements.
- For a non-thesis M.S., one 500-level or higher GEOL-G course (3 cr.) satisfies both the B.S. Geology major concentration requirements, and M.S. Geology graduate coursework requirements.

Doctor of Philosophy in Applied Earth Sciences

The Ph.D. program prepares students for academic positions or research and leadership positions in local, state, national, or private environmental organizations. The goal of the program is to prepare future researchers and leaders who assess complex environmental systems and assist in providing sound options and solutions for optimizing human-environment interactions.

Admission Requirements

Prospective students should have a B.S. or M.S. degree in the physical, biological, or health sciences, and a cumulative GPA of 3.0 or higher is expected. The Graduate Record Examination (GRE) General Test is required. Individuals for whom English is a second language must demonstrate proficiency in English. Scores from the TOEFL exam should be submitted with the application for admission. Each student must submit three letters of recommendation.

Degree Requirements

Upon admittance to the program, students are assigned a preliminary advisory committee from among program faculty. Students identify an appropriate sub-discipline after their first year, and the preliminary advisory committee is reconstituted into a research committee (5 members) to suit the research goals of the student. The research committee includes at least three faculty members from the department of Earth Sciences and the minor advisor (who must be outside the department of Earth Sciences). In order to maintain proper balance in the expertise represented in the research committee, the graduate advisor can petition the Graduate Affairs committee to replace one Earth Sciences faculty with an external member. If not an IU-affiliated faculty, that external member must be approved by the University Graduate School. The research advisory committee ensures successful progress in later coursework, coordinates oral qualifying exams, and advises students in their progress to degree completion as appropriate. Students will complete four or five core graduate courses in applied earth science topical areas, based on their prior academic background. After completing the core courses,

students identify a specialization area and enroll in at least 18 credit hours of additional courses in support of that specialization, with consultation of the research advisory committee. Because of the interdisciplinary nature of the program and the diverse academic background of admitted students, all students are required to take the common core class, "Applied Earth Sciences: The Human Dimension". The advisory committee may recommend one more fundamental earth sciences course to address deficiencies. All Ph.D. students must also complete a minor which is composed of 12 to 15 credit hours of coursework in a related area. The minor is chosen in consultation with the research committee. Students must complete all degree requirements within six years of beginning the study program, and must maintain a B (3.0) average.

Environmental Science Program

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- **Director:** Gabriel Filippelli, Ph.D.
- **Program Advisor:** Jennifer Nelson

Bachelor of Science in Environmental Science

The Bachelor of Science of Environmental Science (BSES) degree is awarded by Indiana University. This program prepares students for graduate studies and for a variety of careers with emphasis on investigation of the environment by federal and state agencies, industry, and consulting firms. The program allows flexibility to accommodate the needs and interests of all students.

Faculty and students in the Departments of Earth Sciences (Science), Geography (Liberal Arts), and the Fairbanks School of Public Health are actively engaged in basic and applied research. Specific research areas include geochemistry, hydrology, paleoclimatology, biogeochemical cycles, soils, wetland restoration, water resource analysis, environmental remote sensing, land cover dynamics, urban ecosystems, human health and the environment, environmental and water resources planning, environmental health policy, food science, and indoor air quality.

The Bachelor of Science in Environmental Science degree program offers three concentrations. The Earth and Water Resources concentration provides students with a quantitative background in soils, hydrogeology, and biogeochemistry and an understanding of biological interactions, processes affecting soil and water resources, and advanced analytical techniques related to environmental quality assessments. The Environmental Remote Sensing and Spatial Analysis concentration builds theoretical background and advanced knowledge in spatial analytical techniques using remote sensing (satellite and airborne sensors), geographic information systems (GIS), and global positioning system (GPS) technologies.The Environmental Management concentration prepares students who wish to focus on the management of pollution in the air, land, and water. Students who complete this concentration have the theoretical foundation and applied skills needed to characterize hazards, track the fate and transport of pollutants, identify health and environmental effects of pollutants, and plan and manage programs to control environmental hazards. The Environmental Remote Sensing and Spatial Analysis concentration builds theoretical background and advanced knowledge in spatial analytical techniques using remote sensing (satellite and airborne sensors), geographic information system (GIS), and global positioning system (GPS) technologies. Selection of a particular concentration should be made in consultation with the academic and concentration advisors.

- Bachelor of Science in Environmental Science

Bachelor of Science in Environmental Science

(Granted by Indiana University)

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows in Science (1 cr.) or an equivalent first-year experience course. BS Environmental Science students are encouraged to take the Themed Learning Community (TLC) SCI-BE499 Sustainabilty - Thriving Communities, Thriving Planet, which includes SCI-I120, GEOL-G107, and SPEA-V222.

Area I English Composition and Communication Competency (9 cr.) See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied by ENG-W230, TCM 22000 or TCM 32000. GEOL-G205 may be used to fulfill the second writing course requirement, but the 3 credit hours cannot then also be counted as part of the core and concentration credit hours required in Area IV.

Area II World Language No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.) See the School of Science requirements under “Undergraduate Programs” in this bulletin. If a student chooses to take the SCI-BE499, Sustainability TLC, SPEA-V222 will count as one Social Science course.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency (26 cr.) BIOL-K341 / BIOL-K342, CHEM-C105 / CHEM-C106, CHEM-C341 / CHEM-C343, and PHYS-P201 / PHYS-P202. No grade below C- will be accepted in any of these courses.

Area IIID Analytical Reasoning Competency (12 cr.) MATH 22100 / MATH 22200, or MATH 23100 / MATH 23200 or MATH 16500 / MATH 16600, CSCI-N207 or another CSCI course approved by the Department of Earth Sciences; and STAT 30100, SPEA-K300, or a

course in statistics approved by the Department of Earth Sciences. No grade below C- will be accepted in any of these courses.

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as an elective.

Area IV Major Core and Concentration Requirements
Thirty-two (32) credit hours of environmental science core courses including:

- GEOL-G107 / GEOL-G117 Environmental Geology Lecture and Laboratory
- GEOL-G205 Reporting Skills in Geoscience (or 300+ GEOL, PBHL, SPEA, or GEOG with approval if G205 is used as the second composition course.
- GEOG-G208 Environment & Society or PBHL-A115 Environment and Human Health
- PBHL-P237 Environmental Ethics
- GEOG-G303 Weather and Climate
- GEOL-G306 Earth Materials
- GEOL-G436 Earth Observation from Space
  - OR GEOL-G477 Climate Change and Society
- GEOG-G315 Environmental Conservation or SPEA-V311 Natural Resources and Environmental Policy
- HIST-A410 American Environmental History

No grade below C- will be accepted in any of these courses.

Concentration Requirements Seventeen to Eighteen (17 - 18) credit hours of courses within one of three Environmental Science concentrations. Students select one of the Environmental Science Concentrations – Earth and Water Resources, Environmental Remote Sensing and Spatial Analysis, or Environmental Management.

A. Earth and Water Resources Seventeen (17) credit hours, including:

- GEOL-G334 Sedimentology and Stratigraphy
- GEOL-G430 Principles of Hydrology
- GEOL-G406 Introduction to Geochemistry

One (1) concentration elective course, chosen from the following:

- GEOL-G486 Soil Biogeochemistry
- GEOL-G483 Isotope Geochemistry
- BIOL-K411 Global Change Biology
- GEOL-G415 Geomorphology
- Other applicable topic courses in GEOL-G as approved by advisor

One (1) capstone course, chosen from the following

- GEOL-G488 Global Cycles
- GEOL-G467 GeoHealth; When our Health Collides with our Environment
- GEOL-G460 Internship
- GEOL-G495 Senior Thesis

No grade below C- will be accepted in any courses in the Earth and Water Resources concentration.

B. Environmental Remote Sensing and Spatial Analysis Eighteen (18) credit hours, including

- GEOL-G338 Introduction to GIS
- GEOG-G336 Environmental Remote Sensing or GEOG-G338 Geographic Information Science
- GEOG-G337 Computer Cartography and Graphics or GEOL-G415 Geomorphology
- Two (2) courses chosen from:
  - GEOG-G436 Advanced Remote Sensing
  - GEOG-G438 Advanced Geographic Information Science
  - GEOL-G487 Remote Sensing of Global Change
  - GEOG-G311 Research Methods in Geography
- One capstone course, chosen from the following
  - GEOG-G439 GIS and Environmental Analysis
  - GEOL-G460 Internship
  - GEOL-G495 Senior Thesis

No grade below C- will be accepted in any courses in the Environmental Remote Sensing and Spatial Analysis concentration.

C. Environmental Management Seventeen (17) credit hours, including:

- PBHL-A316 Environmental Health Science
- SPEA-E476 Environmental Law and Regulation
- One (1) course in Spatial Analysis, chosen from the following:
  - GEOG-G338 Introduction to GIS
  - GEOG-G438 Advanced GIS
  - GEOG-G439 GIS and Environmental Analysis
  - PBHL-A441 Public Health Applications of GIS
- Two (2) concentration elective courses, chosen from the following:
  - PBHL-A435 Energy, Climate Change, Resilience and Health
  - PBHL-A415 Explosions, Collapses, and Toxic Spills
  - PBHL-A430 eWaste, Toxic Matreials and Conflict Minerals
  - PBHL-A445 Global Health and Sustainable Development
  - SPEA-V311 Natural Resources and Environmental Policy
  - GEOG-G315 Environmental Conservation
  - SPEA-V310 Environmental Justice
- One (1) capstone course, chosen from the following:
  - GEOL-G488 Global Cycles
  - GEOL-G467 GeoHealth: When our Health Collides with our Environment
  - GEOL-G460 Internship
  - GEOL-G495 Senior Thesis

No grade below C- will be accepted in any courses in the Environmental Management concentration.

D. Other Requirements See the School of Science requirements under “Undergraduate Programs,

Baccalaureate Degree, General Requirements" in this bulletin.

Environmental Science Plans of Study

There is no single semester-by-semester plan of study for the B.S.E.S. degree because of the flexibility encouraged within the program and the three concentration options. However, a possible plan for courses is given below. Variations from this sample plan of study should be made in consultation with the academic and concentration advisors.

Bachelor of Science Environmental Science Sample Programs (120 hours required)

Sample Plan of Study

- **Freshman Year**

First Semester	
SCI-BE499 Sustainability TLC (GEOL-G107, SPEA-V222, SCI-I120)	7
GEOL-G117 Laboratory: Earth and Our Environment	1
CHEM-C105 Principles of Chemistry I	3
ENG-W131 Reading, Writing and Inquiry	3
1 credit elective	1
Total	**15**
Second Semester	
CHEM-C106 Principles of Chemistry II	3
GEOG-G208 Environment & Society or PBHL-A115 Environment & Human Health	3
Calculus I	3
COMM-R110 Fundamentals of Speech Communication	3
Culutural Understanding Course	3
Total	**15**

Sophomore Year

Third Semester	
GEOL-G205 Reporting Skills in Geoscience (as 2nd composition course)	3
PBHL-P237 Environmental Ethics	3
Calculus 2	3
CSCI-N207 Data Analysis Using Spreadsheets	3
GEOG-G303 Weather and Climate	3
Total	**15**
Fourth Semester	
GEOL-G306 Earth Materials	4
PHYS-P201 Physics 1	5
Social Science or Arts and Humanities Course	3
Arts and Humanities Course	3
Total	**15**

Junior Year - EARTH AND WATER RESOURCES CONCENTRATION

Fifth Semester	
GEOL-G334 Sedimentology and Stratigraphy	5
BIOL-K341 Principles of Ecology and Evolution Lecture	3
BIOL-K342 Principles of Ecology and Evolution Lab	2
PHYS-P202 Physics 2	5
1 credit elective	1
Total	**16**
Sixth Semester	
GEOL-G477 Climate and Society	3
CHEM-C341 Organic Chemistry I Lecture	3
CHEM-C343 Organic Chemistry I Lab	2
SPEA-V311 or GEOG-G335	3
Upper Level GEOL, GEOG, SPEA, or PBHL elective (replace GEOL-G205 as 2nd composition)	3
Total	**14**

Senior Year - EARTH AND WATER RESOURCES CONCENTRATION

Seventh Semester	
STAT 30100 or SPEA-K300	3
GEOL-G430 Hydrology	3
GEOL-G436 Earth Observation from Space	3

GEOL-G406 Geochemistry	3
Elective	3
Total	**15**
Eighth Semester	
Concentration Elective	3
Concentration Capstone	3
HIST-A410 American Environmental History	3
Electives	6
Total	**15**

Junior Year - REMOTE SENSING CONCENTRATION

Fifth Semester	
BIOL-K341 Principles of Ecology & Evolution Lecture	3
BIOL-K342 Principles of Ecology & Evolution Lab	2
PHYS-P202 Physics 2	5
GEOG-G338 Introduction to GIS	3
GEOG-G336 Introduction to Remote Sensing	3
Total	**16**
Sixth Semester	
CHEM-C341 Organic Chemistry I Lecture	3
CHEM-C343 Organic Chemistry I Lab	2
GEOL-G477 Climate and Society	3
SPEA-V311 or GEOG-G315	3
GEOG-G337 or GEOL-G415	3
Total	**14**

Senior Year - REMOTE SENSING CONCENTRATION

Seventh Semester	
STAT 30100 or SPEA-K300	3
Concentration Elective	3
GEOL-G436 Earth Observation from Space	3
Electives	6
Total	**15**
Eighth Semester	
Concentration Elective	3
Concentration Capstone	3
HIST-A410 American Environmental History	3
Upper Level GEOL, GEOG, SPEA, or PBHL elective (replace GEOL-G205 as 2nd composition)	3
Elective	3
Total	**15**

Junior Year - ENVIRONMENTAL MANAGEMENT CONCENTRATION

Fifth Semester	
BIOL-K341 Principles of Ecology and Evolution Lecture	3
BIOL-K342 Principles of Ecology and Evolution Lab	2
PHYS-P202 Physics 2	5
SPEA-E476 Environmental Law and Regulation	3
PBHL-A316 Environmental Health Science	3
Total	**16**
Sixth Semester	
CHeM-C341 Organic Chemistry I Lecture	3
CHEM-C343 Organic Chemistry I Lab	2
GEOL-G477 Climate and Society	3
SPEA-V311 or GEOG-G315	3
Concentration Elective	3
Total	**14**

Senior Year - ENVIRONMENTAL MANAGEMENT CONCENTRATION

Seventh Semester	
SPEA-K300 or STAT 30100	3
Concentration Elective (Spatial Analysis)	3
GEOL-G436 Earth Observation from Space	3
Elective	3
Elective	3
Total	**15**
Eighth Semester	
Concentration Elective	3
Concentration Capstone	3
HIST-A410 American Environmental History	3

Upper Level GEOL, GEOG, SPEA, or PBHL elective (replace GEOL-G205 as 2nd composition)	3
Elective	3
Total	**15**

Forensic and Investigative Sciences Program

IUPUI
Science Building, LD 326
402 N. Blackford Street
Indianapolis, IN 46202-3274
Phone: (317) 274-6882 (undergraduate); (317) 274-8969 (graduate); fax: (317) 274-4701
https://science.iupui.edu/forensic/

- **Director:** Christine J. Picard, Ph.D.
- **Program Advisor:** Amy Maidi, M.S.

Forensic science is the application of the methods of science to matters involving the public. In many cases this means the application of science in solving crimes. Forensic science is multidisciplinary; it involves chemistry, biology, physics, math, biochemistry, engineering, computer science, psychology, medicine, law, criminal justice, etc. Forensic scientists analyze evidence and testify in court. They may be called upon to attend some crime scenes, train police investigators and attorneys, and conduct research.

In the fall of 2004, IUPUI began the first forensic science degree program in Indiana. This FEPAC accredited program was developed by faculty from the School of Law, the School of Science, and the School of Public and Environmental Affairs (SPEA). Completion of this program leads to the Bachelor of Science in Forensic and Investigative Sciences. All students take a core of science classes and university-required courses. Then each student chooses one concentration:

- Forensic Biology
- Forensic Chemistry

The baccalaureate program also includes courses in law and forensic science, laboratory courses in forensic chemistry and biology, as well as opportunities to complete an internship or a research project with a member of the faculty. Graduates of the program will be able to seek employment in crime labs, scientific industries, environmental agencies, and federal or local law enforcement. Students are also well qualified to apply for graduate or medical school.

Admission to the Major

There are specific credit, GPA, and course requirements for admission to the FIS program. These depend upon your status. For more information about the undergraduate program, please contact: Please contact forsci@iupui.edu or 317-274-6882. For information about the graduate program please contact: fisgrad@iupui.edu or 317-274-8969.

- Bachelor of Science
- Minor in Forensic and Investigative Sciences
- Graduate Program

Bachelor of Science

This degree is for students who plan to work in the criminal justice system as scientists in crime laboratories or other law enforcement environments. This degree also allows students to be well prepared for medical school, graduate school, law school, teaching or research laboratories.

Degree Requirements

See the School of Science requirements under “Undergraduate Programs” in this bulletin for additional restrictions.

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency (9 cr.)

Written Communication (6 cr.)

A minimum grade of C must be obtained in both composition courses.

- ENG-W131 Reading, Writing and Inquiry
- The second semester of English composition may be satisfied only by ENG-W270, ENG-W231, ENG-W230, or TCM 32000.

Oral Communication (3 cr.)

A minimum grade of C must be obtained.

- COMM-R110 Fundamentals of Speech Communication

Area II World Language Competency

No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.)

- Arts and Humanities course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.
- Social Sciences course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.
- One additional course (3 cr.) from Humanities or Social Sciences list.
- Cultural Understanding course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency (20 cr.)

- *Physics* Two semesters of basic physics: PHYS-P201 General Physics I (5 cr.) and PHYS-P202 General Physics II (5 cr.)
  - *PHYS 15200 and PHYS 25100 are acceptable substitutes.*
- *Chemistry* Two semesters of introductory college chemistry with a laboratory: CHEM-C105 Principles of Chemistry I (3 cr.) / CHEM-C125 Experimental Chemistry I (2 cr.) and CHEM-C106 Principles of Chemistry II (3 cr.) / CHEM-C126 Experimental Chemistry II (2 cr.)

Area IIID Analytical Reasoning Competency (9 cr.)

- *Mathematics* MATH 23100 Calculus for the Life Sciences I (3 cr.) and MATH 23200 Calculus for the Life Sciences II (3 cr.)
  - *MATH 16500 and 16600 or MATH 22100 and 22200 are acceptable substitutes.*
  - *Students pursuing a BS in Chemistry must take MATH 16500 and 16600.*
- *Computer Programming* Choose one course from the following: CSCI-N200, CSCI-N201, CSCI-N207 recommended), CSCI-N211, or CSCI-N301 (all are 3 cr.)

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID but may count as a general elective.

Area IV Forensic and Investigative Sciences Major Concentration (17 cr.)

A) Required forensic science courses in addition to those required for the concentration (16 cr.) All FIS courses applicable to the major must have a minimum grade of C.

- FIS 20500 Concepts of Forensic Science I (Fall and SS1) (3 cr.)
- FIS 20600 Concepts of Forensic Science II (Spring and SSII) (3 cr.)
- FIS 30100 Forensic Microscopy (1 cr.)
- FIS 30101 Forensic Microscopy Lab (2 cr.)
- FIS 30500 Professional Issues in Forensic Science (3 cr.)
- FIS 41500 Forensic Science and the Law (3 cr.)
- FIS 48000 Forensic Science Professional Capstone I (Spring) (1 cr.)
- FIS 49000 Capstone Experience (Fall) (1 cr.)

B) Required biology courses (10 cr.) A minimum grade of C- is required in all of these courses.

- BIOL-K101 Concepts of Biology I (5 cr.)
- BIOL-K103 Concepts of Biology II (5 cr.)

C) Required chemistry courses beyond introductory chemistry (10 cr.) A minimum grade of C- is required in all of these courses.

- CHEM-C341 Organic Chemistry Lectures I (3 cr.)
- CHEM-C343 Organic Chemistry Laboratory I (2 cr.)
- CHEM-C342 Organic Chemistry Lectures II (3 cr.)
- CHEM-C344 Organic Chemistry Laboratory II (2 cr.)

D) Required statistics course (3 cr.) A minimum grade of C- is required in this course.

- STAT 30100 Elementary Statistical Methods (3 cr.)

E) Concentrations

- **Forensic Biology Concentration (24 cr.)**

FIS courses applicable to the major must have a minimum grade of C. A minimum grade of C- is required in all the Biology course.

- - BIOL-K322 Genetics and Molecular Biology (3 cr.)
  - BIOL-K323 Genetics and Molecular Biology Laboratory (Fall) (2 cr.)
  - BIOL-K324 Cell Biology (3 cr.)
  - BIOL-K325 Cell Biology Laboratory (Spring) (2 cr.)
  - BIOL-K384 Biological Chemistry (3 cr.)
  - FIS 40200 Forensic Biology (Fall) (3 cr.)
  - FIS 40201 Forensic Biology Laboratory (Fall) (1 cr.)
  - FIS 40300 Forensic Genetics (Spring) (3 cr.)
  - FIS 43000 Population Genetics (Spring) (3 cr.)
  - FIS 49001 Forensic Biology Practical Capstone III (Spring) (1 cr.)

F) Advanced Specialization Courses: Refer to the list below (9 cr. minimum)

- **Forensic Biology Concentration Advanced Specialization Course List**
  - ANTH-B426 Human Osteology (3 cr.)
  - ANTH-B468 Bioarchaeology (3 cr.)
  - ANTH-B474 Forensic Anthropology, Archaeology & Taphonomy (3 cr.)
  - BIOL-K331 Developmental Biology (3 cr.)
  - BIOL-K333 Developmental Biology Laboratory (2 cr.)
  - BIOL-K338 Intro Immunology (3 cr.)
  - BIOL-K339 Immunology Laboratory (2 cr.)
  - BIOL-K341 Principles of Ecology & Evolution (Fall & even numbered Springs) (3 cr.)
  - BIOL-K342 Principles of Ecology & Evolution Laboratory (Fall) (2 cr.)
  - BIOL-K356 Microbiology (3 cr.)
  - BIOL-K357 Microbiology Laboratory (2 cr.)
  - BIOL-N217 Human Physiology (5 cr.)
  - BIOL-N261 Human Anatomy (5 cr.)
  - CHEM-C310 Analytical Chemistry (3 cr.)
  - CHEM-C311 Analytical Chemistry Laboratory (1 cr.)
  - CHEM-C360 Elementary Physical Chemistry (3 cr.)
  - CHEM-C325 Introductory Instrumental Analysis (Spring) (5 cr.)
  - CHEM-C430 Inorganic Chemistry (3 cr.)
  - CHEM-C435 Inorganic Chemistry Laboratory (1 cr.)
  - CHEM-C485 Biosynthesis and Physiology (3 cr.)
  - CHEM-C486 Biological Chemistry Laboratory (2 cr.)

- FIS 40100 Forensic Chemistry I (Fall) (3 cr.)
- FIS 40101 Forensic Chemistry Laboratory I (Fall) (1 cr.)
- FIS 40400 Forensic Chemistry II (Spring) (3 cr.)
- FIS 40900 Forensic Science Research (1 - 4 cr.)
- FIS 49002 Forensic Chemistry Practical Capstone III (Spring) (1 cr.)
- FIS 49500 Forensic Science Internship (0 - 5 cr.)
- FIS 49600 Special Topics in Forensic Science (credits vary - repeatable with different topics)
- SPEA-J260 Topics in Criminal Justice (1 cr.) (ONLY topics: Death Investigation, Investigating Post Blast Crime Scene, Serial Murder, and Indiana Homicide)

- **Forensic Chemistry Concentration (19 cr.)**

FIS courses applicable to the major must have a minimum grade of C. A minimum grade of C- is required for all Chemistry courses.

- - CHEM-C310 Analytical Chemistry (3 cr.)
  - CHEM-C311 Analytical Chemistry Laboratory (1 cr.)
  - CHEM-C360 Elementary Physical Chemistry (Spring) (3 cr.)
    - CHEM-C362 is an acceptable substitute for students pursuing a BS in Chemistry.
  - CHEM-C325 Introduction to Instrumental Analysis (Spring) (5 cr.)
    - CHEM-C410 and 411 are acceptable substitutes for students pursuing a BS in Chemistry.
  - FIS 40100 Forensic Chemistry I (Fall) (3 cr.)
  - FIS 40101 Forensic Chemistry I Lab (Fall) (1 cr.)
  - FIS 40400 Forensic Chemistry II (Spring) (3 cr.)
  - FIS 49002 Forensic Chemistry Practical Capstone III (Spring) (1 cr.)

G) Advanced Specialization Courses; refer to the list below (12 cr. minimum)

- **Forensic Chemistry Concentration Advanced Specialization Course List**
  - ANTH-B426 Human Osteology (3 cr.)
  - ANTH-A474 Forensic Anthropology, Archaeology & Taphonomy (3 cr.)
  - ANTH-A468 Bio-Archaeology (3 cr.)
  - BIOL-K322 Genetics and Molecular Biology (3 cr.)
  - BIOL-K323 Genetics and Molecular Biology Laboratory (Fall) (2 cr.)
  - BIOL-K324 Cell Biology (3 cr.)
  - BIOL-K325 Cell Biology Laboratory (Spring) (2 cr.)
  - BIOL-K331 Developmental Biology (3 cr.)
  - BIOL-K333 Developmental Biology Laboratory (1 cr.)
  - BIOL-K338 Intro Immunology (3 cr.)
  - BIOL-K339 Immunology Laboratory (2 cr.)
  - BIOL-K341 Principles of Ecology & Evolution (Fall and even numbered Springs) (3 cr.)
  - BIOL-K342 Principles of Ecology & Evolution Laboratory (Fall) (2 cr.)
  - BIOL-K356 Microbiology (3 cr.)
  - BIOL-K357 Microbiology Laboratory (2 cr.)
  - BIOL-K384 Biological Chemistry (3 cr.)
  - BIOL-K484 Cellular Biochemistry (3 cr.)
  - BIOL-N217 Human Physiology (5 cr.)
  - BIOL-N261 Human Anatomy (5 cr.)
  - CHEM-C430 Inorganic Chemistry (3 cr.)
  - CHEM-C435 Inorganic Chemistry Laboratory (2 cr.)
  - CHEM-C384 Biochemistry (3 cr.)
  - CHEM-C485 Biosynthesis and Physiology (3 cr.)
  - CHEM-C486 Biological Chemistry Laboratory (2 cr.)
  - FIS 40200 Forensic Biology I (Fall) (3 cr.)
  - FIS 40201 Forensic Biology I Laboratory (Fall) (1 cr.)
  - FIS 40300 Forensic Biology II (Spring) (3 cr.)
  - FIS 40900 Forensic Science Research (1 - 4 cr.)
  - FIS 43000 Population Genetics (Spring) (3 cr.)
  - FIS 49001 Forensic Biology Practical Capstone III (Spring) (1 cr.)
  - FIS 49500 Forensic Science Internship (0 - 5 cr.)
  - FIS 49600 Special Topics in Forensic Science (credits vary - repeatable with different topics)
  - SPEA-J260 Topics in Criminal Justice (1 cr.) (approved topics are: Death Investigation, Investigating Post Blast Crime Science, Serial Murder, and Indiana Homicide)

Area V Electives This degree requires no electives not defined by degree requirements.

Additional Policies

1) Overlapping Courses

The Forensic and Investigative Sciences Program will not grant credit for a course when considerable duplication of course content occurs with another course that has been taken for credit. In general, credit will be allowed for the higher-level or Honors courses, but not for the lower-level courses. The following listings are considered to be duplications (lower-level courses listed first):

- CHEM-C101 and CHEM-C105
- MATH 22100 / MATH 22200 and MATH 23100 / MATH 23200 and MATH 16500 / MATH 16600
- PHYS-P201 / PHYS-P202 and PHYS 15200 and PHYS 25100

For example, if a student has earned credit for MATH 16500 / MATH 16600, the student will receive no credit for MATH 22100 / MATH 22200, even if earned previously.

As a result of completing a Bachelor of Science in Forensic and Investigative Sciences and depending on the concentration selected, a student may earn enough credit

hours to satisfy the requirements for a minor in chemistry or biology in addition to the major in FIS. Please consult with the academic advisor for the FIS program and the appropriate academic unit that awards the minor.

Bachelor of Science: Forensic and Investigative Sciences Forensic Biology Concentration Sample Plan of Study (124 cr.)

Freshman Year

First Semester	
BIOL-K101 Concepts of Biology I	5
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 23100 Calculus for the Life Sciences I	3
FIS 20500 Concepts of Forensic Science I	3
SCI-I120 Windows on Science	1
Total	**17**
Second Semester	
BIOL-K103 Concepts of Biology II	5
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 23200 Calculus for the Life Sciences II	3
FIS 20600 Concepts of Forensic Science II	3
Total	**16**

Sophomore Year

Third Semester	
ENG-W131 Reading, Writing and Inquiry	3
BIOL-K322 Genetics and Molecular Biology	3
BIOL-K323 Genetics and Molecular Biology Lab (Fall only)	2
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
Cultural Understanding (choose from list)	3
Total	**16**
Fourth Semester	
COMM-R110 Fundamentals of Speech Communication	3
CHEM-C342 Organic Chemistry II	3
CHEM-C344 Organic Chemistry Laboratory II	2
BIOL-K324 Cell Biology	3
BIOL-K325 Cell Biology Laboratory (Spring only)	2
FIS 30500 Professional Issues Forensic Science	3
Total	**16**

Junior Year

Fifth Semester	
BIOL-K384 Biological Chemistry	3
PHYS-P201 General Physics I	5
2nd Written Communication Course	3
FIS 41500 Forensic Science and the Law	3
Total	**14**
Sixth Semester	
FIS 30100/30101 Forensic Microscopy and Lab	3
Advanced Science Elective	3
PHYS-P202 General Physics II	5
FIS 48000 Forensic Science Professional Capstone I (Spring only)	1
STAT 30100 Elementary Statistical Methods 1	3
Total	**15**

Senior Year

Seventh Semester	
FIS 40200 Forensic Biology I (Fall only)	3
FIS 40201 Forensic Biology I Laboratory (Fall only)	1
FIS 49000 Forensic Science Capstone (Fall only)	1
Computer Programming (CSCI-N207 recommended)	3
Advanced Science Elective	3
Arts and Humanities/Social Sciences (choose from list)	3
Total	**14**
Eighth Semester	
FIS 40300 Forensic Genetics (Spring only)	3
FIS 49001 Forensic Biology Practical Capstone III (Laboratory Spring only)	1
Arts and Humanities/Social Sciences (choose from list)	6
FIS 43000 Population Genetics (Spring only)	3
Advanced Science Elective	3

Total	**16**

Bachelor of Science: Forensic and Investigative Sciences Forensic Chemistry Option Sample Plan of Study (123 cr.)

Freshman Year

First Semester	
BIOL-K101 Concepts of Biology I	5
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 23100 Calculus for the Life Sciences	3
FIS 20500 Concepts of Forensic Science I	3
SCI-I120 Windows on Science	1
Total	**17**
Second Semester	
BIOL-K103 Concepts of Biology II	5
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 23200 Calculus for the Life Sciences II	3
FIS 20600 Concepts of Forensic Science II	3
Total	**16**

Sophomore Year

Third Semester	
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
PHYS-P201 General Physics I	5
ENG-W131 Reading, Writing and Inquiry	3
Cultural Understanding (choose from list)	3
Total	**16**
Fourth Semester	
CHEM-C342 Organic Chemistry II	3
CHEM-C344 Organic Chemistry Laboratory II	2
PHYS-P202 General Physics II	5
FIS 30500 Professional Issues in Forensic Science	3
COMM-R110 Fundamentals of Speech Communication	3
Total	**16**

Junior Year

Fifth Semester	
Computer Programming (CSCI-N207 recommended)	3
CHEM-C310 Analytical Chemistry Lecture	3
CHEM-C311 Analytical Chemistry Lab	1
FIS 30100/30101 Forensic Microscopy and Lab	3
Advanced Science Elective	3
2nd written communication course	3
Total	**16**
Sixth Semester	
CHEM-C325 Intro to Instrumental Analysis (Spring only)	5
STAT 30100 Elementary Statistical Methods	3
Arts and Humanities/Social Science (choose from list)	3
FIS 48000 Forensic Science Professional Capstone (Spring only)	1
Advanced Science Elective	3
Total	**15**

Senior Year

Seventh Semester	
FIS 40100 Forensic Chemistry I (Fall only)	3
FIS 40101 Forensic Chemistry I Lab (Fall only)	1
FIS 41500 Forensic Science and the Law	3
FIS 49000 Forensic Science Capstone II	1
Advanced Science Elective	3
Arts and Humanities/Social Sciences (choose from list)	3
Total	**14**
Eighth Semester	
FIS 40400 Forensic Chemistry II (Spring only)	3
FIS 49002 Forensic Chemistry Practical Capstone III (Laboratory Spring only)	1
Advanced Science Electives	3
CHEM-C360 Introductory Physical Chemistry (Spring only)	3
Arts and Humanities/Social Sciences (choose from list	3
Total	**13**

Minor in Forensic and Investigative Sciences

The minor in Forensic and Investigative Sciences can be used in relevant majors where the student's primary interest is in the major but who wishes to learn the basic concepts of forensic science and how to apply them to other fields of knowledge. Prerequisites to any of the minor courses are not included but are required in order to complete the minor. All FIS classes require a grade of C or higher. All SPEA classes require a grade of C- or higher. Students must have a 2.0 GPA average for all courses used for the minor.

- FIS 10100 Investigating Forensic Science Lecture (1 cr.)
- FIS 10101 Investigating Forensic Science Lab (2 cr.)
- FIS 20500 Concepts of Forensic Science I (3 cr.)
- FIS 20600 Concepts of Forensic Science II (3 cr.)*
- FIS 30500 Professional Issues in Forensic Science (3 cr.)**
- FIS 41500 Forensic Science and the Law (3 cr.)***

*P: FIS 20500 and CHEM-C101 OR 105 OR FIS 10101
**P: FIS 20500 and 20600
***P: FIS 20500 and 20600

Choose 3 credit hours from the following courses:

- FIS 30100 Microscopy Lecture (1 cr.) (P: FIS 20500, 20600)
- FIS 43000 Population Genetics (3 cr.) (P: BIOL-K322, 323, and STAT 30100)
- FIS 49600 Special Topics in Forensic Science (credits vary - repeatable) (3 cr., prerequisites vary)
- SPEA-J303 Evidence (3 cr.) (P: SPEA-J101)
- SPEA-J320 Criminal Investigation (3 cr.) (P: SPEA-J101)

Graduate Program

Master of Science in Forensic Science

Description

The M.S. Program in Forensic Science, which awards a Purdue University degree, requires 30 credit hours of study beyond the baccalaureate level. It is designed for students seeking careers as professional forensic scientists who desire employment in the criminal justice field or a related area. There are two ways to complete the MS, the thesis MS or the non-thesis, accelerated MS. The MS Thesis Program is FEPAC-accredited.

General Degree Options and Requirements

Students must apply in one of the following concentrations; forensic chemistry or forensic biology. All students take a core of required courses which include a professional issues course, law courses and a microscopy course. Each concentration and track (thesis or non-thesis) contains specific required courses taken by students in that concentration and track.

This thesis program requires 17 credit hours of course work and 13 credit hours of thesis completion and defense and is available to full time students. A non-thesis option is available and this program includes 30 credit hours of classes approved by the department. This may include up to six credits of internship and research.

Admission

The **admission requirements** are as follows:

- A Bachelor's degree from an accredited institution in the physical or life sciences such as chemistry, biology, forensic science, pharmacology/toxicology, or a related science
- A minimum GPA of 3.0 for all undergraduate work

The program will serve full- and part-time students who meet the above requirements as well as students who are presently employed full time in a forensic science laboratory or other analytical laboratory.

How to Apply for the Full-Time Thesis MS

Application to the program can be done completely online. The online application is called the "Indiana University Graduate Centralized Application System (CAS)."LINK.

You will be directed to create an account to begin your application. The application can be filled out in stages and saved along the way so you can return to it later. The CAS system has provisions for uploading your personal statement and listing contact names for two letters of recommendation.

These people will automatically be emailed and asked to input their letters of recommendation.

Please arrange for your previous academic institutions to send official, sealed transcripts to FIS Graduate Admissions, 402 N. Blackford St., LD 326, Indianapolis, IN 46202. International applicants will need to provide transcripts in both native language and English, as well as a certificate of diploma.

The Forensic and Investigative Sciences Program accepts applications once a year for beginning matriculation in the fall semester. The deadline for applying to the thesis program is **January 15** of the year you wish to start. Applications must be complete by **January 15** or they will not be considered. Applicants must submit the following:

1. The completed application which will also require:
   - Two letters of recommendation. These would normally be from professors who can evaluate your ability to successfully complete graduate work in forensic science.
   - A personal statement that discusses your educational and work background, interest and experience (if any) in forensic science, and research interests if you are full time. Supplemental questions requests information about which degree (thesis or non-thesis) and track (forensic biology or chemistry) is applied for along with requiring a list of relevant coursework.
2. Official final transcripts from all higher education institutions that you attended.

Applicants are not normally considered on a rolling basis. They are generally considered en masse after the January 15 deadline. You will be notified within a few weeks after the decision is made.

How to Apply for the Non-Thesis MS

Application to the program can be done completely online. The online application is called the "Indiana University Graduate Centralized Application System (CAS)" LINK.

You will be directed to create an account to begin your application. The application can be filled out in stages and saved along the way so you can return to it later. The CAS system has provisions for uploading your personal statement, supplemental questions for, and listing contact names for two letters of recommendation. These people will automatically be emailed and asked to input their letters of recommendation.

The Forensic and Investigative Sciences Program review of applications will begin in late February and will continue on a rolling basis until the **March 15** deadline. Applications will also be considered for the Spring term if there is availability (completed by December 1).

Applicants must submit the following:

1. The completed application which will also require:

- Two letters of recommendation. These would normally be from professors who can evaluate your ability to successfully complete graduate work in forensic science.
- A personal statement that discusses your educational and work background, interest and experience (if any) in forensic science, and research interests if you are full time. Supplemental questions requests information about which degree (thesis or non-thesis) and track (forensic biology or chemistry) is applied for along with requiring a list of relevant coursework.

2. Official final transcripts from all higher education institutions that you attended.

You will be notified within a few weeks after the decision is made.

The Curriculum

The thesis and non-thesis M.S. program consists of 30 semester credit hours. It is anticipated that the thesis program can be completed within two years by full time students. The non-thesis program can be completed in one academic year plus two summer courses. The credit hours are to be distributed as follows:

All students (thesis and non-thesis) take the following courses (course substitutions only with Graduate Advisor approval):

1. FIS 50100/50101 (3) - Forensic Microscopy and Lab
2. FIS 50500 (3) - Profession and Ethical Issues in Forensic Science
3. FIS 51500 (3) - Legal Issues in Forensic Science
4. FIS 69500 (1) - Forensic Science Seminar

Students in the forensic chemistry concentration (thesis and non-thesis) must take the following courses:

1. FIS 51100 (3) - Forensic Chemistry & Lab
2. FIS 51101 (1) - Forensic Chemistry I Lab
3. FIS 51200 (3) - Forensic Chemistry II
4. FIS 51201 (1) - Forensic Chemistry II Lab

Students in the forensic biology concentration (thesis and non-thesis) must take the following courses:

1. FIS 52100 (3) - Forensic Biology I
2. FIS 52101 (2) - Forensic Biology I Lab
3. FIS 53000 (3) - Population Genetics

Thesis students must take the following courses:

1. FIS 69800 (13) - Thesis Research
2. Electives (1 - 4) - approved by department

Non-thesis students must take the following courses:

1. FIS 59700 (2) - Laboratory Project Design
2. FIS 50800 (2) - Forensic Science Laboratory Management
3. LAW-D774 (2) - Law and Forensic Science
4. Electives (6) - approved by department. This may include up to 6 credits of internship. A student may also take courses in other concentrations as part of theses credits.

The Thesis

The faculty of the Forensic and Investigative Sciences Program strongly believe that research should be a major component of a Master of Science degree. For thesis students, 13 of the 30 credit hours of the program are devoted to the thesis. Students are encouraged to identify a thesis topic with the help of the FIS faculty as soon as possible in the program. It is normally expected that the research and write up of the thesis will take at least one year of the program. A master's thesis project may be begun in conjunction with an internship at a crime laboratory and then finished at IUPUI. It may be possible for a student to remain at the internship host for longer than a semester and complete the research. Thesis research done in conjunction with a crime lab must be approved by the student's thesis director at IUPUI.

Financial Aid

Contrary to the situation with Ph.D. programs, there is limited financial support for master's programs. Nonetheless, we are committed to developing as many financial resources for our students as possible. Decisions concerning fellowships and assistantships will normally be at least partly based on merit. Other factors will also be considered. Some funds are usually available from the unit, School of Science, IUPUI and external grants. These will vary from year to year. The "Online Admissions Application" contains a box that should be checked if you would like to be considered for financial aid.

Graduate Student Handbook

The Graduate Student Handbook contains additional information pertaining to the M.S. program.

Interdisciplinary Studies of Bachelor of Science Degree Program

School of Science, IUPUI
Science Building, LD 222
402 N. Blackford Street

Indianapolis, IN 46202-3276
Phone: (317) 274-0625; Fax: (317) 274-0628

- **Director** Jane R. Williams, Ph.D.
- **Program Advisor** Diana S. Sims-Harris
- **Program Advisor** Joseph L. Thompson

The purpose of the Bachelor of Science (B.S.) in Interdisciplinary Studies Program is to provide an opportunity for IUPUI students to construct individual majors that are science-based, interdisciplinary, and not represented by existing major programs. Instead of a prescribed area of study as with standard majors, the interdisciplinary studies (IDS) major will accommodate a variety of plans of study, with courses drawn from many subject areas in the sciences and beyond. The Interdisciplinary Studies degree program provides an academic structure that encourages creative and motivated undergraduates to design unique science-based interdisciplinary majors. In collaboration with an academic advisor and faculty mentors, students will create plans of study that demonstrate coherence, rigor, rationale, and vision. The B.S. in Interdisciplinary Studies requires a capstone project or internship experience, including a strong writing component. Particular plans of study may take advantage of the IUPUI Honors College, the IUPUI Center for Research and Learning, the Consortium for Urban Education to include relevant courses taught at five other Indianapolis colleges and universities, or may include specialized service learning experiences in consultation with the IUPUI Center for Service and Learning.

Though not meant to be a definitive list, examples of interdisciplinary majors with an emphasis in the sciences include:

- Art Restoration and Preservation
- Art Therapy
- Chemical Science and Technology
- Music Therapy
- Physics of Music
- Religion and Science
- Science and Gender
- Science, Technology, and Society
- Scientific Writing
- Urban Ecology

View the following information to learn more about Interdisciplinary Studies.

- Admissions and Curriculum
- Bachelor of Science

Admissions

All students admitted to the Interdisciplinary Studies (IDS) Program must have a minimum GPA of 2.50 and meet existing admission requirements of the School of Science. Students interested in the IDS program should contact the program advisor to discuss the interdisciplinary theme under consideration. The program advisor works with interested students in a pre-IDS period to identify faculty with expertise relevant to the IDS theme. In consultation with those faculty members and the program advisor, the student prepares a program proposal consisting of coursework from two or more disciplines, at least one of which is in the School of Science. The student also prepares a statement explaining the justification for the IDS theme chosen, how it relates to the student's future professional interests and what learning outcomes will be met through the proposed IDS program. The student is accepted for admission to the Interdisciplinary Studies Program when the faculty advisors and the Undergraduate Education Committee of the School of Science approve the student's proposal.

Before admission to the Interdisciplinary Studies Program, students must have completed a minimum of 15 credit hours of course work, but no more than 60 credit hours. The course work must include ENG-W131, a science course with lab, and an appropriate mathematics course. All science and mathematics courses on record must have minimum grades of C. Courses included in a specific IDS major may have prerequisites specified by the departments that offer them.

Curriculum

The curriculum for each interdisciplinary studies student will vary so as to meet the particular academic objective of the student. The interdisciplinary studies major areas of study will consist of a coherent set of courses that define a clearly recognizable focus of study for which faculty can provide oversight and ensure intellectual integrity and rigor. A faculty committee will approve all interdisciplinary study major areas, and each student in the program will work closely with a faculty mentor.

The interdisciplinary major will comprise 40-45 credit hours of regular courses from at least two disciplines and culminate with a 3- to 6-hour senior capstone project or internship.

- A minimum of 120 credit hours in the IDS program will be distributed as follows
  - General education (45-50 credits)
  - Interdisciplinary major with courses from at least two disciplines (40-45 credits)
  - Electives (25-35 credits)

Bachelor of Science Degree Requirements

For details on school specific policies, see the School of Science requirements under ‘‘Undergraduate Programs” in this bulletin. Please note that at least 32 credit hours of course work must be at the 300 level or higher.

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.), or an equivalent first-year experience course.

Area I English Composition and Communication Competency (9 cr.)

English Composition (6 cr.)
- ENG-W131 Elementary Composition I
- Second Composition Course that has ENG-W131 as a prerequisite, e.g. ENG-W270, ENG-W231, ENG-W320, ENG-W350, TCM 22000, or TCM 32000

Speech Communication (3 cr.)
- COMM-R110 Fundamentals of Speech Communication

Area II World Language Competency

No world language proficiency is required for the Bachelor of Science degree. However, if knowledge of a world language is pertinent to the interdisciplinary major, a student may choose to pursue one.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.)

The information about the IIIA requirements in the School of Science part of this bulletin lists courses that may be used to satisfy the requirements below. Students should consult the program advisor before registering for these courses.

- List H course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.
- List S course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.
- One additional course from either List H or List S
- List C course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

See the School of Science requirements under “Undergraduate Programs” in this bulletin. Four courses outside the major from the life and physical sciences, one of which must include a corresponding laboratory. Laboratory courses without a lecture component may be taken for credit, but do not count toward the four-course requirement. No grade below C- will be accepted in any of these courses. Consult the program advisor concerning the acceptability of courses.

Area IIID Analytical Reasoning Competency (9 cr.)

- Two courses beyond algebra and trigonometry. (6 cr.)
- One computer programming course. (3 cr.)

No grade below C- will be accepted in any of these courses.

Note: Computer Science CSCI-N100 level courses and CIT 10600 do not count for credit toward any degree in the School of Science. Also, CSCI-N241 and CSCI-N299 do not count in Area IIID but may count as a general elective.

Area IV Interdisciplinary Major Concentration (40-45 cr.)

Minimum requirements include 40 credit hours of core interdisciplinary major courses.

All courses applicable to the major must have a minimum grade of C.

Curriculum

The curriculum for each interdisciplinary studies student will vary so as to meet the particular academic objective of the student. The interdisciplinary studies major areas of study will consist of a coherent set of courses that define a clearly recognizable focus of study for which faculty can provide oversight and ensure intellectual integrity and rigor. A faculty committee will approve all interdisciplinary study major areas, and each student in the program will work closely with a program advisor and faculty mentors.

The interdisciplinary major area will be comprised of 40-45 credit hours of regular courses from at least two disciplines and culminate with a senior capstone project or internship.

Department of Mathematical Sciences

IUPUI
Science Building, LD 270
402 N. Blackford Street
Indianapolis, IN 46202-3216
Phone: (317) 274-6918; fax: (317) 274-3460
https://science.iupui.edu/math/

Department Chair: Jeffrey X. Watt, Ph.D.

Department Associate Chair: R. Patrick Morton, Ph.D.

Department Advisors:
- Graduate Director: Evgeny Mukhin, Ph.D.
- Undergraduate Advisor: Virginia Ranly

Mathematical sciences include the areas of pure and applied mathematics, mathematics education, actuarial science, and statistics. Mathematics involves the study of problems in areas such as algebra, geometry, analysis, and logic and of problems arising in the real world. Mathematics, actuarial science and statistics are used in the physical sciences, engineering, the social, life, and management sciences. Mathematics education involves the training of prospective secondary teachers.
- Major Requirements and Plans of Study
- Degree Programs
- Graduate
- Minor

Degree Programs

The department offers the Purdue University Bachelor of Science degree in mathematics with options in pure mathematics, applied mathematics, actuarial science, and secondary school teaching.

Graduate degrees offered include the Purdue University Master of Science, with concentrations in Pure Mathematics, Applied Mathematics, Mathematics Education, Applied Statistics, and the Purdue University Doctor of Philosophy in mathematics, by arrangement with Purdue University, West Lafayette, with all requirements completed on the IUPUI campus. In addition, together with the Division of Biostatistics in the Indiana University School of Medicine, the department administers and offers an Indiana University Doctor of Philosophy in Biostatistics, with all requirements completed on the IUPUI campus.

Bachelor of Science

Students are encouraged to declare a mathematics major in their freshman year, so they can receive proper academic advising. A grade point average of 2.50 with no grades below C in mathematics courses through MATH 35100 is a minimum indication of success in this major.

Degree Requirements

The baccalaureate degree general requirements, the area requirements are listed earlier in this bulletin (see the School of Science requirements under “Undergraduate Programs”). For a Bachelor of Science degree in mathematics, the following additional requirements and restrictions apply:

First-Year Experience Course

Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency

No additional requirements beyond School-level requirements, located under the School of Science requirements “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied by ENG-W270, ENG-W231, ENG-W350, TCM 32000 or ENG-W230.

Area II World Language Competency

All degree options require first year proficency (8 credit hours) in a modern world language. American sign language is acceptable.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.)

List H course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

List S course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

One additional course from either List H or List S.

List C course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

Refer to specific mathematics option major requirements for any additional Area IIIC course requirement.

Note: Certain courses, such as CHEM-C101, CHEM-C102, CHEM-C110; PHYS 10000, PHYS 20000, PHYS 21800, and PHYS 21900, may not be used to fulfill the science requirement, Area IIIC, of the School of Science. If in doubt about a particular course, the student should consult a mathematics department advisor.

Area IIID Analytical Reasoning Competency

See Area IV Major Requirements for required mathematics courses. Mathematics courses below MATH 16500 and those mathematics courses in which the student has received grades below C- do not count toward the degree. MATH-M118 will count as general elective.

The Area IIID computer programming requirement must be in a higher-level programming course (not BASIC). A grade of C (2.0) or better is required.

Note: Computer Science CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as a general elective.

Area IV Mathematical Sciences Major Requirements

Mathematics courses in which a student has received grades below C (2.0) do not count in Area IV. The Area IV requirements for the secondary area of concentration and the major for the four degree options—pure mathematics, applied mathematics, actuarial science, and secondary teaching—are described in the following sections. There is no single semester-by-semester plan of study for any of the options because flexibility is encouraged within the various programs. However, a sample program that shows one possible sequence of courses is given for each option. Variations from the sample program should be made in consultation with the student’s advisor. Because of the complexity of the requirements and because certain courses are not offered every semester, it is important that each student consult his or her assigned advisor as soon as possible in order to proceed through a proper plan of study for the chosen degree program. A minimum grade point average of 2.50 is required in all mathematics courses that count toward the major.

Area IV Secondary Area of Concentration Requirements

For each student to acquire some depth of study in a subject outside of the major area, the Department of Mathematical Sciences requires students to have a secondary area of concentration or minor outside of the department. The secondary area of concentration consists of at least 18 credit hours and includes at least three courses beyond the introductory level or a recognized minor from another department. It is subject to the approval of the student’s advisor. Although a second area of concentration is usually in one department, it may be from two or more if the advisor approves.

Courses may be used for the double purpose of fulfilling the general requirements and for fulfilling the secondary area of concentration requirements of the Department of Mathematical Sciences. For students in the Pure Mathematics Option or the Applied Mathematics Option, a secondary area in one of the physical sciences or in a subject that makes substantial use of mathematics, such as computer science, engineering, or economics, is desirable. Students in the Secondary School Teaching Option satisfy the requirements for a secondary area by the courses they take to meet the professional education requirement. Students in the Actuarial Science Option satisfy the requirements for a secondary area by the required economics and business courses they take.

The requirement of 18 credit hours in a secondary area of concentration does not, by itself, constitute

an official minor that would be acknowledged on the student's transcript. A minor must be offered through the department or school in which the minor is taken. Students in the Actuarial Science Option satisfy the requirements for a minor in economics by the economics courses they are required to take (Students must apply to the Economics Department to be awarded an official minor.).

Degree Requirements

Major Requirements

Pure Mathematics Option

With this option, students will be well prepared for graduate work in pure mathematics. However, students with undergraduate degrees in pure mathematics have also been successful with graduate studies in business administration, computer science, economics, educational research, engineering, law, medicine, operations research, physics, psychology, and statistics. Persons with advanced degrees in pure mathematics find careers primarily in college teaching, but careers in business, industry, or government service are also possible.

Courses taken to satisfy the Area IIIC requirements must include PHYS 15200 (or a more advanced physics course).

The Area IV major requirements are as follows:

1. Core curriculum: MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 26600, and MATH 35100
2. MATH 45300 Beginning Abstract Algebra
3. MATH 30000 Logic & Foundations of Algebra
4. MATH 32101 Elementary Topology
5. MATH 44400 Foundations of Analysis I
6. The 45 credit hours required above must include at least 9 credit hours in the required advanced electives listed below plus 1 more 3-credit 300, 400 or 500 level course. *500 level courses require departmental approval
7. Minimum of two credit hours of MATH 49200 Capstone Experience

- MATH 46200 Elementary Differential Geometry OR MATH 57100 Elementary Topology
- MATH 42500 Elements of Complex Analysis OR MATH 445 Foundations of Analysis II
- MATH 45400 Galois Theory OR MATH 45600 Theory of Numbers

Pure Mathematics Option Sample Program (120 credits required)

Freshman Year

First Semester	
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensional Mathematics	3
SCI-I120 Windows on Science	1
ENG-W131 Reading, Writing and Inquiry	3
World Language	4
Total	**15**
Second Semester	
MATH 16600 Analytic Geometry and Calculus II	4
CSCI 23000 Computing I	4
COMM-R110 Fundamentals of Speech Communication	3
Life and Physical Science (approved elective)	3
World Language	4
Total	**18**

Sophomore Year

Third Semester	
MATH 26100 Multivariate Calculus	4
PHYS 15200 Mechanics	4
2nd Written Communication Course	3
MATH 30000 Logic & Foundations of Algebra	3
Secondary Area elective	3
Total	**17**
Fourth Semester	
MATH 26600 Ordinary Differential Equations	3
MATH 35100 Elementary Linear Algebra	3
Life and Physical Science (approved elective)	3
Social Sciences (choose from list)	3
Secondary Area elective	3
Total	**15**

Junior Year

Fifth Semester	
MATH 44400 Foundations of Analysis I	3
Advanced Elective	3
Arts and Humanities/Social Sciences (choose from list)	3
Secondary Area electives	6
Total	**15**
Sixth Semester	
MATH 32101 Elementary Topology	3
Advanced Elective	3
Life and Physical Sciences (approved elective)	3
Secondary Area electives	6
Total	**15**

Senior Year

Seventh Semester	
MATH 45300 Beginning Abstract Algebra	3
Arts & Humanities/Social Science (choose from list)	3
General electives	7
Total	**13**
Eighth Semester	
Advanced Elective	3
Advanced Elective	3
General elective	3
MATH 49200 Capstone Experience	3
Total	**12**

Applied Mathematics Option

Graduates with training in applied mathematics are employed in business, industry, and government. They would probably work as part of a team and would often need to communicate mathematical ideas to persons trained in other subjects. In many instances, they would need to formulate problems for solution on a computer and interpret the answers. Thus, besides a fundamental knowledge of mathematics, a knowledge of what computers can do is essential. This option is also good preparation for graduate study in applied mathematics, computer science, statistics, and engineering.

Courses taken to satisfy the Area IIIC requirements must include PHYS 15200 and PHYS 25100 (or more advanced physics courses).

The Area IV major requirements are as follows:

1. Core curriculum: MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 26600, MATH 30000, and MATH 35100
2. MATH 41400 Numerical Methods
3. Mathematical modeling: MATH 42600 Introduction to Applied Mathematics and MATH 42100 Linear Programming and Optimization Techniques or MATH 42300 Discrete Modeling
4. MATH 44400 Foundations of Analysis I
5. Twelve (12) additional credit hours selected from MATH 27600 and mathematics courses at the 300 level or above and statistics courses numbered 35000 or higher. Courses in computer science or courses in other departments of the School of Science that have appropriate mathematical content may be selected with the approval of the advisor. Normally, no more than 6 credit hours outside of mathematics and statistics will be approved.
6. The 45 credit hours of courses required above must include at least 6 credit hours in each of two of the course sequences listed below. Students planning on attending graduate school in mathematics, economics, engineering, or physics are advised to take MATH 44400 and 44500. MATH 30000 is a recommended advanced elective to be taken as a prerequisite for MATH 44400.
7. Minimum of two credit hours of MATH 49200 Capstone Experience

Course Sequences

Two course sequences (each course 3 credit hours) are required. There must be at least one * sequence. No overlaps are allowed.

- *Differential Equations: MATH 52000 and MATH 52200
- *Biomathematics: Biomathematics course and STAT 35000 or higher
- Foundations of Analysis: MATH 44400 and MATH 44500
- Complex Analysis and Differential Equations: MATH 42500 and MATH 52000
- Abstract Algebra: MATH 45300 and MATH 45400
- Algebra and Number Theory: MATH 45600 and MATH 45300
- Linear Algebra: MATH 35100 and MATH 35300
- Differential Geometry: MATH 46200 and MATH 56200
- *Probability and Statistics: Two statistical-type courses at the STAT 35000 level or higher, with advisor's approval
- *Numerical Analysis: MATH 41400 and CSCI 51500
- *Scientific computing: CSCI 47500 and 47600[2]
- *Theoretical computer science: CSCI 34000 and 48400[2]

[2]Students are generally allowed to select only one of these two course sequences.

Applied Mathematics Option Sample Program (120 credits required)

Freshman Year

First Semester	
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensional Mathematics	3
SCI-I120 Windows on Science	1
ENG-W131 Reading, Writing and Inquiry	3
World Language	4
Total	**15**
Second Semester	
MATH 16600 Analytic Geometry and Calculus II	4
CSCI 23000 Computing I	4
COMM-R110 Fundamentals of Speech Communication	3
Life and Physical Science (approved elective)	3
World Language	4
Total	**18**

Sophomore Year

Third Semester	
MATH 26100 Multivariate Calculus	4
MATH 30000 Logic & Foundations/Algebra	3
PHYS 15200 Mechanics	4
2nd Written Communication Course	3
Secondary area elective	3
Total	**17**
Fourth Semester	
MATH 26600 Ordinary Differential Equations	3
MATH 35100 Elementary Linear Algebra	3
PHYS 25100 Heat, Electricity, and Optics	5
Secondary area elective	3
Total	**14**

Junior Year

Fifth Semester	
MATH 44400 Foundations of Analysis I	3
MATH/STAT sequence or elective	3
Arts and Humanities (choose from list)	3
Secondary area electives	6
Total	**15**
Sixth Semester	
MATH 42600 Introduction to Applied Mathematics and Modeling	3
MATH/STAT sequence or elective	3
Life and Physical Sciences (approved elective)	3
Secondary area electives	6
Total	**15**

Senior Year

Seventh Semester	
MATH 41400 Numerical Methods	3
MATH 42100 Linear Programming and Opt. Tech. or MATH 42300 Discreet Modeling	3
Social Sciences (choose from list)	3
General Elective	3
Total	**12**
Eighth Semester	
MATH 49200 Capstone Experience	2
MATH/STAT sequence or electives	6
Arts and Humanities/Social Sciences (choose from list)	3
General Elective	3
Total	**14**

Actuarial Science Option

The Actuarial Science Option for mathematics majors will provide students with the strong background in mathematics, statistics, and economics necessary to analyze financial risks. This concentration aims to prepare students for the first three actuarial examinations administered by the professional actuarial organizations. The secondary area of concentration for students in this option is fulfilled by required courses in business and economics.

Actuarial science deals with the analysis of financial consequences of risk. Actuaries are highly trained professionals, well versed in mathematical, statistical, and economic techniques that enable them to evaluate financial risk of uncertain future events, especially those pertaining to health care, insurance, and pension plans. Actuaries answer risk-related questions by developing, implementing, and interpreting sophisticated mathematical models.

Courses taken to satisfy Area IIIC requirements must include PHYS 15200 (or a more advanced physics course).

The Area IV major requirements are as follows:

1. Core Curriculum: MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 26600, and MATH 35100
2. ECON-S201, ECON-E202 or ECON-S202, ECON-E305, ECON-E321, ECON-E322
3. BUS-A200, BUS-F300, BUS-F305
4. MATH 37300 Mathematical Finance
5. Mathematical Modeling: MATH 42600 Introduction to Applied Mathematics and Modeling or MATH 42100 Linear Programming and Optimization Techniques or MATH 42300 Discrete Modeling
6. STAT 41600 Probability and STAT 41700 Statistical Theory
7. Actuarial Models: STAT 47200 and STAT 47300
8. Two credit hour or three credit hour STAT elective at the 300 level or above (not STAT 30100, 30200, or 31100) Suggested course: STAT 51200 and STAT 37100 (Prep for Actuarial Exam 1)
9. Three credit hour MATH or STAT course selected from MATH 27600 and mathematics and statistics courses at the 300 level or above (not STAT 30100, 30200, or 31100). Suggested course: STAT 35000 Introduction to Statistics
10. Two or three credit hours of MATH 49200 Capstone Experience

Actuarial Science Option Sample Program (120 credits required)

Freshman Year

First Semester	
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensional Mathematics	3
SCI-I120 Windows on Science	1
ENG-W131 Reading, Writing and Inquiry	3
World Language	4
Total	**15**
Second Semester	
MATH 16600 Analytic Geometry and Calculus II	4
Arts and Humanities (choose from list)	3
COMM-R110 Fundamentals of Speech Communication	3
Life and Physical Science (approved elective)	3
World Language	4
Total	**17**

Sophomore Year

Third Semester	
MATH 26100 Multivariate Calculus	4
STAT 35000 Introduction to Statistics	3
MATH 37300 Financial Mathematics	3
ECON-S201 Introduction to Microeconomics: Honors	3
BUS-A200 Foundations of Accounting	3
Total	**16**
Fourth Semester	
MATH 35100 Elementary Linear Algebra	3
MATH 26600 Ordinary Differential Equations	3
PHYS 15200 Mechanics	4
ECON-E202 Intro to Macro Economics	3
2nd Written Communication Course	3
Total	**16**

Junior Year

Fifth Semester	
STAT 41600 Probability	3
ECON-E305 Money and Banking	3
BUS-F300 Introduction to Finance	3
CSCI 23000 Computing I	4
Social Sciences (choose from list)	3
Total	**16**
Sixth Semester	
STAT 37100 Prep for Exam P/1	2
STAT 41700 Statistical Theory	3
Arts and Humanities/Social Sciences (choose from list)	3
BUS-F305 Intermediate Finance	3
Life and Physical Science (approved elective)	3
Total	**14**

Senior Year

Seventh Semester	
STAT 47200 Actuarial Models I	3
ECON-E322 Intermed. Macroeconomic Theory	3
MATH 42100 Linear Prog. and Optim. Tech. or MATH 423 Discrete Modeling	3
STAT 51200 Regression Analysis	3
Elective or MATH 39000 (Topics)	1
Total	**13**
Eighth Semester	
STAT 47300 Actuarial Models II	3
MATH 49200 Capstone Experience	3
Life and Physical Science (approved elective)	3
ECON-E321 Theory of Prices & Markets	3
General elective	1
Total	**13**

Applied Statistics Option

The Applied Statistics Option for mathematics majors will provide students with the strong background in mathematics and statistics necessary to analyze risks. The secondary area of concentration may be selected by the student or fulfilled by required courses in business and economics.

The Area IV major requirements are as follows:

1. Core Curriculum: MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 26600, MATH 35100.
2. Math Major Concentration: STAT 41600, STAT 41700, STAT 42100, STAT 51200
3. Advanced Electives: STAT 35000 or MATH 51100, MATH 41400, MATH 42100, MATH or STAT elective course.

4. Secondary area of concentration selected by student.
5. Two or three credit hours of MATH 49200 Capstone Experience

Freshman Year

First Semester	
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensional Mathematics	3
SCI-I120 Windows on Science	1
ENG-W131 Reading, Writing and Inquiry	3
World Language	4
Total	**15**
Second Semester	
MATH 16600 Analytic Geometry and Calculus II	4
CSCI 23000 Computing I	4
COMM-R110 Fundamentals of Speech Communication	3
Life and Physical Science (approved elective)	3
World Language	4
Total	**18**

Sophomore Year

Third Semester	
MATH 26100 Multivariate Calculus	4
STAT 35000 Introduction to Statistics	3
MATH 41400 Numerical Methods	3
Course for concentration or minor	3
2nd Written Communication Course	3
Total	**16**
Fourth Semester	
MATH 35100 Elementary Linear Algebra	3
MATH 26600 Ordinary Differential Equations	3
PHYS 15200 Mechanics	4
Arts and Humanities (choose from list)	3
Course for concentration or minor	3
Total	**16**

Junior Year

Fifth Semester	
STAT 41600 Probability	3
Statistics Elective Course	3
Courses for concentration or minor	6
Social Sciences (choose from list)	3
Total	**15**
Sixth Semester	
STAT 41700 Statistical Theory	3
STAT 42100 Modern Statistical Modeling/R & SAS	3
Arts and Humanities/Social Sciences (choose from list)	3
Course for concentration or minor	2
Life and Physical Science (approved elective)	3
Total	**14**

Senior Year

Seventh Semester	
STAT 51200 Applied Regression Analysis	3
MATH 42100 Linear Prog. & Opt. Techniques	3
Course for concentration or minor	3
Free Electives	4
Total	**13**
Eighth Semester	
MATH 49200 Capstone Experience	3
Course for concentration or minor	3
Life and Physical Science (approved elective)	3
Free Electives	4
Total	**13**

Secondary School Teaching Option

Students who wish to teach in secondary schools must meet the requirements for teacher certification in the state in which they expect to teach. Interested persons can obtain these requirements by writing to the Department of Public Instruction, Certification Office, in the capital city of any state.

To satisfy Indiana law, a student should have 40 credit hours in general education courses and a specified core of professional education courses as part of the requirement for a teaching license. Students should be sure to see an advisor to ensure that these hours are properly distributed and that the professional education requirements are met.

Courses taken to satisfy the Area IIIC requirements must include PHYS 15200 (or a more advanced physics course).

The Area IV major requirements are as follows:

1. Core curriculum: MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 26600, and MATH 35100
2. MATH 27600 Discrete Math
3. MATH 30000 Logic and the Foundations of Algebra
4. MATH 45300 Abstract Algebra
5. MATH 46300 Intermediate Euclidean Geometry for Secondary Teachers
6. Probability and Statistics: STAT 35000
7. MATH 58300 History of Elementary Mathematics
8. EDUC-M457 Methods of Teaching Senior High/ Junior High/Middle School Mathematics

Secondary School Teaching Option Sample Program (124 credits required)

Freshman Year

First Semester	
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensional Mathematics	3
SCI-I120 Windows on Science	1
ENG-W131 Reading, Writing and Inquiry	3
World Language	4
Total	**15**
Second Semester	
MATH 16600 Analytic Geometry and Calculus II	4
MATH 27600 Discrete Mathematics	3
COMM-R110 Fundamentals of Speech Communication	3
2nd Written Communication Course	3
World Language	4
Total	**17**

Sophomore Year

Third Semester	
MATH 26100 Multivariate Calculus	4
MATH 30000 Logic and the Foundations of Algebra	3
EDUC-H341 American Culture and Education	3
PSY-B110 Introduction to Psychology	3
Life and Physical Science (approved elective)	3
Total	**16**
Fourth Semester	
MATH 26600 Ordinary Differential Equations	3
MATH 35100 Elementary Linear Algebra	3
MATH 58300 History of Mathematics	3
PHYS 15200 Mechanics	4
Arts and Humanities (choose from list)	3
Total	**16**

Junior Year

Education Block IIA3

Fifth Semester	
CSCI 23000 Computing I	4
Block I-Diversity & Learning, Content Area Literacy, Field Exp.	10
Life and Physical Science (approved elective)	3
Total	**17**
Sixth Semester	
MATH 46300 Intermediate Euclidean Geometry for Secondary Teachers	3
Education Block IIA	7
Education Block IIB-EDUC-M457 Methods of Teaching Senior High/Junior High/ Middle School Mathematics	3
Arts and Humanities/Social Sciences (choose from list)	3
Total	**16**

Senior Year

Seventh Semester	
MATH 45300 Abstract Algebra	3
STAT 35000 Introduction to Statistics	3
Block III-High School Methods, Field Exp.	4
Life and Physical Science (approved elective)	3
Total	**13**
Eighth Semester	
Block IV-Student Teaching in Middle School/Junior High School Student Teaching in High School	14
Total	**14**

Math-Physics Double Major

This option is for students intending to double major in mathematics and physics.
Courses taken to satisfy the Area IIIC requirements must include PHYS 15200, PHYS 25100, CHEM-C105, and CHEM-C106.
The Area IV major requirements are as follows:

1. Core curriculum: MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 26600, and MATH 35100

2. MATH 30000 Logic and the Foundations of Algebra
3. MATH 41400 Numerical Methods
4. MATH 42600 Introduction to Applied Mathematics
5. MATH 44400 Foundations of Analysis I
6. Twelve (12) additional credit hours: three credit hours selected from MATH 35300/35400/45300; three credit hours selected from mathematics courses at the 300 level or above and statistics courses numbered 35000 or higher; three additional credit hours from mathematics or statistics, or from physics courses numbered three hundred or above; and PHYS 44200
7. Students planning on attending graduate school in mathematics or physics are advised to take MATH 44500 and MATH 45300.
8. The double major in mathematics and physics also requires the following additional courses in physics: PHYS 29900, PHYS 31000, PHYS 33000, PHYS 34200, PHYS 35300, PHYS 40000, PHYS 40100, PHYS 41800.
9. Laboratory courses CHEM-C125 and CHEM-C126
10. Minimum of two credit hours of PHYS 49000 Capstone Experience

Math-Physics Double Major Option Sample Program (123 credits required)

Freshman Year

First Semester	
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensional Mathematics	3
SCI-I120 Windows on Science	1
ENG-W131 Reading, Writing and Inquiry	3
CHEM-C105/125 Principles of Chemistry I Lec/Lab	5
Total	**16**
Second Semester	
MATH 16600 Analytic Geometry and Calculus II	4
COMM-R110 Fundamentals of Speech Communication	3
PHYS 15200 Mechanics	4
CHEM-C106/126 Principles of Chemistry II Lec/Lab	5
Total	**16**

Sophomore Year

Third Semester	
MATH 26100 Multivariate Calculus	4
MATH 30000 Logic and the Foundations of Algebra	3
PHYS 25100 Heat, Electricity & Optics	5
PHYS 29900 Intro to Computational Physics	2
2nd Written Communication Course	3
Total	**17**
Fourth Semester	
MATH 26600 Ordinary Differential Equations	3
MATH 35100/51100 Elementary Linear Algebra	3
PHYS 34200 Modern Physics	3
CSCI 23000 Computing I	4
Social Science (choose from list)	3
Total	**16**

Junior Year

Fifth Semester	
MATH 44400 Foundations of Analysis I	3
MATH 45300 or MATH/STAT Elective	3
PHYS 31000 Intermediate Mechanics	4
Arts and Humanities (Choose from List)	3
World Language	4
Total	**17**
Sixth Semester	
MATH 35300/35400 or MATH/STAT Elective	3
MATH 42600 Intro to Applied Math/Modeling	3
PHYS 33000 Intermediate Electricity & Magnetism	3
PHYS 35300 Electronics Laboratory	2
World Language	4
Total	**15**

Senior Year

Seventh Semester	
MATH 41400 Numerical Methods	3
PHYS 40000 Physical Optics	3
PHYS 40100 Physical Optics Laboratory	2
PHYS 44200 Quantum Mechanics	3
Arts and Humanities or Social Science	3
Total	**14**
Eighth Semester	
PHYS 49000 (Capstone)	3
PHYS 41800 Thermal and Statistical Physics	3
MATH/STAT/PHYS Elective	3
General Elective	3

Total	**12**

Minor in Mathematical Sciences

An undergraduate minor in mathematics is useful in many fields. A scientist or engineer may need knowledge of differential equations and linear algebra, while someone in business or a social science may need a background in probability or statistics.

Requirements

1. The calculus sequence MATH 16500, MATH 16600, MATH 17100, and MATH 26100 (15 cr.)
2. Two additional courses selected from mathematics courses numbered MATH 26600 or higher or from statistics courses numbered STAT 35000 or higher
3. Nine (9) credit hours of the minor must be completed at IUPUI.
4. The grade in each course submitted for the minor must be C (2.0) or higher.

Correspondence courses may not be used to fulfill requirements for the minor.

Graduate Programs

The Department of Mathematical Sciences offers graduate training leading to the Purdue University Ph.D. in Mathematics with concentrations in pure mathematics, applied mathematics, and statistics. In addition, the department offers a Master of Science degree in Mathematics, with concentrations in pure mathematics, applied mathematics, math education, and applied statistics. Together with the Department of Biostatistics in the Indiana University School of Medicine and the Indiana University Fairbanks School of Public Health at IUPUI, the department also administers and offers an Indiana University Ph.D. in Biostatistics. Requirements for both Ph.D. programs are completed entirely on the IUPUI campus. The M.S. degree requires two years of full-time study, and the Ph.D. typically requires two to three additional years of full-time study.

Admission Requirements

Students entering a graduate program in mathematics should have completed an undergraduate program containing as many courses as possible in abstract algebra, linear algebra, advanced calculus, differential equations, complex analysis, logic and foundations, statistics and probability.

Students entering the MS graduate program in pure or applied mathematics should hold at least a bachelor's degree (or equivalent) from an accredited institution of higher learning in mathematics, or in the physical sciences or engineering with a strong mathematics background. A minimal cumulative GPA of 3.0 is required. The minimal mathematics background includes at least 13 credit hours of mathematics courses past the calculus sequence (single and multivariate calculus and differential equations).

Students entering the MS graduate program in applied statistics must have at least a bachelor's degree (or equivalent) from an accredited institution. A minimum cumulative GPA of 3.0 is required. The minimal mathematics background is an undergraduate course sequence in univariate and multivariate calculus (equivalent to MATH 16500, 16600, 17100, and 26100 at IUPUI), plus a linear algebra course (equivalent to MATH 35100 or 51100 at IUPUI). Applicants who lack only the linear algebra course may be admitted conditionally and then must complete such a course as soon as practicable.

Students entering the master's program in mathematics education must have at least a bachelor's degree (or equivalent) from an accredited institution. A minimum cumulative GPA of 3.0 is required. The minimal mathematics background includes undergraduate coursework in univariate and multivariate calculus (at IUPUI, MATH 16500, 16600, 17100, and 26100), differential equations, (at IUPUI, MATH 26600), linear algebra (at IUPUI, MATH 35100 or 51100), and abstract algebra (at IUPUI, MATH 45300).

Students entering the Ph.D. program in mathematics must have either an M.S. in mathematics or have successfully completed a bachelor's degree (or equivalent), from an accredited university, with advanced courses in mathematics. A minimum cumulative GPA of 3.0 is required. Competitive applicants will have successfully completed the following course work: linear algebra, abstract algebra, complex analysis, partial differential equations (PDE), ordinary differential equations (ODE), mathematical statistics, probability.

Students entering the graduate program in biostatistics must have a suitable bachelor's or master's degree from an accredited institution and show promise for successfully completing all the degree requirements. In addition to satisfying general Indiana University Graduate School requirements for admission, applicants must have at least a B (3.00 GPA) average in course taken during the last two years of their earlier degree studies, and a grade of B+ (3.50 GPA) in courses required as prerequisites for the program. The minimal mathematics background consists of an undergraduate course sequence in univariate and multivariate calculus (equivalent to MATH 16500, MATH 16600 and MATH 26100 at IUPUI) and a course in linear algebra (equivalent to MATH 35100). In addition, applicants should have had a calculus-based undergraduate level course in probability or statistics. Prospective applicants who do not have this background must acquire it prior to admission to the program.

Application for Admission

Students who wish to pursue an advanced degree in the Department of Mathematical Sciences should complete an online application available from the department's web site at: https://science.iupui.edu/math/admissions/apply/index.html.

For Ph.D. mathematics applicants, the GRE general score is required. For Ph.D. biostatistics applicants, the GRE general test is required. Students for whom English is not their native language and who have not completed a post-secondary degree program from an English-speaking university within the past two years must submit TOEFL scores. While this application is being processed, the student may enter IUPUI as a graduate non-degree student. No more than 12 hours of credit earned under this classification may be applied toward an advanced degree. Those who do not want to pursue an advanced degree, but who desire to take graduate courses for personal

improvement, may also take courses under the graduate non-degree classification.

Transfer Credit

The Department of Mathematical Sciences will accept by transfer a maximum of 12 hours of graduate credit to an MS degree and 30 to a Ph.D. degree in excess of undergraduate degree requirements from approved institutions. Transfer credit must be approved by the student's faculty advisor.

Assistantships and Fellowships

Competitive financial support is available to qualified full-time thesis students in the form of university fellowships, school fellowships, graduate teaching assistantships, and research assistantships.

English Requirements

All advanced degree candidates are required to demonstrate acceptable proficiency in English composition.

Students for whom English is not their native language must take the EAP exam administered by the IUPUI English for Academic Purposes program. Students not scoring high enough will be required to take designated courses in English while pursuing their graduate studies.

Master of Science (Pure and Applied Mathematics Concentrations)

The Master of Science with focus in pure or applied mathematics consists of a minimum of 30 credit hours. Course grades must be A or B with the possible exception of at most two grades of C. Neither a thesis nor a comprehensive examination is required. Several core courses are specific to an M.S. plan of study and vary according to the student's interest in (a) pure mathematics with a Ph.D. objective, (b) pure mathematics without a Ph.D. objective, (c) applied mathematics with a Ph.D. objective, or (d) applied mathematics without a Ph.D. objective. The remaining courses are selected by the student and his or her advisory committee.

Master of Science (Applied Statistics Concentration)

The Master of Science degree with a concentration in Applied Statistics consists of a minimum of 30 credit hours. Course grades must be A or B with the possible exception of at most two grades of C. A combined written and oral final examination is required. Candidates for this degree may choose either the thesis option or the non-thesis option. Both options require 15 credit hours in the core curriculum consisting of STAT 51200, STAT 51400, STAT 51900, STAT 52400, and STAT 52800.

The non-thesis option consists of 15 credit hours beyond the core curriculum, at least 9 of which must be statistics (STAT) courses. The remaining courses may be taken in mathematics or in areas relevant to statistical applications, subject to approval of the academic advisor.

The thesis option requires a thesis worth 6 credit hours on a topic approved by the student's academic advisor. At least 6 of the remaining 9 credit hours must be taken in statistics coursework beyond the core curriculum. The remaining 3 credit hours of coursework may be taken in Mathematics or in a subject related to statistical applications that has been approved by the advisor. An oral defense of the thesis is required.

Master of Science (Mathematics Education Concentration)

The Master of Science with focus in mathematics education consists of a minimum of 30 credit hours and is tailored for secondary school teachers and students who are preparing to become secondary school teachers. Course grades must be A or B with the possible exception of at most two grades of C. Core requirements include a course in abstract algebra (MATH 50500), a course in analysis (MATH 54700 or MATH 50400), a course in geometry (MATH 56100 or MATH 56300), a course in probability (STAT 51600), and a course in statistics (STAT 51700).

Master of Science in Computational Data Science

This degree program is offered through the Departments of Computer & Information Science and Mathematical Sciences of the IUPUI School of Science. The objective of the program is to prepare students to enter the workforce in the rapidly advancing field of data science, an interdisciplinary domain that cuts across computer science and statistics, by providing a solid, comprehensive background in the related topics of theory and their applications.

This program will provide the skills necessary that will enable students to be flexible and competitive in today's job market by gaining deep understanding of theory, implementation (e.g., algorithms and appropriate computing languages), as well as the inherent "nature" of different data modalities, such as classification and prediction challenges on specific data (e.g., sparse and/or incomplete data).

The curriculum requires 30 credits in total that can be completed in three semesters. There are 9 credits for core courses in Computer Science, 6 credits for Statistics core courses, 12 credits for elective courses from Computer Science and/or Statistics, and 3 credits for the capstone course. The students must choose at least two electives from Computer Science and at least two electives from Statistics.

Successful completion of the program requires a minimum plan of study GPA of 3.0, the minimum grade in any course is C and the maximum number of courses with grades of C or C+ is two.

Core Courses:
CSCI 59000 Introduction to Data Science
CSCI 57300 Data Mining
CSCI 57800 Statistical Machine Learning
STAT 51200 Applied Regression Analysis
STAT 52900 Applied Decision Theory and Bayesian Analysis

Capstone Courses:
CSCI 69500 MS Capstone Project
STAT 59800 Topics in Statistical Methods

Elective courses:
CSCI 52000 Computational Methods in Analysis

CSCI 54100 Database Systems
CSCI 55200 Advanced Graphics & Visualization
CSCI 58000 Algorithm Design, Analysis & Implementation
CSCI 59000 Large-Scale Machine Learning
CSCI 59000 High Performance Computing
STAT 51400 Design of Experiments
STAT 52000 Time Series and Applications
STAT 52300 Categorical Data Analysis
STAT 52400 Applied Multivariate Analysis
STAT 52501 Generalized Linear Models
STAT 53600 Introduction to Survival Analysis

The course sequence is crucial for successful completion of this program. Students should consult with the departmental advisor.

General Admission Requirements for MS in Computational Data Science

Prerequisite coursework and/or degrees:

4-year Bachelor's degree in Computer Science, Engineering, Mathematics, Statistics or related fields. 4-year Bachelor's degree in any other area of study will be considered on a case-by-case basis, based on the coursework and corresponding grades in the applicant's transcripts, as well as on the overall potential of successfully completing this program.

GPA: Scores on the Graduate record Exam (GRE) must be submitted for admission consideration.

English Proficiency Requirements: All applicants whose native language is not English are required to submit scores for TOEFL or IELTS. An overall TOEFL IBT score of 80 or higher, or an IELTS band score of 6.5 or higher is required. Applicants submitting TOEFL scores must also meet the following section minimum requirements in addition to the minimum Total requirement: 18 Writing, 18 Speaking, 14 Listening, 19 Reading.

Doctor of Philosophy (Mathematics)

To be admitted to candidacy for the Ph.D. degree, the student must fulfill the following requirements and must be accepted by the graduate committee of the Department of Mathematical Sciences.

Requirements

- The student must pass a suite of four qualifying exams. They must select at least two out of four subject areas from the Core 4 with at least one being either Real Analysis (MATH 54400) or Abstract Algebra (MATH 55300). They must also pass two additional exams from either the remaining Core 4 or the Area Exams.
- The student must satisfy, by one of the five options approved by the graduate school, the world language requirement in German, Russian, or French.
- The student must submit to the graduate school through the department a plan of study including at least 42 credit hours of approved Purdue University graduate coursework.
- The student must pass an advanced topics examination. This examination may be taken only by students who have already passed the qualifying examinations.

A candidate will be recommended to the faculty to receive the Ph.D. degree after a dissertation, submitted in final form, has been accepted by the advisory committee and successfully defended at an open colloquium or seminar.

Doctor of Philosophy (Biostatistics)

Together with the Department of Biostatistics in the Indiana University School of Medicine and the Indiana University Fairbanks School of Public Health at IUPUI, the Department of Mathematical Sciences offers graduate training leading to a Ph.D. in Biostatistics from Indiana University, with all requirements completed on the IUPUI campus. To be admitted to candidacy for the Ph.D. degree, the student must fulfill the following requirements.

Requirements

- The student must pass an initial qualifying examination on the five core courses: STAT 51900, STAT 52500, STAT 52800, STAT 53600, and PBHL-B546.
- The student must complete at least 45 credit hours of formal coursework, consisting of 33 credit hours of required courses and additional 12 credit hours in elective statistics/biostatistics courses of which six credit hours must be at the 600 level and above. An additional 45 credit hours are required and will consist of coursework in a minor area (minimum of 9 credits), further elective courses, independent studies, and directed Ph.D. dissertation research.
- The student must pass a preliminary oral examination, which consists of an oral presentation on an advanced research topic.

A candidate will be recommended to the faculty to receive the Ph.D. degree after a dissertation, submitted in final form, has been accepted by the advisory committee and successfully defended before an open colloquium or seminar.

The department has set time limits for the completion of the Ph.D. degree.

Neuroscience Program

402 N. Blackford Street, LD 124
Indianapolis, IN 46202-3276
Phone: (317) 278-2237; Fax: (317) 274-6756
https://science.iupui.edu/neuroscience/index.html

- **Director** Teri L. Belecky-Adams, Ph.D. (Interim)
- **Advisor** Cynthia Williams

Neuroscience is a rapidly advancing field that examines the structure and function of the nervous system with particular focus on the intersection between the brain and behavior. This field has emerged through the explosive growth of research in the neural sciences and increased interest in the mechanisms that support behavior in humans and in animal models.

The Bachelor of Science degree in Neuroscience offers an interdisciplinary curriculum that is grounded in biology, psychology, physics, chemistry, computer science and mathematical sciences, with the nervous system as a common focus. All students are encouraged to participate in research in laboratories across the School of Science

and the IU School of Medicine utilizing the state-of-the-art experimental methods available to them.

Neuroscience courses will be drawn primarily from the Department of Biology and the Department of Psychology. Foundational coursework will also be completed in Chemistry, Physics, Psychology, and Computer Science. The degree program culminates in a capstone research experience.

Because neuroscience is a rapidly advancing field of inquiry, there is a high demand for trained professionals with knowledge and skills related to neuroscience for careers in medicine, academic or government-supported research, health-related sciences, and biotechnology. It is anticipated that a substantial proportion of graduates may elect to continue their training in graduate or professional school, particularly schools of medicine.

- Bachelor of Science Degree Requirements
- Minor in Neuroscience Requirements
-

Bachelor of Science in Neuroscience Degree Requirements

Degree Requirements

First-Year Experience Course (1 cr.)

Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency (9 cr.)

See the School of Science requirements under “Undergraduate Programs” in this bulletin. The second semester of English composition may be satisfied with ENG-W231 (or ENG-W230, ENG-W270 / ENG-W150, ENG-W320, ENG-W350, TCM 22000, or TCM 32000).

Area II World Language Competency

No world language proficiency is required for a Bachelor of Science degree. However, knowledge of a world language is strongly recommended for any student planning to attend graduate school.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.)

- List H Arts and Humanities Competency: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.
- List S Social Sciences Competency: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin. NOTE: PSY-B110 (or an equivalent introductory psychology course) cannot be used to satisfy this requirement, as the course is required in the major.
- One additional course from List H or List S
- List C Cultural Understanding Competency: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency (19-20 cr.)

The following courses are required:

CHEM-C105 Principles of Chemistry I (3 cr.) and CHEM-C125 Experimental Chemistry I (2 cr.)

CHEM-C106 Principles of Chemistry II (3 cr.) and CHEM-C126 Experimental Chemistry II (2 cr.)

CHEM-C341 Organic Chemistry Lectures I (3 cr.) and CHEM-C343 Organic Chemistry Laboratory I (2 cr.)

One of the following courses or course sequences is required:

CHEM-C342 Organic Chemistry Lectures I (3 cr.) and CHEM-C344 Organic Chemistry Laboratory I (2 cr.)

PHYS 15200 Mechanics (4 cr.) **OR** PHYS-P201 General Physics I (5 cr.) **OR** PHYS 21800 General Physics I (4 cr.)

Area IIID Analytical Reasoning Competency (9 cr.)

Two courses in calculus are required. Starting point to be worked out with departmental advisor based on the math placement test and/or background of the student. Acceptable calculus sequences include

MATH 23100 / MATH 23200 Calculus for the Life Sciences I and II (3 cr./3 cr.)

MATH 22100 / MATH 22200 Calculus for Technology I and II (3 cr./3 cr.)

MATH 16500 / MATH 16600 Analytic Calculus and Geometry I and II (4 cr./4 cr.)

The computer programming requirement may be satisfied with the following. Alternate computer science programming courses may be approved in consultation with an academic advisor.

CSCI-N200 Principles of Computer Science (3 cr.) **OR** CSCCI-N201 Programming Concepts (3 cr.) **OR** CSCI-N207 Data Analysis Using Spreadsheets (3 cr.) **OR** CSCI-N211 Introduction to Databases (3 cr.)

Note: Computer Science CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as a general elective.

Area IV Neuroscience Major Requirements (minimum 48 cr.)

A minimum grade of C- (1.70) or higher is required in all courses in AREA IV, including neuroscience electives. An overall GPA of 2.00 GPA is required for AREA IV.

A. Foundation Courses (25 cr.)

- BIOL-K101 Concepts of Biology I (5 cr.)
- BIOL-K103 Concepts of Biology II (5 cr.) (P: BIOL-K101)
- BIOL-K324 Cell Biology (3 cr.) (P: BIOL-K103 and CHEM-C106)
- NSCI-K416 or BIOL-K416 Cellular & Molecular Neuroscience (3 cr.) (P: BIOL-K324)
- PSY-B110 Introduction to Psychology (3 cr.)

- NSCI-B201 or PSY-B201 Foundations in Neuroscience (3 cr.) (P: PSY-B110 or BIOL-K101)
- NSCI-B301 or PSY-B301 Systems Neuroscience (3 cr.) (P: PSY-B201)

B. Statistical Research Methods(3 cr.)

- PSY-B305/PSY-B306 Statistics with lab (3 cr./1 cr.) (P: Math credit in School of Science and PSY-B110)

OR

- STAT 35000 Introduction to Statistics (3 cr.) (P: MATH 16600)

C. Neuroscience Electives (18 cr.)

Students must complete 3 credits (1 course) from the biology electives course list, and 3 credits (1 course) from the psychology electives course list. Students must also complete an additional 12 credit hours (4 courses) from any courses included in the biology, psychology or chemistry/physics electives course lists. At least 6 Neuroscience elective courses must be completed overall.

A course cannot be used to satisfy two AREA requirements. For example, if CHEM-C342 Organic Chemistry Lecture II is taken for the AREA IIIC Life and Physical Sciences requirement, then it cannot be subsequently used to satisfy AREA IV Part C neuroscience elective requirement. This applies to other courses, including CHEM-C344, PHYS 15200, and PHYS-P201. This is not a complete list of courses that could count in more than one AREA.

Biology Electives Course List

- BIOL-K322 Genetics and Molecular Biology (3 cr.) [strongly recommended, as this serves as a prerequisite for other higher-level electives and is generally required for admission to graduate and professional programs] (P: BIOL-K103 and CHEM-C106)
- BIOL-K331 Developmental Biology (3 cr.) (P: BIOL-K103 and BIOL-K322)
- BIOL-K338 Introductory Immunology (3 cr.) (P: BIOL-K103, BIOL-K322, BIOL-K324, CHEM-C106)
- BIOL-K384 Biological Chemistry (3 cr.) (P: BIOL-K322 or BIOL-K324 and CHEM-C341)
- NSCI-K451 or BIOL-K451 Neuropharmacology (3 cr.) (P: BIOL-K324)
- BIOL-K484 Cellular Biochemistry (3 cr.) (P: BIOL-K322 and CHEM-C342, P or C: BIOL-K324)
- NSCI-K488 or BIOL-K488 Endocrinology in Health and Disease (3 cr.) (P: BIOL-K324 and BIOL-K322 or approved equivalents)
- BIOL-N461 Cadaveric Human Anatomy (only 3 cr. can count here, the other 2 in the upper level lab requirement) (P: BIOL-N261 or permission of instructor)
- BIOL 54410 Sensory Systems (3 cr.) (P: BIOL-K324)
- BIOL 55900 Endocrinology (3 cr.)
- BIOL 56800 Regenerative Biology and Medicine (3 cr.)
- BIOL 57100 Developmental Neurobiology (3 cr.) (Not offered every semester)
- BIOL 69700 Molecular Mechanisms of Neurodegenerative Disease (3 cr.)

Psychology Electives Course List

- PSY-B334 Perception (3 cr.) (P: PSY-B110)
- PSY-B340 Cognition (3 cr.) (P: PSY-B110)
- PSY-B344 Learning (3 cr.) (P: PSY-B110)
- PSY-B356 Motivation (3 cr.) (P: PSY-B110)
- NSCI-B394 or PSY-B394 Drugs and Behavior (3 cr.) (P: PSY-B110)
- NSCI-B398 or PSY-B398 Brain Mechanisms of Behavior (3 cr.) (P: PSY-B301)
- NSCI-I535 or PSY-I535 Clinical Neuroscience (3 cr.)
- PSY-I545 Psychopharmacology (3 cr.)
- PSY-I560 Behavioral Genetics (3 cr.)

Chemistry/Physics Electives Course List

- CHEM-C342 Organic Chemistry II (3 cr.) (If used in AREA IIIC, then the course cannot apply to the AREA IV Part C requirement.)
- CHEM-C371 Chemical Informatics (1 cr.)
- CHEM-C372 Chemical Informatics II: Molecular Modeling (2 cr.)
- CHEM-C484 Biomolecules and Catabolism (3 cr.)
- CHEM-C485 Biosynthesis and Physiology (3 cr.)
- PHYS 15200 Mechanics (4 cr.) (If used in AREA IIIC, then the course cannot apply to the AREA IV Part C requirement.)
- PHYS 25100 Heat, Electricity and Optics (5 cr.)
- PHYS-P201 General Physics I (5 cr.) (If used in AREA IIIC, then the course cannot apply to the AREA IV Part C requirement.)
- PHYS-P202 General Physics II (5 cr.)
- PHYS 21900 General Physics II (4 cr.)
- PHYS 58500 Introduction to Molecular Biophysics (3 cr.)

D. Upper-level Laboratory (1-2 cr.)

To receive credit for a laboratory for which there is an accompanying pre- or co-requisite lecture, the lecture must be completed with a minimum grade of C. Laboratory courses can be enrolled concurrently with the lecture (often preferred) or in a semester after the completed lecture.

- BIOL-K323 Genetics and Molecular Biology Laboratory (2 cr.)
- BIOL-K325 Cell Biology Laboratory (2 cr.)
- BIOL-K333 Developmental Biology Laboratory (1 cr.)
- BIOL-K339 Immunology Laboratory (2 cr.)
- CHEM-C344 Organic Chemistry Laboratory II (2 cr.) (If used in AREA IIIC, then the course cannot apply to the AREA IV Part C requirement.)
- CHEM-C486 Biological Chemistry Laboratory (2 cr.)
- BIOL-N461 Cadaveric Anatomy (2 cr. of the 5 credit course can count here)

E. Capstone (1 course or course sequence; where not indicated, credit hours to be determined in consultation with advisor)

- BIOL-K493 Independent Research (minimally 2 cr.) and BIOL-K494 Senior Research Thesis (minimally 1 cr.) (2 semesters - fall and spring - and requires application due in spring semester before the fall semester starts)

OR

- PSY-B499 Capstone Honors Research (2 semesters - fall and spring - and requires application due in spring semester before the fall semester starts)

  OR

- NSCI-N491 Behavioral Neuroscience Capstone Lab (spring semesters only)

  OR

- NSCI-N492 Capstone in Computational Neuroscience (fall semesters only)

  OR

- CHEM-C494 Intro to Capstone in Chemistry (1 cr.) (junior standing) and CHEM-C495 Capstone in Chemistry (1 cr.) (senior standing). Requires permission from instructor and independent project advisor.

  OR

- MATH 49200 Capstone Experience

  OR

- PHYS 49000 Undergraduate Readings and Research

Neuroscience Plan of Study

No single semester-by-semester plan of study will guide all students through the degree option because of the flexibility encouraged within the program. However, one possible sequence of courses is given below; variations from this example should be made in consultation with the program advisor.

Sample Program (120 cr. required)

Freshman Year

First Semester	
SCI-I120 Windows on Science	1
BIOL-K101 Concepts of Biology I	5
MATH 23100 Calculus for Life Science I	3
PSY-B110 Introduction to Psychology	3
ENG-W131 Reading, Writing and Inquiry	3
Total	**15**
Second Semester	
COMM-R110 Fundamentals of Speech Communication	3
BIOL-K103 Concepts of Biology II	5
MATH 23200 Calculus for Life Science II	3
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
Total	**16**

Sophomore Year

Third Semester	
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
2nd Written Communications Course	3
CSCI-N207 Data Analysis Using Spreadsheets	3
PSY-B201 Foundations of Neuroscience	3
Arts & Humanities (choose from list)	3
Total	**17**
Fourth Semester	
BIOL-K324 Cell Biology	3
CHEM-C341 Organic Chemistry I Lecture	3
CHEM-C343 Organic Chemistry I Laboratory	2
Social Science (choose from list)	3
Culutural Understanding (choose from list)	3
PSY-B301 Systems Neuroscience	3
Total	**17**

Junior Year

Fifth Semester	
BIOL-K416 Cellular and Molecular Neuroscience	3
Major Upper-Level Laboratory Course (choose from list)	2
Statistical Research Methods course (choose from list)	3
Life and Physical Science (choose from list)	5
Elective/Minor course	3
Total	**16**
Sixth Semester	
Major Neuroscience Elective Course	3
Neuroscience Psychology Elective Course	3
Neuroscience General Elective Course	5
Elective (RISE course)	3
Total	**14**

Senior Year

Seventh Semester	
Neuroscience Biology Elective Course	3

Neuroscience Major Elective Course	3-5
Capstone course	1-3
Elective/Minor courses	6
Arts & Humanties/Social Science (choose from list)	3
Total	**13 - 17**
Eighth Semester	
Capstone course	1 - 3
Neuroscience Major Elective course	2 - 4
Elective/Minor courses	1 - 6
Total	**8 - 12**

Minor in Neuroscience Requirements

Minor in Neuroscience

The School of Science offers a minor in the field of neuroscience. Neuroscience is a very interdisciplinary field, encompassing biology, chemistry, mathematics and psychology, as well as other disciplines. Students majoring in one of these areas may have a strong interest in neuroscience, but prefer to major in one of the specific disciplines.

Due to its interdisciplinary nature, a minor in neuroscience intentionally and transparently links different disciplines together. The minor will allow students to understand, apply and analyze the connections among disciplines. These abilities will help them apply their life sciences learning to the rest of their education, and better prepare them for graduate and/or professional studies in this new and expanding field.

Minor Requirements

The minor requires 15 credit hours (5 courses):

Core Courses

- PSY-B201 Foundations of Neuroscience (3 cr.) P: PSY-B110 or BIOL-K101
- PSY-B301 Systems Neuroscience (3 cr.) P: PSY-B201
- BIOL-K416 Cellular and Molecular Neuroscience (3 cr.) P: BIOL-K324

2 Neuroscience elective courses:

One course from the Biology Elective Course List (3 cr.)

- BIOL-K322 Genetics and Molecular Biology P: BIOL-K103 & CHEM-C106 (This course is strongly recommended, as it serves as a prerequisite for other higher-level electives and generally is required for admission to graduate and professional programs.)
- BIOL-K331 Embryology P: BIOL-K103 & BIOL-K322
- BIOL-K338 Introductory Immunology P: BIOL-K103 & CHEM-C106
- BIOL-K384 Cellular Biochemistry P: CHEM-C341 and BIOL-K324 or BIOL-K322
- BIOL-K483 Biological Chemistry P: CHEM-C342
- BIOL 55900 Endocrinology P: BIOL 55600 or equivalent & CHEM-C342
- BIOL 56800 Regenerative Biology and Medicine P: BIOL-K324 or BIOL-K331 or a biochemistry course
- BIOL 57100 Developmental Neurobiology P: consent of instructor (Not offered every semester)

One course from the Psychology Elective Course List (3 cr.)

- PSY-B334 Perception P: see below*
- PSY-B340 Cognition P: PSY-B110
- PSY-B344 Learning P: see below*
- PSY-B356 Motivation P: see below*
- PSY-B394 Drugs and Behavior P: see below*
- PSY-B398 Brain Mechanisms of Behavior P: PSY-B301 or PSY-B320
- PSY-I535 Clinical Neuroscience
- PSY-I545 Psychopharmacology**
- PSY-I560 Behavioral Genetics*

- * P: Three (3) credit hours of introductory psychology
- ** Requires permission of instructor

Apply for a minor

To qualify for minor certification, students must complete the online form. For more information on the Neuroscience program, please contact Cynthia Williams, director of student development, or call 317-274-6765.

Department of Psychology

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Department Advisors:

- Graduate Programs:
  - Jesse Stewart, Ph.D. (Director of Graduate Studies)
  - Leslie Ashburn-Nardo, Ph.D. (Applied Social and Organizational Psychology; Industrial/Organizational Psychology)
  - Cristine Czachowski, Ph.D. (Addiction Neuroscience)
  - Melissa Cyders, Ph.D. (Clinical Psychology)
- Undergraduate Programs:
  - Bethany Neal-Beliveau, Ph.D. (Director of Undergraduate Studies)
  - Jared Trullinger (student last names A - L)
  - Beth Goodman (student last names M - Z)

Psychology is the study of behavior and mental processes. Psychologists apply the scientific method to a range of questions that are as varied as how eyes perceive light and form, how children develop a sense of morality, and under what conditions people help in emergencies. As an applied profession, psychologists use research results to solve personal and social problems. Because the subject matter of psychology is broad, psychologists have become specialized. Specialization allows each psychologist to apply the general principles of science and behavior to a given area of interest.

These include motivation and learning, child and adult development, social behavior of humans and animals, personality, thought processes, consumer behavior, and many more. Many psychologists, who function as research professionals, have academic positions in colleges and universities where they teach and conduct research. Psychologists who function as applied professionals specialize in areas that include clinical, counseling, health care, rehabilitation, human factors, and industrial psychology.

The Department of Psychology offers undergraduate programs leading to the Bachelor of Arts (B.A.) and Bachelor of Science (B.S.) degrees. Four recurring themes are emphasized throughout the curriculum. First, psychology is a science, and its purpose is to describe, explain, predict, and change behavior. Second, behavior is influenced by person variables (internal factors), environment variables (external factors), and their interaction. Third, psychology has evolved in a socio-historical context and its major theoretical perspectives reflect this phenomenon, and fourth, cultural contexts influence how psychological concepts are understood and applied by individuals.

The Department of Psychology offers graduate study in industrial/organizational psychology [Master of Science (M.S.) degree], addiction neuroscience [Doctor of Philosophy (Ph.D.) degree]. applied social and organizational psychology (Ph.D. degree) and clinical (Ph.D. degree).

- Undergraduate Programs
- Undergraduate Honors Programs
- Graduate Programs
- Plan of Study
- Minor

Undergraduate Degree Programs

Bachelor of Arts and Bachelor of Science

Students are encouraged to consult with an academic advisor for determination of whether to pursue B.A. or a B.S. degree.

Degree Requirements

The School of Science Requirements for the Bachelor of Arts and Bachelor of Science degrees are listed in this bulletin (see Area and General Requirements under "Undergraduate Programs").

First-Year Experience Course

Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Transfer students with over 19 credit hours are not required to take SCI-I120, but are strongly urged to take PSY-B303 *Career Planning for Psychology Majors* (1 cr.) in their first semester on campus.

Area Requirements

Area I English Composition and Communication Competency

See the School of Science requirements under “Undergraduate Programs” in this bulletin.

All students are required to complete three courses, totaling 9 credit hours:

- ENG-W131 Reading, Writing, and Inquiry I
- Second semester of English composition (ENG-W231 is recommended)
- COMM-R110 Fundamentals of Speech Communication

Area II World Language Competency

See the School of Science Area Requirements under "Undergraduate Programs" for details

Bachelor of Arts students must have first-year proficiency in a world language: (first-year sequence or two 4-cr. courses); or exam placement into a second-year or third-year course.

Bachelor of Science students are not required to have first-year world language proficiency.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies

See the School of Science requirements under “Undergraduate Programs” in this bulletin for details.

All students are required to complete four courses, totaling 12 credit hours.

List H Arts and Humanities Competency: Choose one course from the list of course choices located in the School of Science Area requirements under "Undergraduate Programs" in this bulletin.

List S Social Sciences Competency: Choose one course from the list of course choices located in the School of Science Area requirements "Undergraduate Programs" in this bulletin. The Social Sciences course cannot be a psychology course.

One additional course from either the Arts and Humanities or Social Sciences list of course choices.

List C Cultural Understanding Competency: Choose one course from the list of course choices located in the School of Science Area requirements under "Undergraduate Programs" in this bulletin. The Culutural Understanding course cannot be a psychology course.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

See the School of Science requirements under “Undergraduate Programs” in this bulletin for details.

Bachelor of Arts students are required to complete at least four science lectures courses (minimum of 12 credit hours), and at least one of the courses must have a laboratory component.

Bachelor of Science students are required to complete at least four science lectures courses (minimum of 12 credit hours), and at least one of the courses must have a laboratory component. Two of the required four courses must be biology and/or chemistry courses.

Students should consult with an academic advisor in the Department of Psychology to determine which courses

are most appropriate to take based on their academic and career goals.

Note: There are science courses that do not count in Area IIIC, as well as overlapping courses with credit not being allowed for both of two overlapping courses / course sequences. A partial list can be found in the School of Science Area or General Requirements. If you have a question about whether a course is applicable or if it overlaps with a course that you have already taken, please consult with an academic advisor in the Department of Psychology or check with the School of Science Dean's Office prior to registering to confirm.

Area IIID Analytical Reasoning Competency

See the School of Science requirements under "Undergraduate Programs" in this bulletin for details.

Bachelor of Arts students must have at least one 3-cr. course in mathematics and one 3-cr. course in computer programming. MATH-M118 Finite Mathematics and CSCI-N207 Data Analysis Using Spreadsheets are recommended to fulfill the IIID Analytical Reasoning Competency Requirement.

Bachelor of Science students must have at least two 3-cr. courses beyond algebra and trigonometry, (total of 6 credit hours). In addition, one 3-cr. computer programming course is required. MATH-M118 Finite Mathematics, MATH-M119 Brief Survey of Calculus, and CSCI-N207 Data Analysis Using Spreadsheets are recommended to fulfill the IIID Analytical Reasoning Competency Requirement. However, some pre-professional programs require specific mathematics courses, so students should consult with an academic advisor.

Note: There are math and computer science courses that do not count for any credit toward a degree in the School of Science or do not count as a Baccalaureate requirement. A partial list can be found in the School of Science Area and General Requirements. If you have a question about whether a course counts toward your degree or fulfills the Baccalaureate requirement, please consult with an academic advisor in the Department of Psychology or check with the School of Science Dean's Office prior to registering to confirm.

Area IV Major Requirements

See the following section, "Major in Psychology (B.A. or B.S.)."

Major in Psychology (B.A. or B.S.)

The Department of Psychology at IUPUI has a program for majors that requires a minimum of 40 credit hours of selected course work.

Introductory Sequence (Three courses; 7 credit hours)

- PSY-B110 Introduction to Psychology
- PSY-B203 Ethics and Diversity in Psychology
- PSY-B303 Career Planning for Psychology Majors

Research Methods Sequence (Two courses, two labs; 9 credit hours)

- PSY-B305 Statistics (P: MATH-M118 or other upper-level mathematics course)
- PSY-B306 Statistics Lab (P: MATH-M118 or other upper-level mathematics course)
- PSY-B311 Research Methods in Psychology (P: PSY-B305)
- PSY-B312 Research Methods Lab in Psychology (P: PSY-B305)

Psychology Foundation Courses (Four courses, 12 credit hours)

- PSY-B310 Life Span Development
- PSY-B320 Behavioral Neuroscience*
- PSY-B340 Cognition
- PSY-B370 Social Psychology

*Students earning a double major in Psychology and Neuroscience or a minor in Neuroscience must replace PSY-B320 with the PSY-B201/PSY-B301 sequence. Students will not receive credit for both PSY-B320 and PSY-B301.

Psychology Content Courses (three courses; 9 credit hours)

Select Three of the following courses:

- PSY-B307 Tests and Measurement
- PSY-B322 Introduction to Clinical Psychology
- PSY-B334 Perception
- PSY-B344 Learning
- PSY-B346 Theories of Personality
- PSY-B356 Motivation
- PSY-B358 Introduction to Industrial/Organizational Psychology
- PSY-B360 Child and Adolescent Psychology
- PSY-B365 Health Psychology
- PSY-B375 Psychology and Law
- PSY-B376 The Psychology of Women
- PSY-B380 Abnormal Psychology
- PSY-B385 Positive Psychology
- PSY-B386 Introduction to Counseling
- PSY-B394 Drugs and Behavior
- PSY-B396 Alcoholism and Drug Abuse
- PSY-B398 Brain Mechanisms of Behavior

Capstone (One course; 3 credit hours)

Select one of the following courses:

- PSY-B433 Capstone Laboratory in Psychology
- PSY-B454 Capstone Seminar in Psychology
- PSY-B456 Capstone Service Learning in Psychology
- PSY-B482 Capstone Practicum in Clinical Psychology*
- PSY-B499 Capstone Honors Research**

*The Capstone Practicum in Clinical Psychology course is only offered in the fall semester and requires an application due in April of the semester prior to taking the course. Ask your advisor for details.

**PSY-B499 requires an application due in April for the following academic year and a two-semester commitment that begins in the fall semester. Ask your advisor for details.

Note: Students should discuss capstone options with an academic advisor to determine which is most appropriate for you based on your career and academic goals. Each option has a set of prerequisites that must be completed before enrolling in the capstone. Except under special

circumstances, capstone courses are taken during the senior year.

Elective Courses

Depending on your program, there will be approximately 40 credit hours of electives. These elective courses can be used to complete minor, certificate, or double major requirements. Psychology offers a number of courses that fulfill the RISE initiative. Students should talk to an advisor to determine which elective courses fit best with their academic and career goals.

Plans of Study

Although there is no single semester-by-semester plan of study for either the B.A. or the B.S. degree, one possible sequence of courses for each of these degrees is given below. Variations from these examples should be made, based on the student's academic history and career plans, through consultation with an academic advisor. For career and graduate school information related to psychology, please refer to relevant sections of the psychology department's website https://psychology.iupui.edu/. To graduate in four years, a student generally must take at least four semesters of 15 credits and four semesters of 16 credits. Students with heavy outside commitments (e.g., work and/or family) may want to decrease their course load each semester. By taking additional courses each summer, it may still be possible to graduate in four years.

Bachelor of Arts Sample Program (120 cr. required)

Freshman Year

First Semester	
SCI-I120 Windows on Science	1
PSY-B110 Introduction to Psychology	3
ENG-W131 Reading, Writing and Inquiry I	3
World Language (Cultural Understanding)	4
MATH-M118 Finite Mathematics*	3
Total	**14**
Second Semester	
COMM-R110 Fundamentals of Speech Communication	3
World Language**	4
Life and Physical Sciences (choose from approved list)***	3
PSY-B203 Ethics and Diversity in Psychology	3
Arts and Humanities (choose from list)	3
Total	**16**

Sophomore Year

Third Semester	
ENG-W231 Professional Writing Skills	3
PSY-B303 Career Planning Psychology Majors	1
Psychology Foundations course (choose from approved list)	3
Life and Physical Sciences (choose from approved list)	4
PSY-B305 Statistics	3
PSY-B306 Statistics Lab	1
Total	**15**
Fourth Semester	
CSCI-N207 Data Analysis Using Spreadsheets	3
PSY-B311 Research Methods in Psychology	3
PSY-B312 Research Methods Lab	2
Psychology Foundations Course (choose from approved list)	3
Arts and Humanities/Social Sciences (choose from list)	3
Total	**14**

Junior Year

Fifth Semester	
Psychology Foundations course (choose from approved list)	3
Psychology Foundations course (choose from approved list)	3
Psychology Content course (choose from approved list)	3
Life and Physical Sciences (choose from approved list)	3
Elective/minor course	3
Total	**15**
Sixth Semester	
Psychology Content course (choose from approved list)	3
Social Science (choose from list)	3
Life and Physical Sciences (choose from approved list)	3
Elective/RISE course	3
Elective/minor course	3
Total	**15**

Senior Year

Seventh Semester	
Psychology Content course (choose from approved list)	3
Elective/minor courses	12
Total	**15**
Eighth Semester	

Psychology Capstone course	3
Elective/minor courses	13
Total	**16**

* Students who do not test successfully into MATH-M118 must complete one or more lower-level math classes to develop the skills necessary to perform well in MATH-M118. Credits earned for these remedial math classes do not count as part of the required 120 credit hours to graduate.

** For students needing courses to establish first-year proficiency in a modern foreign language. Otherwise, other courses may be taken to fulfill area requirements or electives.

***Students should check with their Academic Advisor or the Psychology Peer Advising office for the approved list.

Bachelor of Science Sample Program (120 cr. required)

Freshman Year

First Semester	
SCI-I120 Windows on Science	1
PSY-B110 Introduction to Psychology	3
ENG-W131 Reading, Writing and Inquiry I	3
MATH-M119 Brief Survey of Calculus 1*	3
Life and Physical Science (choose from approved list)**	4
Total	**14**
Second Semester	
PSY-B203 Ethics and Diversity in Psychology	3
COMM-R110 Fundamentals of Speech Communication	3
Arts and Humanities (choose from list)	3
MATH-M118 Finite Mathematics*	3
Life and Physical Science (choose from approved list)	3
Total	**15**

Sophomore Year

Third Semester	
ENG-W231 Professional Writing Skills	3
PSY-B303 Career Planning Psychology Majors	1
PSY-B305 Statistics	3
PSY-B306 Statistics Lab	1
Psychology Foundations course (choose from approved list)	3
CSCI-N207 Data Analysis Using Spreadsheets	3
Total	**14**
Fourth Semester	
PSY-B311 Research Methods in Psychology	3
PSY-B312 Research Methods Lab	2
Psychology Foundations course (choose from approved list)	3
Arts and Humanities/Social Sciences (choose from list)	3
Cultural Understanding (choose from list)	3
Total	**14**

Junior Year

Fifth Semester	
Psychology Foundations course (choose from approved list)	3
Psychology Content course (choose from approved list)	3
Psychology Content course (choose from approved list)	3
Life and Physical Science (choose from approved list)	3
Elective/minor course	3
Total	**15**
Sixth Semester	
Psychology Foundations course (choose from approved list)	3
Social Science (choose from list)	3
Life and Physical Sciences (choose from approved list)	3
Elective (RISE course)	3
Elective/minor course	3
Total	**15**

Senior Year

Seventh Semester	
Psychology Content course (choose from approved list)	3
Elective/minor courses	12
Total	**15**
Eighth Semester	
Psychology Capstone course	3
Elective/minor courses	15
Total	**18**

* Students who do not test successfully into MATH-M118/ MATH-M119 must complete one or more lower-level math courses to develop the skills necessary to perform well in MATH-M118/MATH-M119. Credits earned for the remedial

math courses do not count as part of the required 120 credit hours to graduate.

** Students should check with their Academic Advisor or the Psychology Peer Advising Office for the approved list.

Minors

Minor in Health Psychology

The Department of Psychology offers an undergraduate minor program in health psychology that requires a minimum of 15 credit hours of selected course work. Interested students should obtain information from the Psychology Advising Office (psyadv@iupui.edu). Course requirements are as follows:

Required Courses (Fours courses: 12 credit hours)

- PSY-B365 Health Psychology
- PSY-B320 Behavioral Neuroscience*
- PSY-B370 Social Psychology
- PSY-B380 Abnormal Psychology

*The PSY-B201/PSY-B301 sequence will count in lieu of PSY-B320.

Elective Courses (One course; 3 credit hours)

Select one course from the following:

- PSY-B203 Ethics and Diversity in Psychology
- PSY-B310 Lifespan Development
- PSY-B386 Introduction to Counseling
- PSY-B396 Alcoholism and Drug Abuse
- SOC-R321 Women and Health
- SOC-R381 Social Factors in Health and Illness
- Other approved course (contact Psychology advisor)

PLEASE NOTE:

- No grade lower than C- is acceptable for any course in the minor.
- A minimum grade point average of 2.00 in minor courses is required.
- A minimum of 6 credit hours in the minor must be completed at IUPUI.
- Students pursuing a Psychology major cannot earn a minor in Health Psychology.
- Students pursuing a minor from the department must select either Health Psychology or Psychology. They cannot earn both minors.

Note: PSY-B110 or equivalent is a prerequisite for upper-level psychology courses..

Minor in Psychology

The Department of Psychology offers an undergraduate minor program in psychology that requires a minimum of 15 credit hours of selected course work. Interested students should obtain information from the Psychology Advising Office (psyadv@iupui.edu). Course requirements are as follows:

Psychology Foundation Courses (Two courses; 6 credit hours)

Select two courses from the following:

- PSY-B310 Life Span Development
- PSY-B320 Behavioral Neuroscience*
- PSY-B340 Cognition
- PSY-B370 Social Psychology

*The PSY-B201/PSY-B301 sequence will count in lieu of PSY-B320
NOTE: Additional foundation courses will count towards required content courses.

Psychology Minor Content Courses (Three courses; 9 credit hours)

Select three additional psychology courses from the following:

- PSY-B203 Ethics and Diversity in Psychology
- PSY-B307 Tests and Measurement
- PSY-B322 Introduction to Clinical Psychology
- PSY-B334 Perception
- PSY-B344 Learning
- PSY-B346 Theories of Personality
- PSY-B356 Motivation
- PSY-B358 Introduction to Industrial/Organizational Psychology
- PSY-B360 Child and Adolescent Psychology
- PSY-B365 Health Psychology
- PSY-B375 Psychology and Law
- PSY-B376 The Psychology of Women
- PSY-B380 Abnormal Psychology
- PSY-B385 Positive Psychology
- PSY-B386 Introduction to Counseling
- PSY-B394 Drugs and Behavior
- PSY-B396 Alcoholism and Drug Abuse
- PSY-B398 Brain Mechanisms of Behavior

PLEASE NOTE:

- No grade lower than C- is acceptable for any course in the minor.
- A minimum grade point average of 2.00 in minor courses is required.
- A minimum of 6 credit hours of the minor must be taken at IUPUI.
- Students pursuing a Psychology major cannot earn a minor in Psychology.
- Students pursuing a minor from the department must select either Psychology or Health Psychology. They cannot earn both minors.

Note: PSY-B110 or equivalent is a prerequisite for upper-level psychology courses.

Psi Chi: The International Honor Society in Psychology

To become a member of Psi Chi, an undergraduate psychology major must have earned at least 9 credit hours of psychology classes and possess an overall GPA of 3.00 and a GPA of 3.50 in psychology classes. Interested students should submit an application to the Psi Chi faculty advisor. There is a one-time, lifetime membership fee.

Graduate Programs

The department offers Purdue University Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degree programs and one Indiana University Ph.D. degree program. At the M.S. level, a program is offered in industrial/organizational psychology. At the Ph.D.

level, programs are offered in addiction neuroscience, applied social and organizational psychology and clinical psychology.

M.S. Program

Industrial/Organizational Psychology

The Industrial/Organizational Psychology M.S. program is designed to prepare individuals for positions in industry or for entry into an industrial/ organizational doctoral program. Students are familiarized with the scientist-practitioner model, which emphasizes both research and the application of problem-solving skills to organizational problems. Students in the Program are taught analytic methods for diagnosing work-related problems, developing solutions, and evaluating the effectiveness of those solutions. The curriculum focuses on both the traditional personnel psychology areas of selection, training, compensation, and performance evaluation as well as topics of organizational psychology such as decision-making, motivation, leadership, and organizational effectiveness. The M.S. degree may be completed on a full-time basis and normally takes two or three years to finish. A minimum of 30 credit hours is required including departmental core, area core, and elective courses.

Ph.D. Programs

Addiction Neuroscience

The Addiction Neuroscience Ph.D. program is designed to promote a comprehensive understanding of the neurobiological bases of behavior, with an emphasis on the behavioral and neurobiological aspects of drugs of abuse and addictive behaviors. General goals of the Program are to develop knowledge and expertise in the neurobiological mechanisms of behavior, develop skills in applying methods of behavioral neuroscience research to the problems of alcohol and drug abuse and addiction, and train competence in communication and teaching of knowledge and research skills. Students will obtain broad training in the combined disciplines of the neurosciences (e.g., behavioral and developmental neuroscience, psychopharmacology, and neurobiology) and the behavioral sciences (e.g., experimental psychology, cognitive psychology, learning, experimental design and analysis, and animal models of drug abuse and addiction). A minimum of 85 credit hours (post-baccalaureate) are required, plus approval of the plan of study by the student's advisory committee. The Program intends to train students seeking careers in teaching and/or research in academic environments, medical institutions, pharmaceutical firms, and governmental agencies.

Applied Social and Organizational Psychology

The Applied Social and Organizational Psychology (ASOP) Ph.D. program subscribes to the scientist-practitioner model and is designed to train researchers and practitioners to address societal and organizational issues using theories and methods from social and industrial/organizational (I/O) psychology. Graduates will be prepared for the unique challenges associated with today's increasingly global and diverse workplace through the infusion of diversity throughout our curriculum as well as an innovative concentration in Diversity Science. Diversity Science utilizes social science methods to examine the creation and maintenance of group differences as well as the consequences (e.g., psychological, organizational, and societal) of those differences. The ASOP curriculum integrates aspects of social and I/O psychology, including attitudes and social cognitive processes, staffing and development, and organizational issues at the micro, meso, and macro levels, with a heavy emphasis on quantitative methods and supervised research. As an Indiana University degree program, students must also complete a 12-14 credit hour minor (e.g., in Mixed Methods in Data Analytics for Social/Behavioral Sciences or a customized minor as approved by faculty committee). Graduates will be prepared for faculty positions in Social or I/O Psychology or related sub-disciplines of Psychology or Management.

In addition, they will be prepared for management, consulting, diversity specialist, or research positions in profit, not-for-profit, or governmental agencies. The program is full-time, requires a minimum of 91 credit hours, and is expected to take approximately four years to complete.

Clinical Psychology

The Clinical Psychology Ph.D. program is designed to integrate the assessment and intervention strategies of empirically-based clinical psychology with health/ rehabilitation psychology's emphasis on optimizing the adaption of people with chronic, disabling medical conditions. The Program addresses the psychological and social consequences of physical and mental conditions.

As scientists, we study behaviors, experiences, and attitudes of people with chronic physical and/or mental health conditions and their families, and evaluate the effectiveness of treatment interventions. The Program emphasizes the acquisition of the methods, theories, and knowledge of behavioral science along with the practitioner skills of clinical psychology. As practitioners, we assess individuals and their environment, plan and implement psychosocial interventions, and monitor their progress over time. The Program focuses on a wide variety of social, psychological, and practical problems, such as social functioning, emotional well-being, family relationships, activities of daily living, employment, and independent living. As a Program, we offer specialization training in three areas within clinical psychology: clinical health psychology, severe mental illness/psychiatric rehabilitation or substance use. Within these areas, there is a strong emphasis on research. The range of populations subsumed is broad and includes such populations as people with severe and persistent mental illness, cardiovascular disease, chronic pain, cancer, and substance use disorders.

The Program adheres to a clinical science model of training. As such, students seeking strong research training in conjunction with clinical training with an emphasis in clinical health psychology, severe mental illness/psychiatric rehabilitation, or substance use would be the best fits for this program.

Graduates of the Program will be qualified to assume positions as academicians, evaluators, researchers, trainers, planners, consultants, and direct clinical service providers. The Program emphasizes rigorous academic training, which is combined with practical application in a wide variety of clinical settings in Indianapolis and elsewhere. Full-time study and a minimum of 90 credit hours (post-baccalaureate) are required, and it is expected that it will take five to six years to complete

the Program. The Program includes a diverse training in psychology, including a psychology core, statistics and measurement, clinical psychology, internships and practica, and an empirical thesis and doctoral dissertation. Clinical specialty courses in Health Psychology and Psychiatric Rehabilitation are offered. A course in ethics is also required.

Financial Support

Financial support for eligible graduate students at both the M.S. and Ph.D. levels is available through teaching and research assistantships, tuition stipends, and fellowships. Full assistantships require a minimum of 20 hours of work per week and include at least partial tuition remission in addition to salary.

Admission Requirements

Industrial/Organizational Psychology

Undergraduate training in psychology, mathematics, and the sciences is highly desirable though not required; we will consider applicants with bachelor's degrees in similar areas with coursework in social science statistics and research methods. Applicants should have had at least one undergraduate course in statistics, and one in tests and measurement is also advantageous. To be considered for admission without probation, applicants must obtain (a) a baccalaureate degree from a college or university of recognized standing, (b) a grade point average of 3.00 or higher on a 4.00 scale, (c) competitive GRE scores, and (d) three favorable letters of recommendation, ideally from faculty or others who can speak to the applicant's preparation for graduate level work in psychology. The student who does not meet these standards, but shows potential for graduate studies, could be recommended for conditional admission.

Addiction Neuroscience

This Ph.D. Program is designed for individuals interested in academic or research careers studying addiction neuroscience. Successful applicants typically have (a) an undergraduate and graduate grade point average of 3.20 or higher on a 4.00 scale, (b) competitive GRE scores, (c) three favorable letters of recommendation, and (d) a personal statement expressing an interest in addiction neuroscience. Students with undergraduate degrees in psychology or the life sciences (e.g., biology, chemistry, neuroscience) are encouraged to apply, although other degrees along with appropriate course work will be given full consideration on application.

Applied Social and Organizational Psychology

A bachelor's degree in psychology is highly desirable, but we will consider applicants with bachelor's or graduate degrees in similar areas with coursework in social science statistics and research methods. To be competitive, applicants should have (a) an undergraduate (and graduate, if applicable) grade point average of 3.20 or higher on a 4.00 scale, (b) competitive GRE General Test scores with subtest percentile ranks at or above the 50th percentile, (c) three favorable letters of recommendation, ideally from faculty or others who can speak to the applicant's preparation for graduate level work in psychology, (d) a personal statement expressing an interest in applied social and organizational psychology, and (e) relevant research experience, preferably in psychology or a related social science.

Clinical Psychology

Undergraduate training in psychology, mathematics, and the physical sciences is highly desirable, though not required.

Except in unusual circumstances, students admitted to the Program are expected to have completed at least 15 credit hours in psychology.

Although there are no specific undergraduate course prerequisites for Program entry, students without coursework in the following areas will likely be at a disadvantage when taking some of the required courses:

1. Test and Measurement
2. Statistics
3. Human Physiology or Physiological Psychology (Behavioral Neuroscience)
4. Abnormal Psychology

Students without preparation in these areas may be asked by their instructors to complete some remedial activity prior to enrolling in the graduate course (e.g., reading an undergraduate text or taking an undergraduate course).

The Ph.D. Program seeks talented and motivated people who have an interest in clinical health psychology, severe mental illness/psychiatric rehabilitation, or substance use and who have the potential to make creative contributions as clinical psychologists. Admission to the Ph.D. Program is competitive and only under unusual circumstances will students be considered for admission if they fail to meet the following minimum standards: (a) an undergraduate and graduate grade point average of 3.20 or higher on a 4.00 scale, (b) competitive GRE scores, (c) three favorable letters of recommendation, and (d) a personal statement expressing an interest in the field of clinical psychology. Prior research experience is recommended, but not required for admission. Scores on the Verbal and Quantitative sections at or above the 50th percentile are recommended to b competitive for admission. The Psychology GRE is recommended, but not required.

Admission Information

Students are admitted only for fall enrollment, and the deadline for receipt of application materials is specific to each graduate program:

- December 1 - Clinical (Ph.D.)
- December 1 - Addiction Neuroscience (Ph.D.)
- December 15 - Applied Social and Organizational Psychology (Ph.D.)
- February 1 - Industrial/Organizational Psychology (M.S.)

Students interested in information about admission to graduate programs in psychology should visit the Psychology Department webpage at https://science.iupui.edu/psychology/ for information on admission requirements and application instructions.

Questions may be emailed to the graduate program coordinator at gradpsy@iupui.edu.

Transfer Credit

A maximum of 8 credit hours can be transferred into the M.S. program, and a maximum of 30 credit hours can

be transferred into the Ph.D. program. Transfer hours will be accepted only if they are appropriate and judged acceptable by the student's plan-of-study committee. For full information regarding transfer of credit, please see the Policies and Procedures webpage at: https://bulletins.iu.edu/iu/gradschool/2018-2019/policies/credit.shtml.

Temporary Student Status

A student may enroll in some graduate courses without formal admission into a Psychology graduate program; however, the student must be admitted by the IUPUI Graduate Office into the Graduate Non-Degree Program. No more than 12 hours of credit may be applied to an advanced degree program if an individual is later admitted as a regular graduate student. However, if an application to a regular degree program is approved during the session in which a person is enrolled for the 12th credit hour as a non-degree registrant, then all credits taken before and during that term will be eligible for inclusion in a plan of study for a degree program. For inclusion, the courses must be appropriate to the degree program and acceptable to the department and the graduate school. No course in which a grade of less than B (e.g., B-) has been received will be permitted in a plan of study if the course was taken while the student was enrolled as a non-degree registrant. Non-degree registrants may be required to secure consent from each of the departments in which they would like to register for courses

Research Facilities

The Department of Psychology has extensive laboratory and computer facilities to support faculty and student research. More than 8,000 square feet of laboratory space in the School of Science complex is devoted to psychological research in the areas of clinical psychology, industrial/organizational psychology, and social psychology life span development, and cognition. Separate animal quarters and modern laboratories are also available in the SELB Building to support research in neuroscience. Internship and practicum sites are available at the Indiana University Medical Center and with numerous other organizations in the Indianapolis metropolitan area.

Research Interests of Faculty

Major research interests of faculty include social psychology, industrial/organizational psychology, diversity psychology, measurement theory and development, program planning and evaluation, clinical psychology, health psychology, psychiatric rehabilitation, psychopathology, behavioral and psychopharmacology, developmental psychobiology, behavioral genetics, neurochemistry, animal cognition, and student/faculty performance. A more detailed listing of faculty research interests is available from the department.

Department of Physics

IUPUI
Science Building, LD 154
402 N. Blackford Street
Indianapolis, IN 46202-3273
Phone: (317) 274-6900; fax: (317) 274-2393
https://science.iupui.edu/physics/

Department Chair: Andrew D. Gavrin, Ph.D.

Department Advisors:

- Graduate Programs: Ricardo Decca, Ph.D.
- Undergraduate Programs: Krista Swisher

Physics is the study of matter and energy, from the smallest scale, as in the study of elementary particles, to the largest, as in the study of the formation and evolution of stars and galaxies. In this sense, physics is the science that underlies all of the other sciences. In principle, as well as in practice, physics is involved in virtually all scientific and technical endeavors (e.g., biophysics, geophysics, health physics, etc.).

Physicists tend to view themselves primarily as solvers of problems, especially problems that can be expressed in mathematical terms. Physics students are trained to solve complex problems by learning to analyze complex relations in mathematical terms, often with the help of today's fast computers. Because of this broadly based and flexible problem-solving background, physics graduates find employment in a variety of fields, many of which are not directly associated with physics.

The Department of Physics offers a program leading to a Bachelor of Science degree from Purdue University. In addition, the department offers courses in physics and astronomy for nonmajors. The department also offers graduate courses that lead to a Purdue Master of Science degree. Qualified students may be authorized to pursue the Ph.D. degree in physics at IUPUI in areas where a program has been arranged with Purdue, West Lafayette.

Members of the department conduct research in several disciplines of physics and participate in joint projects with a number of other research groups, such as the Indianapolis Center for Advanced Research and the IU School of Medicine. Student participation in these projects is welcomed and encouraged.

Students majoring in physics consolidate their undergraduate studies by putting what they have learned to use in a capstone experience in one of the department's research laboratories. Each student joins a faculty member in a project that provides experience in a professional setting. The student must obtain the approval of a faculty member and register for PHYS 49000.

Guide to Service Courses

Each student should consult an advisor in the department in which a degree is sought to determine which service course is appropriate. A general guide to the schools served by these courses is as follows:

- AST-A100 / AST-A105: General science courses for students in all majors.
- AST-A130: Focused short courses for students in all majors.
- PHYS 14000: Focused short courses for students in all majors.
- PHYS 10000: For students in allied health, business, and liberal arts (a traditional survey course).
- PHYS 20000: For students in education, SPEA, and liberal arts (a nontraditional course).
- PHYS 21800 / PHYS 21900: A noncalculus sequence for technology students.

- PHYS-P201 / PHYS-P202: A noncalculus sequence for preprofessional students.
- PHYS 15200 / PHYS 25100 / PHYS 34200: For students in science and engineering requiring a calculus-based sequence.

- Bachelor of Science
- Bachelor of Science-Biophysics Option
- Plan of Study
- Graduate Program
- Minor

Bachelor of Science

Degree Requirements

First-Year Experience Course Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency

ENG-W131 or W140 Reading Writing and Inquiry (3 cr.)

Minimum requirements for the School of Science are given in this bulletin (see the School of Science requirements under “Undergraduate Programs”). The second semester of English composition may be satisfied only with ENG-W230, ENG-W231, ENG-W250, ENG-W270, ENG-W331, or TCM 32000.

Area II World Language Competency

No world language proficiency is required for a Bachelor of Science degree.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.)

List H course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

List S course: Choose one course (3cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

One additional course from either list H or List S.

List C course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical Sciences Competency

Minimum requirements for the School of Science are given in this bulletin (see the School of Science requirements under “Undergraduate Programs”).

Courses must include CHEM-C105 / CHEM-C125 and CHEM-C106 / CHEM-C126 with laboratory or their approved equivalent. For Physics majors, course options in this area also include: ECE 20100, ECE 20200, ECE 20400, ECE 27000, ME 30100, ME 31000, ME 31400 and ME 34000.

Students must have grades of C- or higher in Life and Physical Sciences courses. A grade of D or D+ will be allowed for one course only.

Area IIID Analytical Reasoning Competency

Minimum requirements for the School of Science are given in this bulletin (see the School of Science requirements under “Undergraduate Programs”).

Twenty-four (24) credit hours of courses in mathematics are required, which must include MATH 16500, MATH 16600, MATH 17100, MATH 26100 and MATH 26600 and two (2) additional courses beyond MATH 26600.

The computer programming requirement of the School of Science may be satisfied with CSCI 23000, CSCI-N305, CSCI-N317, CSCI-N331, or any higher-level CSCI course.

Students must have grades of C- or higher in Analytical Reasoning courses. A grade of D or D+ will be allowed for one course only.

Note: Computer Science CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as a general elective.

Area IV Physics Concentration

The Department of Physics offers four options for students pursuing the Bachelor of Science degree: a traditional physics program; a biophysics option; a program designed for students planning a career in physics teaching; an accelerated program with a B.S. in physics and a B.S. in electrical engineering; and an accelerated program known as the BPMME program because students earn both a bachelor’s in physics and a master’s in mechanical engineering.

Students pursuing the traditional program must complete PHYS 15200, PHYS 25100, PHYS 29900, PHYS 30000, PHYS 31000, PHYS 33000, PHYS 34200, PHYS 35300, PHYS 40000, PHYS 40100, PHYS 41800, PHYS 44200, and PHYS 49000. These students must complete 6 hours of mathematics above the level of MATH 26600 in courses approved by the Department of Physics.

Students pursuing the biophysics option must complete: Introductory course sequence PHYS-P201 or PHYS 15200, PHYS-P202 or PHYS 25100, PHYS 29900, PHYS 31000, PHYS 33000, PHYS 34200, PHYS 35300, PHYS 44200, PHYS 58500, and PHYS 49000 (Biophysics Capstone). In addition, a minimum of 13 credit hours of biology and 21 credit hours of chemistry is required. Please refer to the Biophysics Option section of the bulletin for detailed information. Note: For this option, students are NOT required to complete two (2) additional courses beyond MATH 26600.

Students pursuing the teaching option must complete: PHYS 15200, PHYS 25100, PHYS 30000, PHYS 31000, PHYS 33000, PHYS 34200, PHYS 35300, and PHYS 49000. The Department of Physics may substitute other science courses for the 400-level courses and recommend education courses in order to meet teacher certification requirements. These students must complete 6 hours of mathematics above the level of MATH 26600 in courses approved by the Department of Physics.

Students pursuing the program in physics and mechanical engineering must complete: PHYS 15200, PHYS 25100,

PHYS 30000, PHYS 31000, PHYS 33000, PHYS 34200, PHYS 35300, PHYS 40000, PHYS 40100, PHYS 41800 and PHYS 55000. These students must complete 3 hours of mathematics above the level of MATH 26600 in courses approved by the Department of Physics. Students in this program must satisfy additional requirements specified by the Department of Mechanical Engineering.

Students pursuing the program in physics and electrical engineering must complete the traditional physics program except PHYS 29900, PHYS 30000, PHYS 49000, a computer programming class, 2 life/physical science classes, and one MATH elective at the 26600-level or higher. The following electrical engineering classes must be completed: ENGR 29700, ECE 20100, ECE 20700, ECE 20200, ECE 26100 & 26300 (concurrently), ECE 20800 & 25500 (concurrently), ECE 27000, ECE 30100, ECE 36200, ECE 38200, ECE 21000, ECE 40100, ECE 44000, ECE 30200, ECE 48700, ECE 48800, and 15 hours of ECE electives in consultation with the electrical engineering advisor. Attendance may be required during summer sessions to avoid academic overload during the fall and spring semesters. Please keep in regular contact with the electrical engineering advisor for frequency and availability of electrical engineering classes.

Students pursuing the program in physics with the embedded Electrical Engineering minor must complete the physics classes for the traditional program plus the following Electrical Engineering classes: ECE 30200, ECE 26300 concurrently with ECE26100, ECE 30100, ECE 36200, and an additional 4-credit-hour ECE elective (ECE 32100 or ECE 36500 or ECE 38200 or ECE 44000).

Unless approved as part of the major, note that all courses taken outside the Schools of Science and Liberal Arts must receive approval from the student's major department and the School of Science Academic Dean's Office. Consult with your major department advisor for information and additional course restrictions.
No more than 6 credit hours of studio, clinical, athletic, or performing arts courses will be approved. See the departmental advisor for details.

Biophysics Option

List H course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

List S course: **For the Biophysics Concentration students must complete SOC-R100 (Introduction to Sociology) and PSY-B110 (Introduction to Psychology)**. These courses will fulfill both the List S requirement and the requirement for an additional course from either List H or List S listed below.

List C course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical and Sciences Competency
See requirements listed below under Area IV Physics (Biophysics) Concentration Requirements.

Students must have grades of C- or higher in Life and Physical Sciences courses. A grade of D or D+ will be allowed for one course only.

Area IIID Analytical Reasoning Competency (21 credits)
Eighteen (18) credit hours of courses in mathematics are required, which must include MATH 16500, MATH 16600, MATH 17100, MATH 26100, and MATH 26600.

The computer programming requirement (3 cr.) of the School of Science may be satisfied with CSCI 23000, CSCI-N305, CSCI-N331, or any higher-level CSCI course.

Students must have grades of C- or higher in Analytical Reasoning courses. A grade of D or D+ will be allowed for one course only.
Note: Computer Science CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as a general elective.

Area IV Physics (Biophysics) Concentration Requirements

Chemistry: A minimum of 21 credit hours is required.

Introductory:

- CHEM-C105 Principles of Chemistry I (3 cr.)
- CHEM-C125 Experimental Chemistry I (2 cr.)
- CHEM-C106 Principles of Chemistry II (3 cr.)
- CHEM-C126 Experimental Chemistry II (2 cr.)

Intermediate:

- CHEM-C341 Organic Chemistry I (3 cr.)
- CHEM-C343 Organic Chemistry I Laboratory (2 cr.)
- CHEM-C342 Organic Chemistry II (3 cr.)
- CHEM-C360 Elementary Physical Chemistry (3 cr.) - OR - CHEM-C361 Physical Chemistry of Bulk Matter (3 cr.)

CHEM-C344 Organic Chemistry II (3 cr.) is not required but is recommended

Biology: A minimum of 13 credit hours of biology is required.

Introductory:

- BIOL-K101 Concepts of Biology I (5 cr.)
- BIOL-K103 Concepts of Biology II (5 cr.)

Advanced:

- BIOL-K483 Biological Chemistry (3 cr.)

Physics: A minimum of 32 credit hours of physics is required.

Introductory:

- PHYS-P201 General Physics I (5 cr.) and PHYS-P202 General Physics II (5 cr.) -OR-
- PHYS 15200 Mechanics (4 cr.) and PHYS 25100 Heat, Electricity & Optics (5 cr.)
- PHYS 29900 Introduction to Computational Physics (2 cr.)

Intermediate/Advanced:

- PHYS 31000 Intermediate Mechanics (4 cr.)
- PHYS 33000 Intermediate Electricity & Magnetism (3 cr.)
- PHYS 34200 Modern Physics (3 cr.)
- PHYS 35300 Electronics Laboratory (2 cr.)
- PHYS 44200 Quantum Mechanics (3 cr.)
- PHYS 58500 Introduction to Molecular Biophysics (3 cr.)
- PHYS 49000 Capstone Experience (3 cr.)

Unless approved as part of the major, note that all courses taken outside the Schools of Science and Liberal Arts must receive approval from the student's major department and the School of Science Academic Dean's Office. Consult with your major department advisor for information and additional course restrictions.

A minimum of 120 credits is required for graduation. This total must include at least 32 credits in courses at the 300-400 level taken at the IUPUI campus. Residence of at least two semesters on the IUPUI campus is also required for graduation.

No more than 6 credit hours of clinical, athletic, or performing arts courses will be approved. See the departmental advisor for details.

Physics-Math Double Major

This option is for students intending to double major in physics and mathematics.

Degree Requirements

First-Year Experience Course

Beginning freshmen and transfer students with fewer than 19 credit hours are required to take SCI-I120 Windows on Science (1 cr.) or an equivalent first-year experience course.

Area I English Composition and Communication Competency

Minimum requirements for the School of Science are given in this bulletin (see the School of Science requirements under “Undergraduate Programs”). The second semester of English composition may be satisfied only with ENG-W270 (preferred), ENG-W230, ENG-W231, ENG-W250, ENG-W331, ENG-W350, or TCM 32000.

Area II World Language Competency

See School of Science requirements under "Undergraduate Programs". Students must have first-year proficiency in a world language (first year sequence (131 & 132) or a 200-level world language course or 200-level world language proficiency.

Area IIIA Arts and Humanities, Social Sciences, and Cultural Understanding Competencies (12 cr.)

List H course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

List S course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

List C course: Choose one course (3 cr.) from this list. The list of course choices is located under the School of Science requirements “Undergraduate Programs” in this bulletin.

One additional course from either List H or List S

For the most current list of courses in the areas of Arts and Humanities, Social Sciences and Cultural Understanding, please refer to the IUPUI General Education Curriculum.

Area IIIC Life and Physical and Sciences Competency

Courses taken to satisfy the Area IIIC requirements must include PHYS 15200, PHYS 25100, CHEM-C105, and CHEM-C106.

Area IIID Analytical Reasoning Competency (21 credits)

Courses taken to satisfy the Area IIID requirements must include MATH 16500, MATH 16600, MATH 17100, MATH 26100, and MATH 26600.

The computer programming requirement (3 cr.) of the School of Science will be satisfied with CSCI 23000.

Note: Computer Science CSCI-N241 and CSCI-N299 do not count in Area IIID, but may count as a general elective.

The Area IV major requirements are as follows:

1. Additional physics requirements: PHYS 29900, PHYS 31000, PHYS 33000, PHYS 34200, PHYS 35300, PHYS 40000, PHYS 40100, PHYS 41800.
2. The calculus sequence: MATH 16500, MATH 16600, MATH 17100, MATH 26100, MATH 26600, and MATH 35100.
3. Additional math requirements: MATH 30000, MATH 41400, MATH 42600, MATH 44400.
4. Twelve (12) additional credit hours: three credit hours selected from MATH 35300/35400/45300; three credit hours selected from mathematics courses at the 300 level or above and statistics courses numbered 35000 or higher; three additional credit hours from mathematics or statistics, or from physics courses numbered three hundred or above; and PHYS 44200
5. Students planning on attending graduate school in mathematics or physics are advised to take MATH 44500, MATH 45300, and PHYS 44200.
6. Laboratory courses CHEM-C125 and CHEM-C126.
7. Minimum of two credit hours of PHYS 49000 Capstone Experience.

Plans of Study

Bachelor of Science Sample Program (120 cr. required)

The Department of Physics recommends the following sample program leading to the degree of Bachelor of Science.

Freshman Year

First Semester	
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 16500 Analytic Geometry and Calculus I	4

MATH 17100 Multidimensional Mathematics	3
ENG-W131 Reading, Writing and Inquiry	3
SCI-I120 Windows on Science	1
Total	**16**
Second Semester	
PHYS 15200 Mechanics	4
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4
COMM-R110 Fundamentals of Speech Communication	3
Total	**16**

Sophomore Year

Third Semester	
PHYS 25100 Heat Electricity and Optics	5
PHYS 29900 Intro to Computational Physics	2
MATH 26100 Multivariate Calculus	4
CSCI 23000 or CSCI-N317	3-4
Arts & Humanities (choose from list)	3
Total	**17-18**
Fourth Semester	
PHYS 30000 Intro. to Elem. Math Physics	3
PHYS 34200 Modern Physics	3
MATH 26600 Ordinary Differential Equations	3
2nd Written Communication Course	3
Social Sciences (choose from list)	3
Total	**15**

Junior Year

Fifth Semester	
PHYS 31000 Intermediate Mechanics	4
MATH Course (MATH 35100 or MATH 511)*	3
Arts & Humanities/Social Sciences (choose from list)	3
Cultural Understanding (choose from list)	3
Elective	3
Total	**16**
Sixth Semester	
PHYS 33000 Intermediate Electricity and Magnetism	3
PHYS 35300 Electronics Laboratory	2
MATH Course Above 26600 (MATH 35100 or MATH 51100)*	3
Life and Physical Science (approved elective)	3
Elective	3
Total	**14**

Senior Year

Seventh Semester	
PHYS 40000 Physical Optics	3
PHYS 40100 Physical Optics Laboratory	2
PHYS 44200 Quantum Mechanics	3
Life and Physical Science (approved elective)	3
Elective	3
Total	**14**
Eighth Semester	
PHYS 41800 Thermal & Statistical Physics	3
PHYS 49000 Capstone Experience	3
Electives	7
Total	**13**

*MATH 35100 (Elem. Linear Algebra) or MATH 51100 (Linear Algebra with Applications) are strongly encouraged

Biophysics Option Sample Program (minimum 120 cr. required)

Freshman Year

First Semester	
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 16500 Analytic Geometry and Calculus I	4
ENG-W131 Reading, Writing and Inquiry	3
COMM-R110 Fundamentals of Speech Communication	3
SCI-I120 Windows on Science	1
Total	**16**
Second Semester	
PHYS-P201 General Physics I or PHYS 15200 Mechanics	4-5

CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4
MATH 17100 Multidimensional Mathematics	3
Total	**16-17**

Sophomore Year

Third Semester	
PHYS-P202 General Physics II or PHYS 25100 Heat, Elec. & Optics	5
CHEM-C341 Organic Chemistry I	3
CHEM-C343 Organic Chemistry Laboratory I	2
MATH 26100 Multivariate Calculus	4
PHYS 29900 Intro to Computational Physics	2
Total	**16**
Fourth Semester	
BIOL-K101 Concepts of Biology I	5
CHEM-C342 Organic Chemistry II (Recommended Only)	3
PHYS 34200 Modern Physics	3
PHYS 35300 Electronics Laboratory	2
MATH 26600 Ordinary Differential Equations	3
Total	**16**

Junior Year

Fifth Semester	
BIOL-K103 Concepts of Biology II	5
PHYS 31000 Intermediate Mechanics	4
Cultural Understanding (choose from list)	3
PSY-B110 Introduction to Psychology	3
Total	**15**
Sixth Semester	
BIOL-K483 Biological Chemistry	3
PHYS 33000 Interm. Electricity & Magnetism	3
CHEM-C360 Intro. Physical Chemistry or CHEM-C361 Physical Chem Bulk Matter	3
SOC-R100 Introduction to Sociology	3
ENG-W270 Argumentative Writing	3
Total	**15**

Senior Year

Seventh Semester	
PHYS 44200 Quantum Mechanics	3
PHYS 49000 Capstone Experience	3
PHYS 58500 Intro. to Molecular Biophysics	3
Elective	3
Total	**12**
Eighth Semester	
Computer Programming (approved elective)	3
Arts and Humanities (choose from list)	3
Electives	9
Total	**15**

Physics-Math Double Major (minimum 123 cr. required)

Freshman Year

First Semester	
CHEM-C105 Principles of Chemistry I Lecture	3
CHEM-C125 Principles of Chemistry I Laboratory	2
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensioal Mathematics	3
ENG-W131 Reading, Writing and Inquiry	3
SCI-I120 Windows on Science	1
Total	**16**
Second Semester	
PHYS 15200 Mechanics	4
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4
COMM-R110 Fundamentals of Speech Communication	3
Total	**16**

Sophomore Year

Third Semester	
PHYS 25100 Heat, Elec. & Optics	5
MATH 26100 Multivariate Calculus	4
MATH 30000 Logic & Foundations of Algebra	3
PHYS 29900 Intro to Computational Physics	2
2nd Written Communication Course	3
Total	**17**
Fourth Semester	
MATH 26600 Ordinary Differential Equations	3
MATH 35100/51100 Elementary Linear Algebra	3
PHYS 34200 Modern Physics	3
CSCI 23000 Computing I	4
Social Science (choose from list)	3
Total	**16**

Junior Year

Fifth Semester	
PHYS 31000 Intermediate Mechanics	4
MATH 44400 Foundations of Analysis I	3
MATH 45300 or MATH STAT Elective	3
Arts & Humanities (choose from list)	3
World Language	4
Total	**17**
Sixth Semester	
PHYS 33000 Interm. Electricity & Magnetism	3
PHYS 35300 Adv. Physics Laboratory I	2
MATH 35300/35400 or MATH/STAT Elective	3
MATH 42600 Intro. to Applied Math/Modeling	3
World Language	4
Total	**15**

Senior Year

Seventh Semester	
PHYS 44200 Quantum Mechanics	3
PHYS 40000 Physical Optics	3
PHYS 40100 Physical Optics Laboratory	2
MATH 41400 Numerical Methods	3
Arts & Humanities or Social Science (choose from list)	3
Total	**14**
Eighth Semester	
PHYS 49000 Capstone	3
PHYS 41800 Thermal & Statistical Physics	3
MATH/STAT/PHYS Elective	3
General Elective	3
Total	**12**

Bachelor of Science in Physics and Electrical Engineering Sample Program (136 cr. required)

The Department of Physics recommends the following sample program for students pursuing the program.

Freshman Year

First Semester	
ENGR 19500 Intro. to the Engineering Profession	1
CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 16500 Analytic Geometry and Calculus I	4
ENG-W131 Reading, Writing & Inquiry or ENG-W140 Elem Composition Honors	3
Arts and Humanities (choose from list)	3
Total	**16**
Second Semester	
PHYS 15200 Mechanics	4
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4
MATH 17100 Multidimensional Mathematics	3
Total	**16**

Summer Year 1

Summer Year 1	

COMM-R110 Fundamentals of Speech Communication	3
Total	**3**

Sophomore Year

Third Semester	
PHYS 25100 Heat Electricity and Optics	5
MATH 26100 Multivariate Calculus	4
ECE 20100 Linear Circuit Analysis I	3
ECE 207 Electronic Measurement Techniques	1
ECE 26300 C Programming and ECE 26100 Engineering Programming Lab	4
Total	**17**
Fourth Semester	
PHYS 34200 Modern Physics	3
ECE 21000 Sophomore Seminar	1
MATH 26600 Ordinary Differential Equations	3
ECE 25500 Intro. to Electronics Analysis & Desing and ECE 20800 Electronic Design and Devices lab	4
ECE 27000 Digital Logic with lab	4
ENGR 29700 Computer Tools for Engineering	1
Total	**16**

Summer Year 2

Summer Year 2	
Arts & Humanities or Social Sciences (choose from list)	3
Arts & Humanities or Social Sciences (choose from list)	3
Total	**6**

Junior Year

Fifth Semester

PHYS 31000 Intermediate Mechanics	4
MATH 35100 Elementary Linear Algebra or MATH 51100 Linear Algebra with Applications	3
ECE 20200 Linear Circuit Analysis II	3
ECE 36200 Microprocessor Systems and Interfacing	4
TCM 32000 Written Comm. in Science & Industry	3
Total	**17**
Sixth Semester	
PHYS 33000 Intermediate Electricity and Magnetism	3
PHYS 35300 Electronics Laboratory	2
ECE 30200 Probabilistic Methods in Electrical Engineering	3
ECE 30100 Signals & Systems	3
ECE 32700 Engineering Economics or ECON-E201 Intro. Microeconomics	3
Cultural Understanding (choose from list)	3
Total	**17**

Senior Year

Seventh Semester	
PHYS 40000 Physical Optics	3
PHYS 40100 Physical Optics Laboratory	2
PHYS 44200 Quantum Mechanics	3
ECE 44000 Introduction to Comm. Systems Analysis	4
ECE 48700 Senior Design I	1
ECE Elective	3
Total	**16**
Eighth Semester	
PHYS 41800 Thermal and Statistical Physics	3
ECE 40100 Engineering Ethics and Professionalism	1
ECE 38200 Feedback Sys Analysis & Design	3
ECE 48800 Senior Design II	2
EE Electives	6
Total	**15**

Bachelor of Science with Embedded Electrical Engineering Minor Sample Program (120 cr. required)

The Department of Physics recommends the following sample program leading to the degree of Bachelor of Science with an embedded minor in Electrical Engineering.

Freshman Year

First Semester	
SCI-I120 Windows on Science	1
CHEM-C105 Principles of Chemistry I	3

CHEM-C125 Experimental Chemistry I	2
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensional Mathematics	3
ENG-W131 or W140 Reading, Writing & Inquiry	3
Total	**16**
Second Semester	
PHYS 15200 Mechanics	4
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4
COMM-R110 Fundamentals of Speech Communication	3
Total	**16**

Sophomore Year

Third Semester	
PHYS 25100 Heat Electricity and Optics	5
PHYS 29900 Intro to Computational Physics	2
MATH 26100 Multivariate Calculus	4
ECE 26300 C Programming (3) and ECE 26100 Engineering Programming Lab (1)	4
Arts & Humanities (choose from list)	3
Total	**18**
Fourth Semester	
PHYS 30000 Intro. to Elem. Math Physics	3
PHYS 34200 Modern Physics	3
MATH 26600 Ordinary Differential Equations	3
2nd Written Communication Course	3
Social Sciences (choose from list)	3
Total	**15**

Junior Year
Fifth Semester

PHYS 31000 Intermediate Mechanics	4
MATH 35100 Elementary Linear Algebra or MATH 51100 Linear Algebra with Applications*	3
ECE 20400 Intro Electl & Electron Circuits	4
Arts & Humanities or Social Sciences (choose from list)	3
Total	**14**
Sixth Semester	
PHYS 33000 Intermediate Electricity and Magnetism	3
PHYS 35300 Electronics Laboratory	2
ECE 30200 Probabilistic Methods in Electrical Engineering	3
ECE 30100 Signals & Systems	3
Cultural Understanding (choose from list)	3
Total	**14**

Senior Year

Seventh Semester	
PHYS 40000 Physical Optics	3
PHYS 40100 Physical Optics Laboratory	2
PHYS 44200 Quantum Mechanics	3
ECE 36200 Microproc Sys & Interfacing	4
Total	**12**
Eighth Semester	
PHYS 41800 Thermal and Statistical Physics	3
PHYS 49000 Capstone Experience	3
ECE Elective**	4
Elective	4
Total	**14**

*MATH 35100 ((Elem. Linear Algebra) or MATH 51100 (Linear Algebra with Applications) are strongly encouraged

**ECE 32100 or ECE 36500 or ECE 38200 or ECE 44000

Bachelor of Science and Master of Science (BPMME)Sample Program (131 cr. required)

The Department of Physics recommends the following sample program for students pursuing the BPMME program

Freshman Year

First Semester	

CHEM-C105 Principles of Chemistry I	3
CHEM-C125 Experimental Chemistry I	2
MATH 16500 Analytic Geometry and Calculus I	4
MATH 17100 Multidimensional Mathematics	3
ENG-W131 Reading, Writing and Inquiry	3
SCI-I120 Windows on Science	1
Total	**16**
Second Semester	
PHYS 15200 Mechanics	4
CHEM-C106 Principles of Chemistry II	3
CHEM-C126 Experimental Chemistry II	2
MATH 16600 Analytic Geometry and Calculus II	4
COMM-R110 Fundamentals of Speech Communication	3
Total	**16**

Sophomore Year

Third Semester	
PHYS 25100 Heat Electricity and Optics	5
MATH 26100 Multivariate Calculus	4
CSCI 23000 or CSCI-N317	3-4
Arts and Humanities (choose from list)	3
Total	**15-16**
Fourth Semester	
PHYS 33000 Intermediate Electricity and Magnetism	3
PHYS 34200 Modern Physics	3
PHYS 35300 Electronics Laboratory	2
MATH 26600 Ordinary Differential Equations	3
Social Sciences (choose from list)	3
Total	**14**

Junior Year

Fifth Semester	
PHYS 31000 Intermediate Mechanics	4
ME 27200 Mechanics of Materials	3
ME 33000 Modeling and Analysis of Dynamic Systems	3
Life and Physical Sciences (approved elective) ME Course Strongly Encouraged	3
2nd Written Communication	3
Total	**16**
Sixth Semester	
PHYS 41800 Thermal and Statistical Physics	3
ME 46200 Engineering Design	3
MATH Course (MATH 35100 or MATH 51100)*	3
Life and Physical Sciences (approved elective) ME Course Strongly Encouraged	3
Arts and Humanities/Social Sciences (choose from list)	3
Total	**15**

Senior Year

Seventh Semester	
ME 500-level ME primary area course	3
Elective: 400 or 500 level Engineering or Physics	3
MATH 53700 Applied Mathematics for Sci. & Eng I	3
Physics 55000 Introduction to Quantum Mechanics	3
Total	**12**
Eighth Semester	
ME 500-level ME primary area course	3
Elective: 400 or 500 level Engineering or Physics	3
MATH 53800 Applied Mathematics for Sci. & Eng II	3
Cultural Understanding (Choose from List)	3
Total	**12**

Fifth Year

Ninth Semester	
ME 500-level ME primary area course	3
ME 500-level ME primary area course	3
Total	**6**
Tenth Semester	

ME 69800 (thesis option) or ME 500-level ME primary/ related area course	3
ME 69800 (thesis option) or ME 500-level ME primary/ related area course	3
Science Elective: Graduate PHYS or MATH course	3
CAND 99100 Candidate for Graduation (with an M.S. in ME)	0
Total	**9**

Minor in Physics

The Department of Physics offers an undergraduate minor in physics with the following requirements:

- The introductory physics sequence: PHYS 15200 and PHYS 25100.
- Introduction to Computational Physics: PHYS 29900
- Modern Physics: PHYS 34200.
- Six (6) more credit hours chosen from PHYS 30000, PHYS 31000, PHYS 33000, PHYS 40000, PHYS 41800, PHYS 44200 or other courses approved by the department/advisor.
- The grade for each course submitted for the minor must be a C (2.0) or higher.

Residency:
Correspondence courses may not be used to fulfill requirements for the minor.

Grades:
No grade below C is acceptable for a course in the minor. A minimum grade point average of 2.0 in the minor is required.

Graduate Programs

Graduate Program

The Department of Physics offers graduate programs leading to Purdue University Master of Science and Doctor of Philosophy degrees. For master's degree students, both thesis and nonthesis options are available.

Admission Requirements

Students who seek enrollment in the physics graduate program should have a baccalaureate degree from an accredited institution and have a background in the usual undergraduate courses in physics, mathematics, and other sciences. An average grade point average of 3.0 (B) or higher in physics courses is expected. Graduates from related fields of study in pure and applied science or engineering may be accepted on a probationary basis until they have completed any necessary undergraduate courses in physics. The Graduate Record Examination (GRE) is normally expected of all applicants. The GRE physics test is recommended, but not required.

Transfer Credit

The Department of Physics will normally accept, from approved institutions, a maximum of 6 transfer hours of graduate credit that are in excess of undergraduate degree requirements.

Application for Admission

Application materials and information can be obtained online at www.physics.iupui.edu or by writing to the chairperson of the graduate committee, IUPUI Department of Physics, Science Building, LD 154, 402 N. Blackford Street, Indianapolis, IN 46202-3273; phone (317) 274-6900. While the application is being processed, it is possible to enter IUPUI as a temporary graduate student. Generally, only 12 hours of credit earned under this classification may be counted toward an advanced degree.

Financial Assistance

Most physics graduate students receive financial support. Types of support available include teaching and research assistantships, fellowships, and tuition remission.

Master of Science

The general requirements include admission to regular graduate status, completion of the English requirement, passing the core physics classes (PHYS 51000, PHYS 51700, PHYS 53000, and PHYS 55000 or equivalent) with a 3.0 grade point average and no grades below B-, satisfactory completion of an approved plan of study, and 30 hours of graduate credit as outlined below.

The English requirement for candidates whose native language is English is satisfied by having no undergraduate grades below B in English composition or by scoring 600 or higher on the Verbal Aptitude Section of the Graduate Record Examination. Students who do not satisfy the English requirement by either of the above methods may take a written examination administered by the Department of English to demonstrate their proficiency. Students whose native language is not English must pass the TOEFL examination with a grade of 79 or higher (with minimums of 18 in Writing, 18 in Speaking, 14 in Listening, and 19 in Reading) and take a diagnostic test when they arrive at IUPUI. The score on this test will determine what English courses are required.

The student's plan of study is worked out in cooperation with the student's graduate advisor and committee. It must be submitted and accepted by the graduate school no later than the semester before the one in which the student plans to graduate. The English requirement must be satisfied before the plan of study may be filed.

The master's degree requires the satisfactory completion of 30 credit hours of course work at the 500 and 600 level. Twenty-four (24) credit hours must be in physics and biophysics. In the thesis option, 6 of the physics credit hours will be earned by enrolling in PHYS 69800 Research M.S. Thesis. This option requires a written thesis. In the non-thesis option, 6 of the physics credit hours will typically be earned through enrollment in PHYS 59000 Reading and Research. This option requires a written report. Six (6) credit hours must be in mathematics, which may be replaced in part by PHYS 60000 Methods of Theoretical Physics. The grade requirements are A or B in 500-level courses; A, B, or C in 600-level courses; A, B,

or C in mathematics courses; and a minimum grade point average of 2.8.

Doctor of Philosophy

The general requirements include admission to regular graduate status, completion of the English requirement, passing the qualifying examination, satisfactory completion of an approved plan of study, passing a preliminary exam, and 60 hours of graduate credit after the completion of an M.S. There are four core courses that must be completed: PHYS 61700, Statistical Mechanics; PHYS 63000, Advanced Theory of Electricity and Magnetism; PHYS 66000, Quantum Mechanics I; PHYS 66100, Quantum Mechanics II. The student must take three additional specialty courses approved by the Graduate Committee. These in general would be relevant to the student's area of interest. Additional courses may be taken based on the student's background and needs.

The English requirement for candidates whose native language is English is satisfied by having no undergraduate grades below B in English composition or by scoring 600 or higher on the Verbal Aptitude Section of the Graduate Record Examination. Students who do not satisfy the English requirement by either of the above methods may take a written examination administered by the Department of English to demonstrate their proficiency. Students whose native language is not English must pass the TOEFL examination with a grade of 79 or higher (with minimums of 18 in Writing, 18 in Speaking, 14 in Listening, and 19 in Reading) and take a diagnostic test when they arrive at IUPUI. The score on this test will determine what English courses are required.

The qualifying examination is a written examination composed and graded by the Indiana University-Purdue University Indianapolis (IUPUI) Department of Physics. The examination will be physically given at IUPUI and supervised and graded by IUPUI Physics faculty. Students are allowed two attempts to pass the exam, plus an optional attempt before starting our program at IUPUI.

The qualifying exam is given twice a year, shortly before classes begin in the Fall and Spring semesters. The examination consists of two, 3-hour parts given on successive days. There are eight problems in each part.

The IUPUI Physics Department Graduate Committee sets passing scores on the exam. Traditionally the Ph.D. pass is around 50%.

This examination requies a knowledge of classical mechanics at the level of the texts by Fowles, *Analytical Mechanics,* and Marion and Thornton, *Classical Dynamics of Particles and Systems;* of electricity and magnetism as presented in Griffiths, *Introduction to Electrodynamics* and Reitz, Milford and Christy, *Foundations of Electronmagnetic Theory* and Marion, *Classical Electromagnetic Radiation*; of quantum physics at the level of French and Taylor, *An Introduction to Quantum Physics* and Eisberg and Resnick, *Quantum Physics of atoms, molecules, solids, nuclei, and particles*; and of Thermal Physics as found in Kittel and Kroemer, *Thermal Physics*. Finally, a general knowledge of modern physics at the level of texts by Weidner and Sells, Krane, Sandin, Serway and Tipler is required.

New students are encouraged to take the exam at the first opportunity upon arrival at IUPUI before taking any classes to become familiar with the exam and for the Department to assess their standing. This attempt is not counted against the two attempts provided the student has no graduate degrees in Physics from U.S. institutions. Students must take the exam after completing nine (9) hours of graduate courses. If the exam is failed, it must be taken again at the next time it is given (exceptions may be made in extenuating circumstances). Those entering the program with a graduate degree in physics from an institution in the U.S. are permitted only one further attempt beyond the one taken before the first semester of enrollment. The further attempt must be no later than the beginning of their second semester of study in the Department.

The preliminary exam is a certification exam where the student presents a plan of work to be followed to perform his/her research. It is defended in front of the advisory committee. Besides the preliminary exam, students need to present annual progress reports to the advisory committee.

Departments & Centers

- Teaching Certification
- Pre-Professional Programs
- Honors Program
- Undergraduate Research

Graduate Pre-Professional Programs

Undergraduate

Special Programs

Graduate Preprofessional Programs

Preparation for a career in the graduate health professions (e.g., medicine, dentistry, pharmacy, et al) is a multi-dimensional task. One important aspect is intellectual and academic development—the college education. The preprofessional student is urged to select a degree program that is of greatest interest to them. There is no preprofessional major. Most graduate health profession careers depend upon daily use of science, so a strong science foundation is critical in the student's preparation. These careers also require academic breadth and depth, so a balanced science/non-science curriculum is advised. While some health professional programs (dental, pharmacy, veterinary medicine) may not require an undergraduate degree for especially strong applicants, the vast majority of the successful applicants have an undergraduate degree. Having a bachelor's degree provides the necessary background, and serves as a backup plan if the student does not matriculate to a professional program.

Students may choose from a variety of majors while completing preprofessional requirements. Students are encouraged to consult with prospective major academic advisor, as well as the School of Science Preprofessions Health advisor in the PREPs Office (if enrolled in a School of Science degree program; if not, see the health professions adviser in the Health and Life Science Advising Center).

There are many schools across the country for each health profession from which to choose and we encourage students to apply to multiple programs. However, our

preprofessional course advising is aligned with the programs with which we are most closely affiliated – IUPUI, IU Bloomington and Purdue University in West Lafayette.

Post-baccalaureate students may choose to take prerequisite courses through the School of Science for entry into professional programs. These students should consult with the health professions' advisor for help with the admission process and course selection.

Graduate professional programs require not only specific prerequisite courses, a strong GPA, and a profession-specific or general entrance test, but also experience including shadowing in the field, volunteering and leadership activities. See your health professions adviser to discuss opportunities and resources to build professional development skills.

Pre-Medical Program

Students planning to apply to medical school must choose a degree program in addition to taking courses that fulfill the admission requirements for their chosen medical school. While many opt to complete their degrees with science majors, any major is acceptable. Freshmen should declare their chosen major and seek advising for their degree requirements from the academic advisor in their major department. IUPUI offers preprofessions health advising for the School of Science at the Preprofessional and Career Preparation (PREPs) office and for majors outside of the School of Science advising is conducted by the Health Life Sciences Advising Center (HLS). Pre-medical students should consult their preprofessions health advisor within their first semester at IUPUI. Baccalaureate students who are selecting courses in the School of Science to prepare for medical school are also invited to use the preprofessions health advising service for help with the admission process.

Following are the IUPUI courses that meet the requirements for application to IU School of Medicine and most medical schools around the country, and represent the content for the Medical College Admission Test (MCAT). Please see medical school websites for any school specific requirements. The premedical student should complete the bachelor's degree. The MCAT is required for all medical schools both allopathic (M.D.) and Osteopathic (D.O.).

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
CHEM-C342 Organic Chemistry II*	3 cr.
PHYS-P201 General Physics I	5 cr.
PHYS-P202 General Physics II	5 cr.
BIOL-K483 Biological Chemistry	3 cr.
PSY-B110 Introduction to Psychology	3 cr.
SOC-R100 Introduction to Sociology	3cr.

*CHEM-C344 (Organic Chemistry II Laboratory) is not required for the IU School of Medicine. Students are strongly encouraged to complete the course as it may be required by other universities as well as a requirement for Science degree completion.

Pre-Dental, Pre-Veterinary Medicine, Pre-Optometry

Dentistry, Veterinary Medicine, and Optometry are career goals and not majors at the undergraduate level. Students generally select a bachelor degree of their choice in which they can excel and incorporate specific pre-requisites prior to entering a dental, veterinary or optometry school. Since these careers involve a strong background in life and physical sciences as well as working with people, students often choose a major in Biology, Psychology or Chemistry to fulfill their requirements. Students should also include coursework in humanities to ensure they are well rounded. In very rare situations, a handful of students are admitted to these professional programs after completing only the 90 hours of pre-requisites; however this is not the norm. A bachelor degree is strongly recommended. Pre-Dental, Pre-Veterinary Medicine and Pre-Optometry coursework requires careful planning and preparation. Advising for degree requirements is provided in the department where the major is housed. Pre-Professional advising on pre-dental, pre-optometry, and pre-veterinary professional development such as resources for shadowing, internships, research, and volunteering as well as interview preparation is available in the Pre Professional and Career Preparation (PREPs) office. Post baccalaureate and graduate students working on pre-dental requirements are also advised in the same manner. Pre-requisites listed below are for Indiana University and Purdue University programs. Students applying to different programs are encouraged to check with the schools admissions office for a current listing of specific program pre-requisites.

Pre-Dentistry

The Dental Admission Test (DAT) is required for admission to dental school. Applicants should also show evidence of manual dexterity and complete 100 hours of shadowing in General Dentistry.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
BIOL-K384 Biological Chemistry	3 cr.
BIOL-K356 Microbiology or BIOL-K338 Immunology	3 cr.

BIOL-K324 Cell Biology or BIOL-K322 Genetic & Molecular Biology	3 cr.
BIOL-N217 Human Physiology	5 cr.
BIOL-N261 Human Anatomy	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
CHEM-C342 Organic Chemistry II*	3 cr.
PHYS-P201 General Physics I	5 cr.
PHYS-P202 General Physics II	5 cr.
PSY-B110 Introduction to Psychology	3 cr.
ENG-W131 Reading, Writing and Inquiry I	3 cr.
COMM-R110 Fundamentals of Speech Comm.	3 cr.

*CHEM-C344 (Organic Chemistry II Laboratory) is not required for the IU School of Dentistry. Students are encouraged to complete the course as it may be required by other universities.

Pre-Veterinary Medicine

The Graduate Record Exam (GRE) is required for admission to most veterinary schools. Purdue University no longer requires the GRE. It is also recommended that students gain some practical experience working with animals before applying to a veterinary program.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
BIOL-K322 / BIOL-K323 Genetics and Molecular Biology/Lab	3 cr./2 cr.
BIOL-K356 / BIOL-K357 Microbiology/Lab	3 cr./2 cr.
(or MICR-J210 Microbiology and Immunology)	(4 cr.)
BIOL-K384 Biological Chemistry	3 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
CHEM-C342 / CHEM-C344 Organic Chemistry II/Lab	3 cr./2 cr.
PHYS-P201 General Physics I	5 cr.
PHYS-P202 General Physics II	5 cr.
STAT 30100 Elementary Statistical Methods I	3 cr.
(or STAT-N501 or SPEA-K300)	(3 cr.)
ANSC 22300 Animal Nutrition	3 cr.
(may be taken at Purdue WL or online)	
ENG-W131 Reading, Writing and Inquiry I	3 cr.
COMM-R110 Fundamentals of Speech Communication	3 cr.
Arts and Humanities electives	9 cr.

Pre-Optometry

The Optometry Aptitude Test (OAT) is required for admission. It is suggested that students also have some exposure to the Optometry profession before applying to a program.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
BIOL-K356 / BIOL-K357 Microbiology/Lab	3 cr./2 cr.
Advanced Biology: BIOL-K322 Genetics and Molecular Biology	3 cr.
(or BIOL-K324 Cell Biology)	(3 cr.)
BIOL-K384 Biochemistry	3 cr.
BIOL-N217 Human Physiology*	(5 cr.)
BIOL-N261 Human Anatomy*	(5 cr.)
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
ENG-W131 Reading, Writing and Inquiry I	3 cr.
ENG-W270 Argumentative Writing	3 cr.
(or ENG-W231 Professional Writing Skills)	(3 cr.)
MATH 15300 Algebra and Trigonometry I	3 cr.
MATH 15400 Algebra and Trigonometry II	3 cr.

PHYS-P201 General Physics I	5 cr.
PHYS-P202 General Physics II	5 cr.
PSY-B110 Introduction to Psychology	3 cr.
STAT 30100 Elementary Statistical Methods I	3 cr.
(or STAT-N501 or PSY-B305 or ECON-E270)	(3 cr.)
If the student does NOT have a bachelor's degree, additional courses are required:	
Arts and Humanities	6 cr.
World language	6 cr.
(students having completed 2 or more years in high school with C or better are exempt)	
Social and Historical Studies	6 cr.
Additional credit hours to reach 90 credit hours	

*BIOL-N217 and BIOL-N261 are strongly recommended but not required.

Pre-Pharmacy

The Pre-Pharmacy program at IUPUI consists of approximately 70-90 hours of coursework required to apply to pharmacy schools. A bachelor degree is not required however; many students elect to complete a degree program in a science major before application to Pharmacy school. Students declaring pre-pharmacy upon admission are assigned to the Department of Biology for completion of the required courses. Admission information as well as professional development activities including resources for shadowing, volunteering, research and internships is provided by the Pre-Professional and Career Preparation (PREPs) Office. The Pharmacy College Admission Test (PCAT) is required by approximately 2/3 of Pharmacy schools. Purdue University does not require the PCAT for admission. Additional categories of electives are required for graduation from the pharmacy program at Purdue. Since they are not required for admission to the program, they may be completed concurrently with pre-requisite coursework or after admission to the program. Pre-requisite courses listed below are for the Purdue University School of Pharmacy. Students are encouraged to check with all schools they are applying to for specific course requirements.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
BIOL-K356 / BIOL-K357 Microbiology/Lab	3 cr./2 cr.
BIOL-N217 Human Physiology	5 cr.
BIOL-N261 Human Anatomy	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
CHEM-C341 / CHEM-C343 Organic Chemistry I/Lab	3 cr./2 cr.
CHEM-C342 / CHEM-C344 Organic Chemistry II/Lab	3 cr./2 cr.
COMM-R110 Fundamentals of Speech Comm.	3 cr.
PSY-B110 Intro. to Psychology	3 cr
(or SOC-R100 Intro. to Sociology)	3 cr.
ECON-E101 Survey of Economic Issues and Problems	3 cr.
(or ECON-E201 Intro. to MicroEcon. or ECON-E202 Intro. to MacroEcon)	3 cr.
MATH 23100 / MATH 23200 Calculus for the Life Sciences I and II	3 cr./3 cr.
(or MATH 22100 / MATH 22200 or MATH 16500 / MATH 16600)	3 cr./3 cr. or 4 cr./4 cr.
STAT 30100 Elem. Statistical Methods I	3 cr.
(or STAT 35000 Intro. to Stats. or PSY-B305 Statistics)	3 cr.
PHYS-P201 General Physics I	5 cr.
ENG-W131 Reading Writing and Inquiry I	3 cr.

Pre-Occupational Therapy (OTD)

Students may select any undergraduate major and include a set of core courses needed for pre-requisites for a doctoral degree in Occupational Therapy. Undergraduate degree programs in Biology or Psychology may be of interest to the pre-occupational therapy student. Advising for undergraduate degree requirements is available in the major department. Additional pre-professional advising including resources such as shadowing, internships, volunteering, and research as well as application and admission assistance to OT programs is provided in the Pre-Professional and Career Preparation (PREPs) Office. An advisor in the IUPUI School of Health and Human Sciences is also available for consultation. Applicants must have completed a bachelor degree for consideration for a graduate program in OT. There is no entrance exam required. Students must have 40 observational hours in three different OT settings. Pre-requisite courses listed below are for Indiana University School of Health and Rehabilitation Sciences. Students are encouraged to check with all schools they are applying to for specific course requirements.

BIOL-N217 Human Physiology	5 cr.

BIOL-N261 Human Anatomy	5 cr.
PSY-B110 Introduction to Psychology	3 cr.
PSY-B310 Life Span Development	3 cr.
PSY-B380 Abnormal Psychology	3 cr.
SOC-R100 Introduction to Sociology	3 cr.
STAT 30100 Elementary Statistical Methods I	3 cr.
(or STAT-N501 or PSY-B305 or ECON-E270)	(3 cr.)
PHYS-P201 or PHYS 21800*	4-5 cr.
CLAS-C209 Medical Terms from Greek and Latin	2 cr.
(or HIA-M330 Medical Terminology or RADI-R108 Medical Terminology (need dept. consent))	3 cr. or 1 cr.

*Students should be at or above the level of mathematics in MATH 15300/15400 or MATH 15900 to be successful in Physics.

Pre-Physical Therapy (DPT)

Students may select any undergraduate major and include a set of core courses needed for pre-requisites for a doctoral degree in Physical Therapy. Undergraduate degree programs in Biology, Chemistry or Psychology may be of interest to the pre-physical therapy student.

Advising for undergraduate degree requirements is available in the major department. Additional pre-professional advising including resources such as shadowing, internships, volunteering, and research as well as application and admission assistance to PT programs is provided in the Pre-Professional and Career Preparation (PREPs) Office. An advisor in the IUPUI School of Health and Human Sciences is also available for consultation. Applicants must have completed a bachelor degree for consideration for a graduate program in PT. The Graduate Record Examination (GRE) is required for admission to DPT programs. Students must have 40 clinical observation hours for admission; 20 hours in an acute setting and 20 hours in an outpatient setting. Pre-requisite courses listed below are for Indiana University School of Health and Rehabilitation Sciences. Students are encouraged to check with all schools they are applying to for specific course requirements.

BIOL-N217 Human Physiology	5 cr.
BIOL-N261 Human Anatomy	5 cr.
CHEM-C105 / CHEM-C125 Principles of Chemistry I/ Lab	3 cr./2 cr.
CHEM-C106 / CHEM-C126 Principles of Chemistry II/ Lab	3 cr./2 cr.
PHYS-P201 General Physics I & PHYS-P202 General Physics II	5 cr. & 5 cr.
(or PHYS 21800 & 21900 General Physics)	4 cr. & 4 cr.
PSY-B110 Introduction to Psychology	3 cr.
PSY-B310 Life Span Development	3 cr.
STAT 30100 Elementary Statistical Methods I	3 cr.
(or STAT-N501 or PSY-B305 or ECON-E270 or SOC-R359 or SPEA-K300)	(3 cr.)
HIA-M330 Medical Terminology*	3 cr.
(or CLAS-C209 Med. Terms from Greek & Latin or RADI-R108 Med. Term.)	2 cr./1 cr.
Two 3-credit hour courses in the humanities, social sciences area.	6 cr.

*Medical Terminology required only if offered admission to program

Pre-Physician Assistant (PA)

Students may select any undergraduate major and include a set of core courses needed for pre-requisites for a graduate program as a Physician Assistant. Undergraduate degree programs in Biology, Chemistry or Psychology may be of interest to the pre-PA student.

Advising for undergraduate degree requirements is available in the major department. Additional pre-professional advising including resources such as shadowing, internships, volunteering, and research as well as application and admission assistance to PA programs is provided in the Pre-Professional and Career Preparation (PREPs) Office. An advisor in the IUPUI School of Health and Rehabilitation Science is also available for consultation. Applicants must have completed a bachelor degree for consideration for a graduate program as a Physician Assistant. The Graduate Record Examination (GRE) is optional for admission to the PA program offered by Indiana University but, many other programs still require it. In addition, PA programs also require that students have accumulated a minimum of 10 hours of hours of shadowing prior to acceptance to a PA graduate program. Indiana University no longer has this requirement. Pre-requisite courses listed below are for Indiana University School of Health and Rehabilitation Sciences. Students are encouraged to check with all schools they are applying to for specific course requirements.

BIOL-K101 Concepts of Biology I	5 cr.
BIOL-K103 Concepts of Biology II	5 cr.
BIOL-N261 Anatomy	5 cr.
BIOL-N217 Physiology	5 cr.
BIOL-N251 Intro to Microbiology	3 cr.
(or MICR-J210 Microbiology & Immunology or BIOL-K356 & K357 Microbiology and Lab)	(4 cr. or 3/2 cr.)

CHEM-C105/CHEM-C125 Principles of Chemistry I/ Lab	3/2 cr.
CHEM-C106/CHEM-C126 Principles of Chemistry II/ Lab	3/2 cr.
CHEM-C341/CHEM-C343 Organic Chemistry I/Lab	3/2 cr.
STAT 30100 (or SPEA-K300, or PSY-B305 or SOC-R359)	3 cr.
SHRS-N265 (or HPER-N220, or FN 30300, or SHRS-W361)	3 cr.
PSY-B110 Introduction to Psychology (or SOC-R100)	3 cr.
HIA-M330 (or CLAS-C209 or RADI-R108)	3 cr./2cr./1 cr.

IUPUI Honors College and Science Honors

The IUPUI Honors College is open to students in both the Purdue and Indiana University degree programs. Continuing science students with an overall grade point average (GPA) of 3.5 after their first full academic year of work can apply. Entering freshmen applicatns must have a cumulative high school GPA of 3.75 (weighted) and are required to provide ACT or SAT scores as part of their application materials. The deadline to apply for entering freshmen is November 15. Continuing students will apply via Science Honors. Applications for Science Honors are due mid-April each year. Students must have at least four semesters remaining after admission to complete the Science Honors program. Students with a GPA of more than 3.5 who are not enrolled in Honors College may be permitted to take honors courses. They should, however, discuss the matter with their academic advisor and the Honors College before doing so.

In general, students may take no more than 6 credit hours of honors coursework each semester. Students may earn honors credit by taking special Honors College courses (HON H300, HON H399, HON H400), by taking specially designed honors course sections, by doing special overseas or internship work, or by contracting for honors credit using an H-Option contract in conjunction with regular classes.

H-Option contracts are the most popular and frequent way that students earn honors credit. An H-Option requires that a student work out with the instructor of a course a specific contract for a paper, field project, oral presentation, etc., early in the semester. The contract is not merely an extension of the regular class work, but an opportunity not provided by regular assignments. The Honors College reviews all contracts prior to students beginning projects.

In order to receive an honors notation at graduation, students must complete 24 hours of honors coursework with at least a 3.3 cumulative GPA. For students entering the Honors College via Science Honors, 12 of the required 24 hours must be science courses. In order to remain in good honors academic standing, students also must maintain a 3.3 semester and cumulative GPA, enroll in honors coursework each semester, achieve a B or higher in all honors courses, and take honors coursework each fall and spring semester.

For additional information, contact the IUPUI Honors College, 0124 University Library, 755 W. Michigan Street, Indianapolis, IN 46202-5164; phone (317) 274-2660; https://honors.iupui.edu.

Undergraduate Research Program

IUPUI has established an Undergraduate Research Opportunities Program (UROP) to encourage and recognize undergraduates who participate in research projects with faculty in the school.

Undergraduate research students may receive the transcript notation on their academic transcript concurrent with the awarding of the degree by fulfilling a set of requirements listed below. Such a transcript notation provides obvious evidence of a student's participation in independent laboratory and scholarly and research other creative work. The notation will certify and spotlight research proficiency or successful completion of some other creative activity.

UROP has established a program of requirements that must be fulfilled to qualify for transcript notation. The requirements are:

1. Students must register for and complete five credits of formal research in their departments or units. Students whose departments have no independent research credit may use the Honors Course HON-H399. The definition of research credit will be left up to the student's department or unit, but should conform to the general definition of research and consist substantially of an independent project by the student.
2. Students must prepare a substantial written product from the research. This could include a senior thesis or journal publication. Other appropriate activities to the discipline may be substituted for this, for example, an art exhibit or other performance. Substitutions must receive prior approval from the UROP Director.
3. Students must attend an outside professional meeting in a discipline at the state, regional, or national level. Attendance at other professional events will be considered as appropriate to the discipline. The student's faculty mentor will certify attendance. Students will be encouraged to present their work at a professional meeting or other event.
4. Students must participate in at least one annual UROP symposium. Students must present at least one oral paper to receive transcript notation. If appropriate to research and creative activity in the discipline, other types of presentations may be acceptable at the discretion of the UROP Director and with the recommendation the student's faculty mentor.
5. Students must prepare a Research Portfolio, which may be in an electronic form. The Research Portfolio is prepared with the student's faculty mentor and must be submitted four weeks prior to the student's anticipated graduation date. Information about preparing a research portfolio can be found at http://crl.iupui.edu/resources/.

Further information about undergraduate research opportunities and transcript notation may be found at http://crl.iupui.edu/resources/.

Courses

Biology

Undergraduate Level

BIOL-K 102 Honors Concepts of Biology I (5 cr.) P: High school or college chemistry and math placement at MATH 15300 or higher. For Honors Credit: Fall. An introductory course emphasizing the principles of cellular biology; molecular biology; genetics; and plant anatomy, diversity, development, and physiology. Faculty-supervised research projects and approved independent projects provide greater depth for honors students. This course carries honors credit.

BIOL-K 103 Concepts of Biology II (5 cr.) P: BIOL-K 101. An introductory biology course emphasizing phylogeny, structure, physiology, development, diversity, evolution and behavior in animals. Fall, Spring, Summer.

BIOL-K 104 Honors Concepts of Biology II (5 cr.) P: BIOL-K 101 and accepted into honors program or BIOL-K 102. An introductory biology course emphasizing phylogeny, structure, physiology, development, diversity, evolution and behavior in animals. This course will expose honors students to a unique series of laboratory investigations. Spring. (not offered every year)

BIOL-K 195 Introductory Topics in Biology (0-3 cr.) P: Freshman or sophomore standing or consent of instructor. Other prerequisites may be announced at the time of topic offering. Lectures on contemporary issues in biology. This course may also include reading assignments and special projects. Fall, Spring, Summer.

BIOL-K 295 Intermediate Topics in Biology (0-3 cr.) P: P: Freshman or sophomore standing; other prerequisites may be announced at the time of topic offering. Lectures on contemporary issues in biology. This course may also include reading assignments and special projects. Repeatable

BIOL-K 322 Genetics and Molecular Biology (3 cr.) P: BIOL-K 103 and CHEM-C 106. The course covers the principles of classical and molecular genetics including Mendelian inheritance, linkage, nucleic acids, gene expression, recombinant DNA, genomics, immunogenetics, and regulation. Fall, Spring.

BIOL-K 323 Genetics and Molecular Biology Laboratory (2 cr.) P: (BIOL-K103 or BIOL-K104) and CHEM-C106 with a minimum grade of C- in each course. Applied principles of genetics and molecular biology using organisms of increasing complexity from viruses to fruit fly. Laboratory experiments include linkage analyses, deletion mapping, isolation of human chromosomes, mutagenesis, DNA extraction, restriction enzyme analysis, and PCR. Fall.

BIOL-S 323 Honors Genetics and Molecular Biology Laboratory (2 cr.) P: or C: BIOL-K 322. In this course, students will apply principles of genetics and molecular biology using organisms of increasing complexity from bacteria to the fruit fly. In this laboratory, students will learn many important genetics and molecular biology lab techniques such as: mutagenesis, DNA extraction, restriction enzyme analysis, primer design, bioinformatics applications, and PCR. There will be a major emphasis on primary research literature. Fall.

BIOL-K 324 Cell Biology (3 cr.) P: BIOL-K 103 and CHEM-C 106. Examination of the structure and activity of eukaryotic cells and subcellular structures. Emphasis is on regulation of and interactions among subcellular events, such as protein targeting, transmembrane signaling, cell movement, and cell cycle. Fall, Spring.

BIOL-K 325 Cell Biology Laboratory (2 cr.) P: or C: BIOL-K 324. Experiments on the molecular and biochemical basis of organization and function of eukaryotic cells. Spring.

BIOL-S 325 Honors Cell Biology Laboratory (2 cr.) P: or C: BIOL-K 324. The goal of this course is to demonstrate the concepts of how fundamental cellular processes can be demonstrated in a laboratory setting. The course reflects a breadth of experimental approaches used in cell biology today and will allow students to develop a sense of how cells accomplish certain ends and why. There is a major emphasis on primary research literature. Spring (not offered every year).

BIOL-K 331 Developmental Biology (3 cr.) P: BIOL-K 103 and BIOL-K 322. The development of animal embryos from fertilization through organogenesis and some non-embryonic developmental phenomena. Fall, Spring.

BIOL-K 333 Developmental Biology Laboratory (2 cr.) P: or C: BIOL-K 331. Spring. A series of original and embryonic chick cell tissue-based experiments will be performed. These experiments will illustrate mechanisms of animal development.

BIOL-K 338 Introductory Immunology (3 cr.) P: BIOL-K 103, BIOL-K 322, BIOL-K 324, and CHEM-C 106. Principles of basic immunology with an emphasis on the cells and molecules underlying immunological mechanisms. Fall, Spring, Summer.

BIOL-K 339 Immunology Laboratory (2 cr.) P: BIOL-K322 with a minimum grade of C-. Demonstration of immunological principles by experimentation. Exercises include cells and factors of the innate and the adaptive immune systems. Fall, Spring.

BIOL-K 341 Principles of Ecology and Evolution (3 cr.) P: BIOL-K 103. A study of the interactions of organisms with one another and with their nonbiotic environments in light of evolution. Fall, Spring.

BIOL-K 342 Principles of Ecology and Evolution Laboratory (2 cr.) P: BIOL-K103 or BIOL-K104 with a minimum grade of C-. Application of ecology and evolution principles in laboratory and field experiments as well as demonstration of techniques of general ecology. Fall.

BIOL-K 350 Comparative Animal Physiology (3 cr.) P: BIOL-K103 and CHEM-C106 A comparative examination of principles of animal physiology from molecular to organismal levels using homeostasis, regulation, and adaptation as central themes. Fall.

BIOL-K 356 Microbiology (3 cr.) P: BIOL-K 103, CHEM-C 341. Introduction to microorganisms: cytology, nutrition, physiology, and genetics. Importance of microorganisms in applied fields including infectious disease. Fall, Spring.

BIOL-K 357 Microbiology Laboratory (2 cr.) P: or C: BIOL-K 356. Laboratory experiments and demonstrations to yield proficiency in aseptic cultivation and utilization of microorganisms; experimental investigations of biological principles in relation to microorganisms. Spring.

BIOL-S 357 Honors Microbiology Lab (2 cr.) P: or C: BIOL-K 356. In this course, students will become proficient in techniques for cultivation and utilization of microorganisms, along with many assays for microorganism identification. There will be a major emphasis on primary research literature. Spring.

BIOL-K 384 Biochemistry (3 cr.) P: BIOL-K322 or BIOL-K324 or equivalent and CHEM-C341 or equivalent Biochemistry covering the fundamentals of the chemistry of life including biomolecule structure and function, the dependence of biological processes on chemical and physical principles, and pathways of carbohydrate and fatty acid metabolism. Recommended for pre-professional students. Fall, Spring, Summer.

BIOL-K 395 Advanced Topics in Biology (1-3 cr.) P: Junior or senior standing or consent of instructor; other prerequisites may be announced at the time of topic offering. Lectures on contemporary issues in biology. This course may also include reading assignments and special projects. Fall, Spring, Summer.

BIOL-K 411 Global Change Biology (3 cr.) P: BIOL-K 101 and BIOL-K 103 or GEOL-G 109 and one course in chemistry or consent of instructor. Examination of changes in earth's environment over history. In-depth study of effects of environmental change, including global warming, on the ecology of various organisms. Spring of odd-numbered years.

BIOL-K 416 Cellular Molecular Neuroscience (3 cr.) P: BIOL-K 324. This course is designed to provide an in-depth analysis of topics within the field cellular and molecular neuroscience. It will cover invertebrate and vertebrate neurobiology, cell and molecular biology of the neuron, neurophysiology, neuroanatomy, developmental neurobiology, regeneration and degeneration, learning and memory, and will include comparisons of neural mechanisms throughout the animal kingdom. Fall.

BIOL-K 451 Neuropharmacology (3 cr.) P: BIOL-K 324. Recommended completion of upper-level biochemistry course. This course focuses on the molecular underpinnings of neuropharmacology. In the first part of the course - Fundamentals of Neuropharmacology - we will look at basic principles of neuropharmacology including understanding how drugs bind to their targets. Also, we will evaluate how neurons communicate with each other and how those signals are transduced on a molecular level. Part 2 will evaluate where drugs act in the brain and some of the major neurotransmitters. Part 3 will focus on neuronal dysfunction in various disorders and how we can treat those disorders pharmacologically. Spring.

BIOL-K 483 Biological Chemistry (3 cr.) P: CHEM-C 342. P: or C: BIOL-K 324. Chemistry of biologically important molecules including carbohydrates, lipids, proteins, and nucleic acids. Special emphasis on chemistry of intermediary metabolism. Not offered on a regular basis.

BIOL-K 484 Cellular Biochemistry (3 cr.) P: BIOL-K 322 and CHEM-C 342. P or C: BIOL-K 324. Emphasis on selected topics in cellular biochemistry, including nucleic acid: protein interactions, protein: protein interactions, protein synthesis, biogenesis of membranes, and signal transduction. Current techniques for studying these processes in higher eukaryotes will be discussed. (not offered on a regular basis)

BIOL-K 488 Endocrinology in Health and Disease (3 cr.) P: BIOL-K 103, BIOL-K 324, and BIOL-K 322 or approved equivalent courses. Upper-level biochemistry or equivalent course recommended. An introduction to human endocrinology, including the biology of the major endocrine organs and the roles of the hormones that they release. Both normal endocrine function and common diseases involving hormone physiology are examined. In addition, the course examines how endocrinology impacts everyday life. Spring.

BIOL-K 490 Capstone (1 cr.) P: Senior standing. Faculty-directed or approved independent library research on an area of public, scientific interest or a community service activity in local industry, government, schools, or other public science-related groups or organizations. Fall, Spring, Summer.

BIOL-K 493 Independent Research (1-3 cr.) P: Consent of instructor. A course designed to give undergraduate students majoring in biology an opportunity to do research in fields in which they have a special interest. Fall, Spring, Summer.

BIOL-K 494 Senior Research Thesis (1 cr.) P: BIOL-K 493. A formally written report describing the results or accomplishments of BIOL-K 493. Fall, Spring, Summer.

BIOL-K 495 Special Topics in Biology (0-3 cr.) P: Junior or senior standing or consent of instructor; other prerequisites may be announced at the time of topic offering. Lectures on contemporary issues in biology. This course may also include reading assignments and special projects. Fall, Spring, Summer.

Courses for the Nonmajor

BIOL 10011 Principles of Biomedical Sciences (3 cr.) Students investigate the human body systems and various health conditions including heart disease, diabetes, sickle-cell disease, hypercholesterolemia, and infectious diseases. They determine the factors that led to the death of a fictional person, and investigate lifestyle choices and medical treatments that might have prolonged the person's life. The activities and projects introduce students to human physiology, medicine, research processes and bioinformatics. This course is designed to provide an overview of all the courses in the Biomedical Sciences program and lay the scientific foundation for subsequent courses.

BIOL 10012 Human Body Systems (3 cr.) P: BIOL 10011. Students examine the interactions of body systems as they explore identity, communication, power, movement, protection and homeostasis. Students design data acquisition software to monitor body functions such as muscle movement, reflex and voluntary action, and respiration. Exploring science in action, students build organs and tissues on a skeletal manikin, work through

interesting real world cases and often play the role of biomedical professionals to solve medical mysteries.

BIOL 10013 Medical Interventions (3 cr.) P: BIOL 10012. Students investigate the variety of interventions involved in the prevention, diagnosis and treatment of disease as they follow the lives of a fictitious family. The course is a "How-To" manual for maintaining overall health and homeostasis in the body as students explore: how to prevent and fight infection; how to screen and evaluate the code in human DNA; how to prevent, diagnose and treat cancer; and how to prevail when the organs of the body begin to fail. Through these scenarios, students are exposed to the wide range of interventions related to immunology, surgery, genetics, pharmacology, medical devices and diagnostics. Lifestyle choices and preventive measures are emphasized throughout the course as well as the important roles scientific thinking and engineering design play in the development of interventions of the future.

BIOL 10014 Biomedical Innovation (3 cr.) P: BIOL 10013. In this capstone course, students apply their knowledge and skills to answer questions or solve problems related to the biomedical sciences. Students design innovative solutions for the health challenges of the 21st century as they work through progressively challenging open-ended problems, addressing topics such as clinical medicine, physiology, biomedical engineering, and public health. They have the opportunity to work on an independent project and may work with a mentor or advisor from a university, hospital, physician's office, or industry. Throughout the course, students are expected to present their work to an adult audience that may include representatives from the local business and health care community.

BIOL-N 100 Contemporary Biology (3 cr.) Selected principles of biology with emphasis on issues and problems extending into everyday affairs of the student. Fall, day, night; Spring, day, online; Summer

BIOL-N 107 Exploring the World of Animals (4 cr.) Equiv. PU BIOL 109. This course introduces students to animals and their native environments. It surveys individual ecosystems and highlights the interactions, features, and characteristics of the animals found there. Examples of discussion topics include unique features of animals, animal relationships, societies and populations, exotic species, and behavior, including mating, communication, feeding and foraging, and migration. Environmental issues including the effects of pollution on ecosystems are also discussed. Not equivalent to BIOL-K 103. Fall, Spring.

BIOL-N 108 Plants, Animals and the Environment (3 cr.) This course is designed to provide students and future K-8 teachers with a background in the general biology concepts of plants, animals and the environment, which are the backbone of the State of Indiana science standards. Not offered on a regular basis.

BIOL-N 120 Topics in Biology (3 cr.)

BIOL-N 200 The Biology of Women (3 cr.) This course examines the biological basis for bodily functions and changes that take place throughout the life of females. Fall, Spring.

BIOL-N 207 Physiology for Healthcare Management (3 cr.) Spring, Summer. This course is designed to provide students with a beginning, but solid foundation in Physiology. This course will focus on the study of internal and external structures, and the physical relationships between these structures. Physiology in this course will be studied at many levels, from molecular through microscopic to whole body, and we will also analyze some physiological concepts from a pathophysiology perspective.

BIOL-N 211 Anatomy for Healthcare Management (3 cr.) This course focuses on internal and external structures and the physical relations between them. Anatomy is studied at many levels, from molecular through microscopic to gross anatomy, and anatomical concepts are studied from a developmental perspective. Models, slides, photographs, and dissections are used. Note: Cannot substitute for BIOL N261 Human Anatomy (5 cr.). Fall, Spring.

BIOL-N 212 Human Biology (3 cr.) Equiv. PU BIOL 201. Fall, day. First course in a two-semester sequence in human biology with emphasis on anatomy and physiology, providing a solid foundation in body structure and function.

BIOL-N 213 Human Biology Laboratory (1 cr.) P: or C: BIOL-N 212. Accompanying laboratory for BIOL-N 212. Fall, Summer.

BIOL-N 214 Human Biology (3 cr.) P: BIOL-N 212. Equiv. PU BIOL 202. Continuation of BIOL-N 212. Spring, Summer.

BIOL-N 215 Human Biology Laboratory (1 cr.) P: or C: BIOL-N 214. Accompanying laboratory for BIOL-N 214. Spring, Summer.

BIOL-N 217 Human Physiology (5 cr.) Equiv. IU PHSL-P 215. Lectures and laboratory work related to cellular, musculoskeletal, neural, cardiovascular, gastrointestinal, renal, endocrine, and reproductive function in humans. Fall, day; Spring, day; Summer, day.

BIOL-N 222 Special Topics in Biology (1-3 cr.) A variable-topic course dealing with current topics in biology. In a given semester, a topic such as disease, genetics, the environment, etc., will be dealt with as a separate course.

BIOL-N 225 Urban and Suburban Gardening (2 cr.) P: High School biology. Course is intended for both biology and non-biology majors. Designed to expand understanding of the science and techniques of gardening with emphasis on healthy soil and its impact on plant growth. After completing the course, students will be able to describe what makes plants grow and what makes plants grow healthy. No gardening experience is required. Spring, even years.

BIOL-N 226 Wildflowers and Ferns of Indiana Forests (2 cr.) This course will focus on spring wildflowers and other plants that occur in the various forest types in Indiana. At the end of the course, students are expected to be proficient in identifying by both common and botanical names up to 75 forest plants. In addition, they will learn nomenclature, basic taxonomic classification, and how to use simple dichotomous keys. Students will also become familiar with the natural regions of Indiana, natural

community types, and natural history information of select plant species. Spring.

BIOL-N 230 Biology, Design and History of Japanese Gardens (3 cr.) This course will introduce students to the different styles of Japanese gardens including dry landscape gardens, pond gardens, stroll gardens, tea gardens, and courtyard gardens. The course will emphasize the growth and maintenance of plants in a controlled environment and the interplay of the plants with the non-living elements of the garden. Selected gardens in Kyoto, Uji, and Nara, Japan will serve as examples of the various types of gardens, the periods of history that they represent and the design influences exhibited by these gardens. Importantly, the gardens will be experienced first hand allowing the students to form their own impressions and feelings for the gardens. This class will be intensive and will involve walking to and through the gardens. Not offered on a regular basis.

BIOL-N 251 Introduction to Microbiology (3 cr.) P: One semester general chemistry or one semester life science. This course includes a laboratory component. The isolation, growth, structure, functioning, heredity, identification, classification, and ecology of microorganisms; their role in nature and significance to humans. Fall, Spring, Summer.

BIOL-N 261 Human Anatomy (5 cr.) Equiv. IU ANAT-A 215. Lecture and laboratory studies of the histology and gross morphology of the human form, utilizing a cell-tissue-organ system-body approach. Fall, Spring, Summer.

BIOL-N 322 Introductory Principles of Genetics (3 cr.) P: BIOL-N 107 or BIOL-K 101. Equiv. PU AGR 430. Basic principles of plant and animal genetics. Emphasis on transmission mechanisms as applied to individuals and populations. For students in health and agricultural sciences. Spring.

BIOL-N 400 Biological Skills for Teachers (3 cr.) P: Consent of instructor. Fall, night. Concepts and laboratory skills necessary to prepare teachers with diverse backgrounds to return to graduate academic biology courses are reviewed. Topics include general principles of biology, biochemistry, and biomathematics.

BIOL-N 461 Cadaveric Human Anatomy (5 cr.) P: BIOL-N 261 Human Anatomy, (minimum grade of B) and BIOL-N 217 Human Physiology (minimum grade of B) or instructor approval. This course is designed for upper-level undergraduate students who desire an advanced understanding of Human Anatomy, especially those who intend to pursue a career in the health professions. Through the use of cadaveric dissection, prosected materials, and digital images, the student will explore the structural details of the human body, with a particular emphasis on functional anatomy and clinical correlations. This course will be an intensive learning experience for motivated undergraduates. Spring.

Advanced Undergraduate and Graduate Level

BIOL 50700 Principles of Molecular Biology (3 cr.) P: BIOL-K 322, CHEM-C 342, or consent of instructor. Molecular aspects of structure and function of nucleic acids and proteins, including recombinant DNA research. Prokaryotic and eukaryotic molecular biology are given equal weight. Spring

BIOL 51600 Molecular Biology of Cancer (3 cr.) P: BIOL-K 322, CHEM-C 342 or a course in biochemistry. A detailed course examining the molecular mechanisms controlling the growth of animal cells. Emphasis on current experimental approaches to defining the molecular basis of growth regulation in developing systems and the uncontrolled proliferation of cells in metabolic disorders, such as cancer. Spring. Not offered on a regular basis.

BIOL 53000 Introductory Virology (3 cr.) P: BIOL-K 356, CHEM-C 342. Detection, titration, and chemistry of viruses; viral host interactions: bacteriophage-bacterium, animal virus-animal cell, plant virus-plant cell; tumor viruses: infection and transformation. Not offered on a regular basis.

BIO 99999 Test (3 cr.)

BIOL 54000 Topics in Biotechnology (3 cr.) P: BIOL-K 322 and CHEM-C 341, or consent of instructor. Examines research techniques and applications for several technologies situated at currently recognized biological frontiers, including recombinant DNA technology, hybridoma technology, protein engineering, agricultural research, and microbiological engineering. Not offered on a regular basis.

BIOL 54410 Sensory Systems (3 cr.) P: BIOL-K 324. The goal of Sensory Systems is to gain an understanding of the mechanisms that underlie sensory perception at the molecular, cellular, and systems level. This will be accomplished by examining how various forms of energy are transduced into the electrochemical messages of the nervous system, what pathways the information travels within the nervous system, and how this information is processed and perceived. Spring.

BIOL 54800 Techniques in Biotechnology (3 cr.) P: BIOL-K 322, CHEM-C 342, or consent of instructor. Laboratory experience in techniques applicable to biotechnology: protein chemistry, molecular biology, and immunology. Not offered on a regular basis.

BIOL 55000 Plant Molecular Biology (3 cr.) P: BIOL-K 322, CHEM-C 341, or consent of instructor. A comprehensive study of plant molecular biology and plant molecular genetics. Topics will include the structure and expression of plant nuclear, chloroplast, and mitochondrial genomes, and plant viruses. Fall.

BIOL 55600 Physiology I (3 cr.) P: BIOL-K 103, CHEM-C 342. Principles of physiology: nerve and muscle, temperature regulation, ion and water balance. Fall.

BIOL 55700 Physiology II (3 cr.) P: 556 or consent of instructor. A study of human cardiovascular, pulmonary, blood, and gastrointestinal systems. Higher neuronal functions and intersystem interactions will be discussed. Spring.

BIOL 55900 Endocrinology (3 cr.) P: BIOL 55600 or equivalent, and CHEM-C 342. The study of hormone function. Consideration will be given to the role of hormones in growth, development, metabolism, homeostasis, and reproduction. Fall.

BIOL 56010 Clinical and Molecular Aspects of Neurodegenerative Diseases (3 cr.) P: BIOL-K 416 or

BIOL-K 451 or instructor consent. This course focuses on the molecular and clinical aspects of neurodegenerative diseases. The first part of the course will briefly introduce critical brain structures, with a focus on neurons and glia and will evaluate molecular mechanisms that underlie protein aggregation and cell death. The remainder of the course will focus on the multiple aspects of specific neurodegenerative diseases. Fall.

BIOL 56100 Immunology (3 cr.) P: BIOL-K 103, CHEM-C 341. Introduction to basic principles and experimentation in cellular and humoral immunology. Fall.

BIOL 56400 Molecular Genetics of Development (3 cr.) P: BIOL-K 322 or similar course or consent of instructor. The course examines the genetic and developmental bases as well as phenotypes of 40 genetic disorders. Chromosomal, single gene, complex and developmental genetic disorders are studied in detail. Emphasis is placed on molecular techniques and understanding current primary literature. Spring.

BIOL 56600 Developmental Biology (3 cr.) P: BIOL-K 322. Principles of animal development. The emphasis is on concepts and underlying mechanisms of developing and regenerating systems and stem cell properties, including molecular and biochemical approaches. Fall.

BIOL 56800 Regenerative Biology and Medicine (3 cr.) P: BIOL-K 324 or BIOL-K 331 or a biochemistry course. This course examines the mechanisms of natural regeneration (regenerative biology) and the application of these mechanisms to the development of therapies to restore tissues damaged by injury or disease (regenerative medicine). Not offered on a regular basis.

BIOL 57000 Biological Membranes (3 cr.) P: CHEM-C 342 or consent of instructor. An examination of structure and function of biological membranes. Topics include lipid and protein composition and interactions, physiological properties of membranes, physiological methods of analysis, model membrane systems, and survey of specific biological membranes and their modes of action. Not offered on a regular basis.

BIOL 57100 Developmental Neurobiology (3 cr.) P: Consent of instructor. The major phases of nervous system development beginning with neurolation and neurogenesis and ending with the onset of physiological activity will be studied in a variety of animals, mainly avians and mammals (including man). Neural developmental disorders and behavioral ontogeny will also be considered. Fall.

BIOL 57310 Stem Cell Biology (3 cr.) P: BIOL-K 324. In this course, students will develop a clear understanding of stem cells' defining features, activities and potential utility. Stem cell research is pursued in nearly all areas of medicine. This course focuses on important definitions and characteristics of stem cells and develops a general overview of stem cell biology. The course builds on this overview of stem cell biology by examining specific examples of developmental biology, methodology and the potential applications of stem cell therapy. Spring.

BIOL 57410 Molecular and Cellular Bone Biology (3 cr.) P: BIOL-K 101, BIOL-K 103, BIOL-K 324. This course is designed for graduate and senior undergraduate students. Concentration on basic cellular and molecular concepts of bone and cartilage with applications to engineering concepts. Topics include bone development and growth, cartilage and chondrocyte, signal transduction in bone cells, stem cells, skeletal regeneration, tissue engineering, gene therapy and cancer bone metastasis. Fall.

BIOL 57850 Epigenetics (3 cr.) P: Undergraduate course in biochemistry and/or molecular biology or consent of instructor. Epigenetics refers to heritable patterns of gene expression and phenotype that occur without altered DNA sequence. The molecular basis for many epigenetic phenomena resides at the level of chromatin structure. Originally thought to provide primarily a packaging function, the assembly of DNA with proteins to form chromatin is now known to be a dynamic process that is essential for proper regulation of gene expression. It is now appreciated that perturbed epigenetic regulation is associated with a variety of human diseases, such as cancer, and that a better understanding of this biology may reveal novel therapeutic approaches to treat these disorders. This course will introduce students to epigenetic phenomena in various organisms, ranging from yeast to humans, and explore the fundamental molecular biology that controls this level of gene regulation. Students will be exposed to the primary scientific literature, and gain experience in presenting original research findings to their peers. Not offered on a regular basis.

BIOL 59500 Special Assignments (1-3 cr.) P: Consent of instructor. Special work, such as directed reading, independent study or research, supervised library, laboratory or fieldwork, or presentation of material not available in the formal courses of the department. Fall, Spring, Summer.

BIOL 51600 Molecular Biology of Cancer (3 cr.) P: BIOL-K 322, CHEM-C 342 or a course in biochemistry. A detailed course examining the molecular mechanisms controlling the growth of animal cells. Emphasis on current experimental approaches to defining the molecular basis of growth regulation in developing systems and the uncontrolled proliferation of cells in metabolic disorders, such as cancer. Spring.

Graduate Level

BIOL 60900 Scientific Research Bootcamp (3 cr.) P: Enrolled in an MS Thesis or PhD program in the School of Science. This course introduces graduate students (Thesis Masters's and Ph.D.) to research approaches and analysis programs, research presentation skills, and the proper conduct of research. This bootcamp course fulfills the requirement for Responsible Conduct in Research training that is required for students with certain funding and paid off of NIH/HSF grants. Moreover, this course introduces students to programs such as Adobe Illustrator, Adobe Photoshop, GraphPad Prism, SPSS, and Image J., some or all of which they will be using during their graduate careers and beyond.

BIOL 62500 Immune System Disorders (3 cr.) P: BIOL-K 338. The aim of this course is to understand the underlying mechanisms that contribute to immune system dysfunction. We will discuss the genetic defects in the immune system, immune complex diseases, immune mediated hypersensitivity reactions and autoimmune

diseases. This course covers fundamentals as well as current topics in the field of immunology. Spring.

BIOL 64100 Microbial Genetics (2 cr.) P: BIOL-K 323, CHEM-C 342 and consent of instructor. Genetics of bacteria, bacterial viruses, and other microorganisms with emphasis on organization, replication, and function of the genetic material. Not offered on a regular basis.

BIOL 69600 Seminar (1 cr.) Each semester there are several separate offerings. They will likely be on the following topics: biochemistry, biology teaching, ecology and population biology, genetics, mechanisms of development, microbiology, neurobiology, and plant physiology. Oral presentations required. Fall, Spring. May be repeated for credit.

BIOL 69700 Special Topics (1-3 cr.) The frontiers of biology. Critical examination of developments in the various specialties represented by the members of the department. Currently, advanced work in the following and related fields can be offered: molecular genetics; structure and biosynthesis of biologically significant molecules; the nature of biological specificity and enzyme catalysis; the fine structure and chemistry of subcellular particles, cells, and tissues; microbial and plant metabolism; comparative biochemistry; genetics and physiology of viruses, bacteria, fungi, protozoa, helminths, and cells of higher forms of life; the genetics, structure, development, and physiology of plants and animals, including endocrinology and work physiology; excitable membranes; neurobiology, ecology, systematics, and evolution of microorganisms, plants, and animals; host-parasite relationships including immunology; and the teaching of biology. The field in which work is offered will be indicated in the student's record. May be repeated for credit.

BIOL 69800 Research M.S. Thesis (Arr. cr.) M.S. Thesis.

BIOL 69900 Research Ph.D. Thesis (Arr cr.) Research Ph.D. Thesis.

BIOL-G 901 Advanced Research (6 cr.)

Chemistry

Undergraduate

CHEM-C 100 The World of Chemistry (3 cr.) A topically oriented, nonmathematical introduction to the nature of matter. Topics covered include fossil fuel and nuclear sources of power; environmental issues involving chemistry such as recycling, acid rain, air and water pollution, global warming, ozone depletion; genetic modification of foods, DNA profiling, use of food additives and herbal supplements; and other public policy issues involving science.

CHEM-C 101 Elementary Chemistry I (3 cr.) P: At least one semester of high school algebra. C: CHEM-C 121. Fall, day, night; Spring, day, night; Summer II, day. Essential principles of chemistry, atomic and molecular structure, bonding, properties and reactions of elements and compounds, stoichiometry, solutions, and acids and bases. For students who are not planning careers in the sciences and for those with no previous course work in chemistry. Note: most degree programs that include CHEM-C101 require the concurrent laboratory, CHEM-C121.

CHEM-C 105 Principles of Chemistry I (3 cr.) P: Two years of high school algebra and one year of high school chemistry. C: CHEM-C 125. A placement examination may be required for admission to this course. See "Chemistry Placement Examination" above. Fall, day, night; Spring, day; Summer I, day. Principles of inorganic and physical chemistry emphasizing physical and chemical properties, atomic and molecular structure, chemical bonding, and states of matter.

CHEM-C 106 Principles of Chemistry II (3 cr.) P: CHEM-C 105 or equivalent. C: CHEM-C 126. Fall, day; Spring, day, night; Summer II, day. Continuation of CHEM-C 105. Topics include condensed phases, solution chemistry, thermodynamics, equilibrium, and kinetics.

CHEM-C 110 The Chemistry of Life (3 cr.) High school chemistry recommended. Optional laboratory: CHEM-C 115. A nonmathematical introduction to organic molecules and their transformation to useful materials such as drugs and polymers. An emphasis is placed on the chemical features of biomolecules including hormones and neurotransmitters, proteins, lipids (fats), carbohydrates (sugars), and nucleic acids (DNA/RNA). The chemistry of enzymes, carcinogens, vitamins, antihistamines, anesthetics, genetic engineering, mental health, and other health-related topics.

CHEM-C 115 Laboratory for C110 The Chemistry of Life (2 cr.) P: or C: CHEM-C 110. Laboratory work illustrating topics covered in CHEM-C 110.

CHEM-C 121 Elementary Chemistry Laboratory I (2 cr.) P: or C: CHEM-C 101 (3 cr.) Fall, day, night; Spring, day, night; Summer II, day. Introduction to the techniques and reasoning of experimental chemistry. Emphasis is given to study of physical and chemical properties of inorganic compounds.

CHEM-C 125 Experimental Chemistry I (2 cr.) P: or C: CHEM-C 105 or equivalent. Fall, day, night; Spring, day, night; Summer I, day. Laboratory work illustrating topics covered in CHEM-C 105.

CHEM-C 126 Experimental Chemistry II (2 cr.) P: CHEM-C 105 and CHEM-C 125; P or C: CHEM-C 106 or equivalent. Fall, day, night; Spring, day, night; Summer II, day. Continuation of CHEM-C 125. Laboratory work illustrating topics covered in CHEM-C 105 and CHEM-C 106.

CHEM-C 209 Special Problems (1-2 cr.) P: Two semesters of college chemistry and consent of instructor. Every semester, time arranged. Individually supervised special problems of chemical interest, e.g., environmental problems, development of experiments, development of audiovisual materials, etc. May be repeated for credit, but maximum of 2 credit hours may be applied toward a chemistry degree.

CHEM-C 294 Cornerstone in Chemistry (1 cr.) P: CHEM-C 106. Fall, Spring. To engage sophomore chemistry majors in important educational and professional topics such as departmental research opportunities, career planning, library research skills, scientific communication, scientific ethics and science in society issues.

CHEM-C 301 Chemistry Seminar I (1 cr.) P: or C: CHEM-C 409 and consent of instructor. Fall, day. Topics

in various areas of chemistry. Students are required to attend departmental seminars and prepare and present at least one seminar on their research. CHEM-C 301 and CHEM-C 302 may be elected three semesters for credit.

CHEM-C 302 Chemistry Seminar II (1 cr.) P: or C: CHEM-C 409 and consent of instructor. Spring, day. Content same as CHEM-C 301.

CHEM-C 309 Cooperative Education in Chemistry (1 cr.) P: General and organic chemistry and consent of departmental chairperson. Every semester, time arranged. Industrial or similar experiences in chemically oriented employment. Grade is determined on basis of employment visitations, a written student report, and a supervisor evaluation report. May be repeated for a maximum of 5 credit hours, of which 3 may be used to satisfy an advanced chemistry elective.

CHEM-C 310 Analytical Chemistry (3 cr.) P: CHEM-C 106 and CHEM-C 126. Fall, Spring. Fundamental analytical processes including solution equilibria, theory and applications of electrochemistry and spectrophotometry, and chemical methods of separation.

CHEM-C 311 Analytical Chemistry Laboratory (1 cr.) P: or C: CHEM-C 310. Fall, Spring. Laboratory instruction in the fundamental analytical techniques discussed in CHEM-C 310.

CHEM-C 325 Introductory Instrumental Analysis (5 cr.) P: CHEM-C 310, CHEM-C 311. Spring. Instrumental methods of chemical analysis and separation for the chemical technician or preprofessional chemistry major.

CHEM-C 341 Organic Chemistry I (3 cr.) P: CHEM-C 106. Fall, day, night; Spring, varies; Summer I, varies. Comprehensive study of organic compounds. Valence bond theory, stereochemistry, and physical properties of organic compounds are discussed in detail. Introduction to reaction mechanisms and to spectroscopic identification. Synthesis and reactions of selected compounds are also discussed.

CHEM-C 342 Organic Chemistry II (3 cr.) P: CHEM-C 341. Fall, day; Spring, day, night; Summer II, varies. Continuation of CHEM-C 341. The chemistry of aromatic compounds and other major functional groups are discussed in detail. Multistep synthetic procedures and reaction mechanisms are emphasized. Introduction to biological chemistry.

CHEM-C 343 Organic Chemistry Laboratory I (2 cr.) P: CHEM-C 126; P or C: CHEM-C 341. Fall, day, night; Spring, day, night; Summer I, varies. Fundamental laboratory techniques of organic chemistry, introduction to spectroscopic methods of compound identification, and general synthetic methods.

CHEM-C 344 Organic Chemistry Laboratory II (2 cr.) P: CHEM-C 343. P: or C: CHEM-C 342. Fall, night; Spring, day, night; Summer II, varies. Preparation, isolation, and identification of organic compounds, spectroscopic methods of compound identification, qualitative organic analysis, multistep synthesis.

CHEM-C 360 Elementary Physical Chemistry (3 cr.) P: CHEM-C 106, MATH 22200 or MATH 23200, PHYS-P 202. Spring, day. Properties of gases and liquids, intermolecular forces, diffusion, chemical thermodynamics, ligand binding, kinetics, and introduction to quantum chemistry and spectroscopy. Includes topics in biophysical chemistry. For students who desire a survey course in physical chemistry.

CHEM-C 361 Physical Chemistry of Bulk Matter (3 cr.) P: CHEM-C 106, MATH 16600, and PHYS-P 202 or PHYS 25100. C: MATH 26100. Spring, day. Kinetic-molecular theory, gases, liquids, thermodynamics, statistical mechanics, solutions, transport properties, and phase and chemical equilibria.

CHEM-C 362 Physical Chemistry of Molecules (4 cr.) P: CHEM-C 106, MATH 16600, and PHYS-P 202 or PHYS 25100. C: MATH 26100. Fall, day. Quantum chemistry, symmetry, atomic and molecular structure and spectra, solids, chemical kinetics, photochemistry, and introduction to statistical thermodynamics.

CHEM-C 363 Experimental Physical Chemistry (2 cr.) P: CHEM-C 362 and P or C: CHEM-C 361 Spring. Experimental work to illustrate principles of physical chemistry and to introduce research techniques.

CHEM-C 371 Chemical Informatics I (1 cr.) P: CHEM-C 106, Fall. Basic concepts of information representation, storage, and retrieval as they pertain to chemistry. Structures, nomenclature, molecular formulas, coding techniques for visualization of chemical structures and properties.

CHEM-C 372 Chemical Informatics II: Molecular Modeling (2 cr.) P: CHEM-C 341. Introduction to computer representation of molecular structure and simulation of chemical reactions; visualizing fundamental chemical concepts, such as reaction paths of standard organic reactions, molecular orbital diagrams, vibrations and conformational changes; quantitative structure activity relationships (QSAR), pharmacophore docking to biomolecules, and related methods for drug design.

CHEM-C 384 Biochemistry (3 cr.) P: or C: CHEM-C 342 or equivalent. BIOL-K 101 or equivalent recommended. Summer. Biochemistry covering the fundamentals of the chemistry of life including biomolecule structure and function, the dependence of biological processes on chemical and physical principles, and pathways of carbohydrate and fatty acid metabolism. Recommended for pre-professional students. Course meets requirements for preprofessional students requiring a biochemistry course.

CHEM-C 409 Chemical Research (1-3 cr.) P: Junior or senior standing and consent of instructor. Every semester, time arranged. Chemical or literature research with a report. Can be elected only after consultation with research advisor and approval of program. May be taken for a total of 10 credit hours, which count toward graduation. A minimum of three (3) credit hours may be used to satisfy the advanced chemical elective in the Bachelor of Science in Chemistry degree program.

CHEM-C 410 Principles of Chemical Instrumentation (3 cr.) P: CHEM-C 310 and CHEM-C 361. P or C: CHEM-C 362. Fall. Modern methods of instrumental analysis, including spectroscopy, chromatography, and electrochemistry.

CHEM-C 411 Principles of Chemical Instrumentation Laboratory (2 cr.) P: CHEM-C 311. P or C: CHEM-C 410.

Fall. Laboratory instruction in the instrumental analysis techniques discussed in CHEM-C 410.

CHEM-C 430 Inorganic Chemistry (3 cr.) P: CHEM-C 362. Spring. Atomic structure; periodic trends and properties of the elements. Introduction to symmetry and group theory. Valence bond, molecular orbital and ligand field theories of bonding and their application to structure and properties of inorganic and organometallic compounds. Spectroscopic properties and acid-base, oxidation-reduction, and coordination reactions of inorganic compounds.

CHEM-C 435 Inorganic Chemistry Laboratory (1 cr.) P: or C: CHEM-C 430. Spring. Synthesis, characterization, and study of chemical and physical properties of inorganic and organometallic compounds.

CHEM-C 471 Chemical Information Sources (1 cr.) P: CHEM-C 341. Fall. Techniques for the storage and retrieval in both printed and computer-readable formats; sources of chemical information, including Chemical Abstracts; development of search strategies; and online searching of chemical databases.

CHEM-C 472 Computer Sources for Chemical Information (1 cr.) P: CHEM-C 471. Spring. Techniques for the utilization of the major computer-based information tools found in academic and industrial environments.

CHEM-C 475 Approaches in Chemical Biology (3 cr.) P: CHEM-C484 and CHEM-C410. Spring. Chemical Biology is a broad discipline in which the concepts of chemistry and biology are used together to develop tools to study biological phenomena at the molecular level and to invent new technologies. In the field of Chemical Biology, biological problems are addressed with a chemical mindset. Approaches in Chemical Biology is an advanced course that introduces Chemical Biology as a discipline and, through the use of case studies, examines how chemical and biological techniques are used to study biological systems. Topics will be selected from the current literature and will cover technologies such as genomics, transcriptomics, proteomics, metabolomics, (combinatorial) synthesis of chemical probes, high throughput screening, synthetic biology, and bioorthogonal ligation. A blended didactic and project-based approach will enable students to develop skills in reading and understanding the scientific literature, oral presentation, illustration of scientific concepts, and scientific writing.

CHEM-C 485 Biosynthesis and Physiology (3 cr.) P: CHEM-C 484 or equivalent. Fall. Mechanisms of biological catalysis, metabolism, biosynthesis.

CHEM-C 486 Biological Chemistry Laboratory (2 cr.) P: CHEM-C 484 or equivalent. Fall. An introduction to the important laboratory techniques currently employed by practicing biological chemists, including biomolecule isolation, purification, enzyme kinetics, and biomolecule characterization by electrophoresis, centrifugation, and spectroscopic methods.

CHEM-C 488 Introduction to Medicinal and Agricultural Chemistry (3 cr.) P: CHEM-C 384 or equivalent. Fall. Medicinal chemistry plays an integral role in drug discovery, providing the link between target identification and the development of a therapeutic agent. This course examines the role of chemistry in the discovery of bioactive molecules, highlighting the similarities and differences in the search for novel medicinal and agricultural chemicals.

CHEM-C 489 The Practice of Medicinal Chemistry (3 cr.) P: CHEM-C 488 or consent of instructor. This course provides an introduction to many parameters involved in the drug discovery process, including how fundamental physico-chemical properties of molecules may be used to predict biological activity. Methods contributing to the drug discovery process will be discussed, including genomics, molecular biology, high-throughput screening, X-ray crystallography, and various computational approaches.

CHEM-C 495 Capstone in Chemistry (1 cr.) P: Senior standing, B.A. or B.S. program. Fall, day; Spring, day. Independent study, under the supervision of a chemistry faculty member or appropriate academic advisor can be earned by completion of: (a) a chemical research project; (b) a library research project in an area of current scientific investigation; (c) a research investigation in industry; or (d) a service activity in university, government, public schools, or other science-related groups or organizations. Students will report the results of their activities in both a formal written report and oral presentation, prepare portfolios of undergraduate work in chemistry, discuss recent scientific literature, and explore chemistry in society. Enrollment in the Capstone in Chemistry requires joint approval of the capstone instructor and the independent project advisor.

CHEM-C 496 Methods in Teaching Chemistry (1 cr.) P: CHEM-C 105. Fall; Spring. Designed for workshop leaders, this course offers continued support and training in group dynamics and learning theory. The larger goals for this course are to continue the development of leadership skills, foster ongoing communication among workshop leaders, and provide an environment for reviewing content knowledge.

Graduate

CHEM 53300 Introductory Biochemistry (3 cr.) P: CHEM-C 342 or equivalent. A rigorous one-semester introduction to biochemistry.

CHEM 54200 Inorganic Chemistry (3 cr.) P: CHEM-C 362 or equivalent or consent of instructor. Atomic structure; periodic trends and properties of the elements. Introduction to symmetry and group theory. Valence bond, molecular orbital, and ligand field theories of bonding and their application to structure and properties of inorganic and organometallic compounds. Spectroscopic properties and acid-base, oxidation-reduction, and coordination reactions of inorganic compounds. Advanced topics in main group or transition element chemistry.

CHEM 57500 Intermediate Physical Chemistry (3 cr.) P: CHEM-C 362 or equivalent. Quantum theory of atoms and molecules, theories of chemical bonding, molecular spectroscopy, methods for determining molecular structure, and electrical and magnetic properties.

CHEM 59000 Special Topics in Chemistry (3 cr.) Fall, Spring. Lecture courses offered on topic areas that are not part of the regular graduate curriculum. Repeatable up to 2 times.

CHEM 59900 Special Assignments (1-4 cr.) P: Consent of instructor. Every semester including summer I and

II, time arranged. Directed reading or special work not included in other courses.

CHEM 62100 Advanced Analytical Chemistry (3 cr.) P: CHEM-C 310 and CHEM-C 410. A critical survey of recent developments in chemical and instrumental methods of analysis.

CHEM 62900 Chromatographic Methods of Analysis (3 cr.) P: CHEM-C 410 or equivalent or consent of instructor. Principles and practice of modern gas and liquid chromatography and capillary electrophoresis are developed from an integrated point of view. Emphasis is placed both on theory and on features useful for practical analytical separations.

CHEM 63400 Biochemistry: Structural Aspects (3 cr.) P: CHEM-C 310, CHEM-C 342, CHEM-C 361, and CHEM-C 362 or equivalent. Chemistry of materials of biochemical interest: carbohydrates, lipids, proteins, amino acids, nucleic acids, porphyrins, biochemistry of blood.

CHEM 63600 Biochemical Mechanisms (3 cr.) P: One year of physical chemistry and CHEM 65100. The chemical basis of enzymatic catalysis with particular emphasis on catalytic interactions important in aqueous media.

CHEM 64100 Advanced Inorganic Chemistry (3 cr.) P: CHEM-C 430 or CHEM 54200 or equivalent or consent of instructor. Applications of symmetry and group theory to structure, bonding and spectral properties of inorganic compounds. Advanced topics in main group and transition element chemistry including determination of structure from physical and spectroscopic properties, bonding in coordination, and organometallic compounds and inorganic reaction mechanisms.

CHEM 65100 Advanced Organic Chemistry (3 cr.) P: CHEM-C 342 or equivalent. Modern structural organic chemistry. Introduction to bonding theory, stereochemistry, and computational chemistry.

CHEM 65200 Synthetic Organic Chemistry (3 cr.) P: CHEM 65100 or CHEM 65700. An advanced treatment of methods for preparing major types of organic functionalities and bonds, stressing stereo- and regio-chemical control, and employing mechanistic organic chemistry for understanding choice of reagents and reactions conditions

CHEM 65700 Reaction Mechanisms (3 cr.) P: CHEM-C 342 or equivalent or consent of instructor. Modern structural organic chemistry, introduction to physical organic chemistry, mechanisms of representative reactions, and methods used for understanding reactivity in organic transformations.

CHEM 67200 Quantum Chemistry (3 cr.) P: One year of physical chemistry. Basic principles of classical and quantum mechanics, approximation methods, atomic structure, spectroscopy, application of group theory, and theory of molecular bonding.

CHEM 67500 Chemical Kinetics (2-3 cr.) P: One year of physical chemistry. Experimental and theoretical considerations of chemical reaction rates and mechanisms.

CHEM 68200 Statistical Thermodynamics (3 cr.) P: CHEM-C 362 or equivalent. Application of statistical mechanics to the description of imperfect gases, liquids, and solutions, and to order-disorder phenomena in solids and surfaces; Monte Carlo techniques and molecular dynamics.

CHEM 69500 Seminar (0-1 cr.)

CHEM 69600 Special Topics in Chemistry: Analytical Spectroscopy (1-3 cr.) P: Bachelor of Science in chemistry from an accredited institution or consent of instructor. Survey of modern techniques, applications of spectroscopy, and imaging in analytical chemistry.

CHEM 69600 Special Topics in Chemistry: Electroanalytical Chemistry (3 cr.) Principles of modern methods of electroanalytical chemistry and quantitative applications to electrode reaction mechanisms and analytical determinations.

CHEM 69600 Special Topics in Chemistry: Applied Computational Chemistry and Molecular Modeling (1-3 cr.) Applied computational techniques that are widely used in the chemical and pharmaceutical industry, including computational chemistry, molecular modeling, and computer-aided synthesis.

CHEM 69600 Special Topics In Chemistry: Bioanalytical Chemistry (3 cr.) Modern techniques for the study of biological macromolecules, such as protein and peptides, carbohydrates, DNA, RNA, and lipids, including (1) spectroscopy (UV-Vis, Raman, NMR, mass spectrometry, and light scattering); (2) bioseparations (chromatography, electrophoresis, and microdialysis); (3) electrochemistry (sensors, electron transfer, and LCEC); and (4) miscellaneous topics (amino acid analysis, sequencing, microcalorimetry, and immunochemistry).

CHEM 69600 Special Topics in Chemistry: Biochemistry-Dynamic Aspects (1-3 cr.) Mechanisms of biological catalysis, metabolism, biosynthesis, regulation of genetic information, and molecular biology.

CHEM 69600 Special Topics in Chemistry: Bioelectrochemistry (1-3 cr.) Principles of electrochemical measurements including potentiometry, amperometry, and linear sweep and cyclic voltammetry and application to the study and utilization of biological molecules. Topics covered include redox transformations in biological systems, electron transfer between electrodes and biological molecules, and electrochemical sensors for detection and quantitation of biological analytes.

CHEM 69600 Special Topics in Chemistry: Bioinorganic Chemistry (1-3 cr.) A study of the occurrence, properties, and mechanistic roles of transition and main group elements in biological processes including photosynthesis, oxygen evolution, respiration, nitrogen fixation, metabolic detoxification, and electron transfer.

CHEM 69600 Special Topics in Chemistry: Bioorganic Chemistry (1-3 cr.) Structure and reactivity of biological macromolecules, such as proteins, enzymes, and nucleic acids, and their relevance to bioorganic chemistry. Current experimental studies of enzymes, nucleic acids, and model systems.

CHEM 69600 Special Topics in Chemistry: Biomaterials (1-3 cr.) Introduction to the field of biomaterials science including chemistry, physics, and

engineering of biomaterials; biological and biochemical aspects of biomaterials; and biomaterials in medicine.

CHEM 69600 Special Topics in Chemistry: Biophysical Chemistry (1-3 cr.) The study of structure and properties of biologically important macromolecules in solution using physical techniques, with special emphasis on optical, fluorescence, and magnetic resonance spectroscopy to describe protein conformation, denaturation, catalytic center structure, thermodynamics of ligand binding, time dependent processes, and membrane properties.

CHEM 69600 Special Topics in Chemistry: Chemical Information Technology (1-3 cr.) Overview of chemical informatics techniques, including chemical information and data systems, chemical structure and data representation and search systems, and bioinformatics techniques.

CHEM 69600 Special Topics in Chemistry: Medicinal Chemistry (1-3 cr.) The application of basic concepts of organic chemistry, biochemistry, and pharmacology to the design of organic medicinal agents as well as recent advances in synthesis and evaluation of pharmaceuticals.

CHEM 69600 Special Topics in Chemistry: Organometallics in Organic Synthesis (1-3 cr.) Recent developments in the use of transition metals in synthetic organic methodology. Emphasis is placed on applications of methods in the synthesis of complex organic molecules.

CHEM 69600 Special Topics in Chemistry: Protein Structure and Function (1-3 cr.) Physical forces stabilizing protein structure; protein folding. Essential features of macromolecular interactions. Introduction to enzyme kinetics and chemical mechanism in enzyme reactions.

CHEM 69600 Special Topics in Chemistry: Group Theory in Chemistry (1-3 cr.) This course is on molecular symmetry and how we obtain information about the quantum states of molecules through application of group theoretical techniques related to the symmetries of molecules.

CHEM 69600 Special Topics in Chemistry: Solid-Phase Synthesis and Combinatorial Chemistry: Theory and Practice (1-3 cr.) This course will explore how the tools of solid-phase synthesis and combinatorial chemistry are being used to solve a wide variety of problems requiring chemical solutions. Examples range from medicinal chemistry and drug discovery to new catalyst creation, from new "chiral selectors" to new biochemical probes. The course will focus on the rationale for employing a combinatorial approach in chemical discovery. It will teach the basics of solid-phase organic chemistry, and the methodology, equipment, and analytical technology employed to use it as a tool to rapidly and effectively carry out a combinatorial approach to problem solving.

CHEM 69800 Research M.S. Thesis (Arr. cr.) Research M.S. Thesis

CHEM 69900 Research Ph.D. Thesis (Arr. cr.) Research Ph.D. Thesis

Psychology

Undergraduate Level

PSY-B 101 Exploring the Brain - Introduction to Neuroscience for Non-Majors (3 cr.) Everything we think, say, feel, and do is because of electrical and chemical activity in the brain. The goal of this course is to help the student understand not only normal brain function but also the diseased drug affected, damaged or cognitively compromised brain. Emphasis will also be placed on how to maintain healthy brain function and maximize performance. PSY-B101 is a non-majors introductory course geared towards first-year and sophomore students, although others may take it. Cross-listed with NSCI-B101. Anyone who plans to major or minor in neuroscience will need to take NSCI-B201/PSY-B201.

PSY-B 110 Introduction to Psychology (3 cr.) Equiv. to IU PSY-P 155 and PU PSY 12000. This foundational course introduces students to psychology as a systematic and scientific way to think about the biological and social aspects of behavior and mental processes. Topics include Research Methods, Behavioral Neuroscience, Sensation/Perception, Learning, Memory, Cognition and Language, Motivation/Emotion, Personality, Social, Stress and Health, Psychological Disorders and Treatment, and Life-span Development.

PSY-B 201 Foundations of Neuroscience (3 cr.) P: PSY-B 110 or BIOL-K 101. An introduction to neuroscience that explores how our brains develop, how they work, and how they are changed by life experiences. Topics include neural communication, localization of brain function, neural systems, and control of behavior. Cross-listed with NSCI-B201.

PSY-B 203 Ethics and Diversity in Psychology (3 cr.) P: PSY-B110 or equivalent. This course introduces students to values and professional issues in psychology, with an emphasis on ethics and diversity. Students will learn to recognize the importance of ethical behavior in all aspects of science and practice of psychology and that sociocultural factors and personal biases may shape research and practice.

PSY-B 252 Topics in Psychology (1-3 cr.) Topics in psychology and interdisciplinary applications. May be repeated provided different topics are studied, for a maximum of 4 credit hours.

PSY-B 292 Readings and Research in Psychology (1-3 cr.) P: Consent of instructor. Independent readings and research on psychology problems. For freshmen and sophomores only.

PSY-B 301 Systems Neuroscience (3 cr.) P: PSY-B 201. This course focuses on how our brains allow us to sense, move, feel, and think, with an emphasis on modern concepts and methods in integrative neuroscience. Topics include sensory and motor systems, motivation and emotion, brain rhythms, language, brain development, and learning and memory. This course is intended for students earning a major or minor in neuroscience. Psychology majors should take PSY-B 320 unless they plan to also major or minor in neuroscience. Credit given for only one of PSY-B 301 or PSY-B 320. Cross-listed with NSCI-B301.

PSY-B 303 Career Planning for Psychology Majors (1 cr.) P: PSY-B110 or equivalent. Equiv. to IU PSY-P199. Students will explore careers, practice job search skills, and learn about graduate and professional school application processes. Students will utilize resources across campus and in psychology, map an academic and co-curricular plan, and develop an understanding of how

knowledge gained from the discipline of psychology can be integrated into their career.

PSY-B 305 Statistics (3 cr.) P: PSY-B110 or equivalent and 3 credits of mathematics that carry School of Science credit. Equivalent to IU PSY-K 300, PSY-K 310, and PU PSY 20100. Introduction to basic statistical concepts; descriptive statistics and inferential statistics. Introduction to data analytic software.

PSY-B 306 Statistics Laboratory (1 cr.) P: PSY-B110 or equivalent and 3 credits of mathematics that carry School of Science credit. C: PSY-B305 The goal of this laboratory course is to orient students to analyzing data using the statistics they are learning in PSY-B305. Statistical concepts and competencies to be developed in this course include, descriptive statistics, hypothesis testing, t-tests, correlation and regression.

PSY-B 307 Tests and Measurement (3 cr.) P: PSY-B110 or equivalent and PSY-B305. Equivalent to IU PSY-P 336 and PU PSY 20200. Overview of statistical foundations of psychological measurement (e.g., test development, norms, reliability, validity). Survey of commonly used assessment instruments (e.g., intelligence/aptitude, personality, academic achievement tests) and applications of psychological testing in different settings (e.g., clinical, industrial/ organizational, school, forensic/legal settings). Recommended for students considering graduate training in clinical, industrial/organizational, school, or related areas of psychology.

PSY-B 310 Life Span Development (3 cr.) P: PSY-B110 or equivalent. Equivalent to PU PSY 23000. Emphasizes the life span perspective of physical and motor, intellectual and cognitive, language, social and personality, and sexual development. Commonalities across the life span, as well as differences among the various segments of the life span, are examined. Theory, research, and practical applications are stressed equally.

PSY-B 311 Research Methods in Psychology (3 cr.) P: PSY-B110 or equivalent and PSY-B 305. Equiv. to IU PSY-P 211, and PU PSY 20300. Introduction to the science of psychology and to the basic research methods that psychologists use to study thoughts, feelings, and behavior. Topics include measurement, research design (descriptive, correlational, experimental), scientific writing, and ethical issues. By the end of the course, you should be ready to design and analyze your own research.

PSY-B 312 Research Methods in Psychology (2 cr.) P: PSY-B110 or equivalent and PSY-B305/PSY-B306. C: PSY-B311 This lab is designed to teach the research process one step at a time. These steps include conceptualizing and structuring scientific questions, learning how to obtain pertinent but credible sources of information, referencing prior research, articulating a research hypothesis, constructing a method to test the hypothesis, and carrying out a research study. Finally, students learn how to communicate their results via APA-formatted written reports and by oral and poster presentations.

PSY-B 320 Behavioral Neuroscience (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 326 and PU PSY 22000. This course focuses on how behavior emerges from the organ that produces it, the brain. Topics include evolution and anatomy of the brain, neurophysiology, how brain networks function, and what happens to behavior when the brain has problems. A better understanding of structure-function relationships within the central and peripheral nervous system will be achieved through examples from human neuropsychology and animal behavior. Students pursuing a major or minor in Neuroscience are required to take PSY-B201 plus PSY-B301 in lieu of PSY-B320. Credit given for only one of PSY-B301 or PSY-B320.

PSY-B 322 Introduction to Clinical Psychology (3 cr.) P: PSY-B110 or equivalent A survey of various aspects of the practice of clinical psychology from a scientist-practitioner perspective. Aspects of the historical framework of clinical psychology will be discussed. In addition, various aspects of the present state of clinical psychology will be covered in addition to directions for the future.

PSY-B 334 Perception (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 329 and PU PSY 31000. Consideration of the concepts and research in perception. Relation of sense organ systems to human behavior. Some attention to social and cultural factors.

PSY-B 340 Cognition (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 335 and PU PSY 20000. A survey of information processing theories from historical antecedents through current theories. Research methodology and theory will be emphasized throughout the discussion of issues such as perception, attention, memory, reasoning, and problem solving.

PSY-B 344 Learning (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 325 and PU PSY 31400. History, theory, and research involving human and animal learning and cognitive processes.

PSY-B 346 Theories of Personality (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 319 and PU PSY 42000. Methods and results of the scientific study of personality, including the development, structure, and functioning of the normal personality.

PSY-B 356 Motivation (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 327 and PU PSY 33300. Study of motivational processes in human and animal behavior, how needs and incentives influence behavior, and how motives change and develop.

PSY-B 358 Introduction to Industrial/Organizational Psychology (3 cr.) P: PSY-B110 or equivalent. Equiv. to IU PSY-P 323 and PU PSY 37200. This course surveys various aspects of behavior in work situations using the scientist-practitioner perspective. Traditional areas covered from personnel psychology include selection, training, and performance appraisal; areas surveyed from organizational psychology include leadership, motivation, and job satisfaction.

PSY-B 360 Child and Adolescent Psychology (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 316 and PU PSY 23500. Development of behavior in infancy, childhood, and adolescence, including sensory and motor development and processes such as learning, motivation, and socialization.

PSY-B 365 Health Psychology (3 cr.) P: PSY-B110 or equivalent. This course will familiarize students with the study of physical health within the field of psychology.

Topics include the relationship between stress and health, health promotion, health behaviors, chronic illness, and the patient-physician relationship. Research methods in health psychology as well as major theories underlying the field will be examined and evaluated. Psychological variables related to physical health will be examined within the framework of these theories. Practical application of constructs will be emphasized through activities and writing assignments.

PSY-B 366 Concepts and Applications in Organizational Psychology (3 cr.) P: PSY-B 358. Some organizational psychology topics introduced in the I/O psychology survey course are covered in more depth. Advanced information is presented for each topic, and students have the opportunity for several different hands-on applications, including case projects and computer exercises. Example topics are organizational culture, employee attitudes, motivation, and leadership.

PSY-B 368 Concepts and Applications in Personnel Psychology (3 cr.) P: PSY-B 358. Some personnel psychology topics introduced in the I/O psychology survey course are covered in more depth. Advanced information is presented for each topic, and students have the opportunity for several different hands-on applications, including case projects and computer exercises. Example topics are job analysis, selection, performance appraisal, and training.

PSY-B 370 Social Psychology (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 320 and PU PSY 24000. Study of the individual in social situations including socialization, social perception, social motivation, attitudes, social roles, and small group behavior.

PSY-B 375 Psychology and Law (3 cr.) P: PSY-B110 or equivalent. This course provides an overview of the U.S. legal system from a behavioral science perspective. Topics include: careers in psychology and law; theories of crime; police investigations and interrogations; eyewitness accuracy; jury decision-making; sentencing; assessing legal competence; insanity and dangerousness; and the psychology of victims.

PSY-B 376 The Psychology of Women (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 460 and PU PSY 23900. A survey of topics in psychology as related to the biological, social, and psychological development of women in modern society.

PSY-B 380 Abnormal Psychology (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU PSY-P 324 and PU PSY 35000. Various forms of mental disorders with emphasis on cause, development, treatment, prevention, and interpretation.

PSY-B 385 Positive Psychology (3 cr.) P: PSY-B110 or equivalent. Equivalent to IU EDUC-G 355. This course is an introduction to Positive Psychology. The two main goals are for students to (1) learn about the content and science that informs Positive Psychology, and (2) apply in their own lives empirically-validated strategies that help people develop a happier and more meaningful life. This course will include a positive view of human functioning and a review of research and practices in Positive Psychology. Emphasis will be placed on science and its applications with regard to topics such as human strengths and values, neuroscience as it relates to happiness/ mindfulness, gratitude, cultural (eastern/western) aspects of happiness/values, process vs. outcome, optimism, the new field of self-compassion, positive affect, coping, friendship and love, spirituality, and resilience.

PSY-B 386 Introduction to Counseling (3 cr.) P: PSY-B110 or equivalent, PSY-B 310, and PSY-B 380. This course will help students acquire a repertoire of basic counseling interview skills and strategies and expose students to specific helping techniques. This will be an activity-based course and students will enhance the general-education goals of listening and problem solving.

PSY-B 394 Drugs and Behavior (3 cr.) P: PSY-B110 or equivalent. Equivalent to PU PSY 42800. An introduction to psychopharmacology, the study of drugs that affect behavior, cognitive functioning, and emotions, with an emphasis on drugs of abuse. The course will explore how drugs alter brain function and the consequent effects, as well as the long-term consequences of drug exposure. Cross-listed with NSCI-B394.

PSY-B 396 Alcoholism and Drug Abuse (3 cr.) P: PSY-B110 or equivalent. Introduction to the use and abuse of alcohol and other psychoactive drugs. Topics include theories of alcohol and other drug use, neurobiology, and the factors that influence use, abuse, and addiction. Addiction assessment, recovery, treatment, relapse, and prevention are also covered.

PSY-B 398 Brain Mechanisms of Behavior (3 cr.) P: PSY-B 301 or PSY-B 320. An advanced topical survey of the neurobiological basis of behavior, focusing on the neural substrates and the cellular and neurochemical processes underlying emotions, motivation and goal-directed behavior, hedonic experience, learning, and cognitive function. Integrates experimental research across different levels of analysis (genetic, molecular, cellular, neural systems).

PSY-B 421 Internship in Psychology (1-3 cr.) P: Consent of instructor, PSY-B 103, PSY-B 104, PSY-B 305 and three additional credit hours of psychology. A professional internship that allows students to apply psychological knowledge and skills to a specific work setting, develop work related skills, explore career options and gain experience in a field of interest.

PSY-B 422 Professional Practice (1 - 3 cr.) P: Faculty or staff must approve and oversee activity. Registration is by permission only. For students who have applied for and are approved to be a Peer Advisor in the Psychology Advising Office or have been approved to be a Teaching Assistant for a psychology course.

PSY-B 433 Capstone Laboratory in Psychology (3 cr.) P: PSY-B 305/B306, PSY-B 311/B312, at least two 300-level PSY foundation courses and senior standing. This advanced research course builds on the skills and knowledge students have acquired during their undergraduate education that will enable them to conduct a team research project in a specialized area of psychology in order to further develop and consolidate their understanding of psychology as a science.

PSY-B 434 Capstone Laboratory in Behavioral Neuroscience (3 cr.) P: PSY-B201 and PSY-B301 This Capstone Laboratory is for seniors who are neuroscience majors. The goals are to enhance critical thinking skills

in experimental approaches to behavioral neuroscience, understand translational neuroscience through model systems, develop more advanced understanding of quantitative and analytic approaches to studying the links between brain and behavior, promote the ability to evaluate and communicate essential knowledge about neuroscience relevant to society, develop skills in collaborative learning, and generate career development tools with an e-Portfolio.

PSY-B 452 Seminar in Psychology (1-3 cr.) P: PSY-B110 or equivalent. Topics in psychology and interdisciplinary applications. May be repeated, provided different topics are studied, for a maximum of 6 credit hours.

PSY-B 454 Capstone Seminar in Psychology (3 cr.) P: PSY-B 305/306, PSY-B 311/B312, at least two 300-level PSY foundation courses and senior standing. Topics in psychology and interdisciplinary applications, which have been approved to fulfill the capstone course requirement.

PSY-B 456 Capstone Service Learning in Psychology (3 cr.) P: PSY-B 305/B306 and PSY-B 311/B312; and at least two of the following: PSY-B 310, PSY-B 320, PSY-B 340, or PSY-B 370; and Senior Standing. The primary goal of the course is to provide an opportunity for students to integrate and apply the content and discipline-specific ways of thinking from their program of study within the context of service learning. This course is designed to connect service experiences, psychology content knowledge, and critical reflection. As such, community engagement is enhanced, academic concepts are more deeply understood, and personal growth is facilitated.

PSY-B 482 Capstone Practicum in Clinical Psychology (3 cr.) P: PSY-B 305/B306, PSY-B 311/B312, PSY-B 386, at least two 300-level PSY foundation courses, senior standing and consent of instructor. Application is required. Students are placed in a clinical/community setting and gain applied practicum experience working with individuals who have psychological, medical, and/or physical health problems. Relevant multicultural issues will be addressed.

PSY-B 492 Readings and Research in Psychology (1-3 cr.) P: Consent of instructor. Equivalent to IU PSY-P 495 and PU PSY 39000 and PSY 39100. Gain hands-on research experience in a research lab or with an independent research project mentored by an instructor in the psychology department. For highly motivated students who are planning to attend graduate school or work in a field that requires a solid foundation in research. Projects need to be pre-arranged with faculty and registration is by permission only.

PSY-B 499 Capstone Honors Research (3 cr.) P: PSY-B 305/B306, PSY-B 311/B312, at least two 300-level PSY foundation courses, senior standing and consent of instructor. Application is required. Equivalent to IU PSY-P 499. Independent readings and research resulting in a research paper.

PSY-B 110 Introduction to Psychology (3 cr.) Equiv. to IU PSY-P 155 and PU PSY 12000. This foundational course introduces students to psychology as a systematic and scientific way to think about the biological and social aspects of behavior and mental processes. Topics include Research Methods, Behavioral Neuroscience, Sensation/Perception, Learning, Memory, Cognition and Language, Motivation/Emotion, Personality, Social, Stress and Health, Psychological Disorders and Treatment, and Life-span Development.

Graduate Level

PSY 51800 Memory and Cognition (3 cr.) A graduate-level survey of theories and research concerned with the acquisition, retention, and retrieval of information. Topics include amnesia, eyewitness memory, forgetting, developmental trends in memory, related issues in attention, language processing, and problem solving.

PSY 54000 History of Psychology (3 cr.) P: Nine (9) credit hours of psychology. A review of the philosophical, theoretical, and methodological issues that entered into the development of modern psychology. Emphasis on historical themes that continue to be active in the science and profession of psychology.

PSY 56500 Interpersonal Relations (3 cr.) P: Nine (9) credit hours of psychology. Review of major current theoretical formulations of the interpersonal relationship, including a discussion of some of the more prominent research. Focus is primarily on two-person interpersonal relations.

PSY 57000 Staffing (3 cr.) Spring. This seminar course will introduce students to HR practices associated with bringing new members into organizations. Topics covered include recruitment, procedures for assessing the individual differences of applicants, models used to make selection decisions, and legal considerations associated with personnel selection (e.g., discrimination and affirmative action). The course will focus on theory and empirical research related primarily to the fields of industrial/organizational psychology and management.

PSY 57200 Organizational Psychology (3 cr.) A survey of basic behavioral science research and thinking as these contribute to the understanding of individual, dyadic, group, intergroup, and other large organization behavioral phenomena. The topics covered include motivation, perception, attitudes and morale, communication, leadership, conflict, problem solving, behavior change, and organizational effectiveness.

PSY 57400 Psychology of Industrial Training (3 cr.) P: Three (3) credit hours of psychology. Use of psychological measurement techniques in assessing training needs and evaluating training effectiveness and the application of learning research and theory to industrial training.

PSY 57600 Human Resource Development (3 cr.) Spring. This is a graduate level course intended for individuals who are seeking advanced training in the science and practice of employee development. Employee Development is construed broadly in this course to include performance management and employee training. Students will be exposed to the critical extant literature, to best practices in the development of these human resources systems in organizations, and will gain applied experience through course projects.

PSY 59000 Individual Research Problems (1-3 cr.) P: Twelve (12) credit hours of psychology and consent of instructor. Opportunity for students to study particular

problems in any field of psychology or to learn research techniques under the guidance of a faculty member.

PSY 60000 Statistical Inference (3 cr.) P: Student must be a degree-seeking student in psychology graduate program or have consent of instructor and B305 or equivalent. Emphasis on principles underlying both parametric and nonparametric inference.

PSY 60100 Correlation and Experimental Design (3 cr.) P: 600. Continuation of 600, with emphasis on the design and analysis of experiments.

PSY 60500 Applied Multivariate Analysis (3 cr.) P: 600. A survey of the most frequently employed multivariate research techniques, such as multivariate generalizations of univariate tests and analysis of variance, principal components, canonical analysis, and discriminant analysis. A central theme of the course is the general linear model, both univariate and multivariate. A multipurpose program for this model provides the student with practical experience in conducting multivariate research.

PSY 60800 Measurement Theory and the Interpretation of Data (3 cr.) P: 600 and B307, or equivalent. The theory of measurement and the development of reliability and the Spearman-Brown equations, true scores and variables, and correction for attenuation. Variance or covariance of combinations of variables. Item analysis and test construction strategies. Reliability and validity of measurements and the influence of measurement error and measurement threats to research design.

PSY 60901 Multilevel Modeling (3 cr.) P: PSY 60100 or equivalent. Course includes (1) generalized linear mixed (multilevel) models often used in social sciences; (2) best practices in the models' applications and interpretations. Models are extensions of classic linear regression models (multilevel modes, hierarchical and mixed models, etc.). Conceptual introduction of models and methods and illustrations using real and simulated data.

PSY 61100 Factor Analysis (3 cr.) P: 600. Theory and applications of factor analysis in psychological research.

PSY 61500 Introduction to Psychobiology (3 cr.) P: Consent of instructor. A survey of the integrated neurosciences emphasizing physiological psychology. Neural processes of sensory and motor function, arousal and sleep, motivation, learning and memory, language function, and personality disorders will be presented with selected coverage of neuroanatomy, neurophysiology, neuropharmacology, and neuroendocrinology. Both normal and pathological functions will be covered.

PSY 62200 Animal Learning (3 cr.) A survey of the methods, problems, and research in Pavlovian, instrumental, and operant conditioning. Current issues and attempts at theoretical integration are highlighted. Emphasis is also given to the empirical and conceptual foundations of the present views on the mechanisms governing learned behavior.

PSY 62400 Human Learning and Memory (3 cr.) P: A first course in human learning and consent of instructor. Selected survey of important problems in the encoding, storage, and retrieval of laboratory and naturalistic events.

PSY 62800 Perceptual Processes (3 cr.) This course is an advanced introduction to the psychology of perception. The course emphasizes visual and auditory perception, reviewing basic concepts, methodologies, research findings, and theoretical approaches. Theories of direct perception, constructivist perception, and computational vision are discussed in detail.

PSY 64000 Survey of Social Psychology I (3 cr.) P: B370 or equivalent. An extensive survey of methods, research, and theory in social psychology.

PSY 64600 Seminar in Social-Personality Psychology (3 cr.) 646 Seminar in Social-Personality Psychology (3 cr.) P: consent of instructor. A seminar covering a special topic in personality or social psychology. Specific topic varies from seminar to seminar.

PSY 65500 Cognitive Development (3 cr.) P: consent of instructor. An analysis of research findings and current theories relevant to the development of cognitive processes. Emphasis on the changing characteristics of some fundamental cognitive processes. Special attention is given to verbal behavior and language.

PSY 68000 Seminar in Industrial-Personnel Psychology (3 cr.) P: 570, 572, and 601. Extensively surveys the various areas of industrial-personnel psychology (e.g., selection, placement, training, performance appraisal). Provides a critical and up-to-date review of recent and classical research in these areas.

PSY 68100 Seminar in Research Methodologies of Industrial/Organizational Psychology (3 cr.) P: 57000, 57200, 60100, or consent of instructor. Intensive analysis of application of various research and statistical methods to the study of human behavior in organizational settings.

PSY 68200 Advanced Seminar in Industrial/ Organizational Psychology (3 cr.) P: 57000, 57200, or equivalent. Special topics in industrial and organizational psychology are offered on a rotating basis. Examples of the special topics are work motivation, leadership, advanced selection and placement, and performance appraisal. One topic will be treated each semester.

PSY 68300 Seminar in Industrial-Social Psychology (3 cr.) P: 57000, 57200, or equivalent. Study of research and theory emphasizing social perception, attitudes, supervisory behavior, employee participation, motivation, and organizational structure.

PSY 68400 Practicum in Industrial/Organizational Psychology (3 cr.) P: 570, 572, and consent of instructor. Practical experience in the development and implementation of field research in organizational settings. Gives students the opportunity to spend eight hours per week in local business organizations to gain experience and skills in industrial/organizational psychology.

PSY 69800 Research M.S. Thesis (3 cr.) 698 Research M.S. Thesis (3 cr.)

PSY 69900 Research Ph.D. Thesis (0-12 cr.) 699 Research Ph.D. Thesis (0-12 cr.)

PSY-G 901 Advanced Research (6 cr.)

PSY-I 501 Multicultural Counseling (3 cr.) I501 Multicultural Counseling (3 cr.) P: graduate standing. This course explores the role of increasing diversity in the U.S.

population and how it will affect the delivery of mental health services. The focus of the course is on different ethnic and minority groups, their customs and values, and the impact that these cultural factors have on the utilization of psychological services.

PSY-I 535 Clinical Neuroscience (3 cr.) P: consent of instructor. A primary goal of the course is to examine how psychology, neuroscience, pharmacology, and medicine come together to manage mental illness. Mental illness will be examined systematically and the nature of how biological alterations lead to aberrant behaviors that define psychopathology will be examined. The course will heavily discuss the ethics involved in the field of Clinical Neuroscience.

PSY-I 544 Psychobiology of Learning and Motivation (3 cr.) P: B320 or equivalent. The course examines past and present biologically based theories of learned and motivated behavior. Neural processes of feeding, drinking, aggression, fear, anxiety, and sexual behavior will be emphasized. Selected coverage of behavioral research principles used to investigate these processes also will be discussed.

PSY-I 545 Psychopharmacology (3 cr.) P: 615 or consent of instructor. A survey of the effects of drugs on behavior, cognitive functioning, and emotions. Emphasis will be placed on the practical advantages of understanding how psychotropic drugs work, and on how the brain functions in health and disease. Students will be exposed to the most current theories and research in the field.

PSY-I 549 Introduction to Vocational Rehabilitation (3 cr.) P: Nine (9) credit hours of psychology. Philosophy, procedures, and practices underlying the vocational rehabilitation movement, including the historical, social, cultural, and economic factors and legislation that have contributed to its rapid development.

PSY-I 555 Medical and Psychosocial Aspects of Chronic Illness (3 cr.) I555 Medical and Psychosocial Aspects of Chronic Illness (3 cr.) P: Nine (9) credit hours of psychology including I549. Provides medical information for rehabilitation counselors and introduces students to medical terminology. Includes knowledge of the etiology, prognosis, methods of treatment, and effects of disabling conditions, and implications for the rehabilitation counselor. Counselor relationships with other health-related personnel are emphasized.

PSY-I 565 Seminar in Cognitive, Affective, and Developmental Aspects of Behavior (3 cr.) P: Graduate student in Psychology or permission of instructor. Students examine key ideas in cognitive, affective, and developmental aspects of behavior. Provides: a solid foundation to graduate students in psychology, substantive breadth of cognitive, affective, and development psychology for graduate students in psychology and allied disciplines, advanced undergrauates a firm grasp of important discoveries in the field.

PSY-I 570 Drugs of Abuse (3 cr.) P: Graduate: None Undergraduate: Permission of instructor pending review of prior undergraduate course work. This course will cover the basic principles of the study of drugs of abuse, as well as focusing on particular drugs and drug classes. For each drug or drug class, we will discuss issues ranging from basic pharmacology to the social impact of the abuse of the particular substance. We will utilize a text book as well as current literature in the field, and critical examination of all course material will be encouraged.

PSY-I 573 Occupational Health Psychology (3 cr.) P: Regular graduate standing in Psychology or permission of instructor. Fall, every other year. Occupational health psychology (OHP) is one of the most heavily researched areas within the work domain, although it is not well publicized in the traditional IO psychology domain. For instance, traditional topics in IO, such as job design (job characteristic model), person- environment fit, shift work, job stress, coping and adjustment, type A/B, safety climate, workplace violence, and so on, are covered in the OHP. This course provides an in depth treatment of this literature with the foci on occupational stress, violence, and safety.

PSY-I 575 Psychology and Law Seminar (3 cr.) P: Permission of instructor. Fall, every other year. This seminar examines the relevance of social psychological and industrial/organizational (I/O) theory and research to various forensic contexts, including criminal and tortious behavior, police and other investigatory processes, evaluation of scientific and behavioral evidence, employment law issues, and the role of psychological consultants and expert witnesses.

PSY-I 578 Occupational Analysis (3 cr.) P: 570. Survey of systematic study of human work, including techniques for analyzing jobs and occupations for personnel and related purposes. Survey of occupational research and related topics. Practice in job analysis.

PSY-I 579 Foundations of Diversity Science (3 cr.) P: Regular graduate standing in Psychology or permission of instructor. Fall, every other year. Diversity science investigates the creation, consequences, and maintenance of group differences. This graduate-level seminar takes a sociocultural approach to diversity science questions at the micro-level of analysis, focusing on the psychological processes that give rise to intergroup behavior and individual strategies for addressing and coping with group-based biases and stigma.

PSY-I 580 Survey of Clinical Approaches with Children and Adolescents (3 cr.) P: Nine (9) credit hours in psychology. Introduction to the following as they relate to children and adolescents: (1) psychopathological disorders and behavior problems, (2) theories of psychopathology and behavior problems, (3) evaluation techniques, and (4) therapeutic and behavioral change procedures. This is a lecture course.

PSY-I 581 Gender Issues in the Workplace (3 cr.) P: Regular graduate standing in Psychology or instructor permission. Spring. This is a graduate seminar that examines women's (and by comparison, men's) experiences in the workplace, with a focus on intersectionality. Topics will span the psychological and related social science literature on gender issues in career interests, occupational decisions, work experiences, advancement, discrimination, and organizational interventions to address these issues.

PSY-I 582 Organizational Diversity and Intergroup Relations (3 cr.) P: Regular graduate standing in Psychology or permission from instructor. Spring, every other year. Examines the importance of diversity in groups, discrimination and biases in organizations, minority and majority group reactions to different diversity initiatives, the unintended consequences of diversity initiatives, and the importance of empirically validating diversity interventions and trainings.

PSY-I 583 Judgment and Decision Making in Organizations (3 cr.) P: Regular graduate standing in Psychology or instructor permission. Fall, as needed. This graduate seminar examines how decisions are made by individuals and groups in various organizational and institutional settings. Topics covered include how individuals process information, make judgments, and reach decisions; how groups reach decisions through interactive social processes; and how choices, decisions and plans are formulated by individuals and groups in selected real-world contexts (e.g., legal, medical, politics, sports, business, etc.). The course will rely heavily on theory and research in psychology, but also draw on the scholarly literature in related social science fields (e.g., sociology).

PSY-I 591 Psychopathology (3 cr.) P: enrollment in psychology graduate program or consent of instructor. An intensive survey of the methods, theories, and research concerning the nature, causes, and development of psychopathology. An evaluation of current systems of assessment and classification of abnormal behavior is emphasized.

PSY-I 595 Seminar in Teaching Psychology (0-3 cr.) P: consent of the Department of Psychology. A problem-solving approach to teaching psychology at IUPUI. Planning the course; anticipating problems; and dealing with ongoing teaching problems. Current faculty members will present their innovative techniques. Participants will evaluate each other's classroom performance.

PSY-I 613 Psychiatric Rehabilitation (3 cr.) P: consent of instructor. A seminar examining recent developments in the rehabilitation of persons with severe psychiatric disabilities. Covers assertive case management, vocational approaches, clubhouse models, residential alternatives, psychoeducation, and the consumer movement. Field observations complement classroom instruction. Issues in program planning and cost effectiveness will be discussed.

PSY-I 614 Behavioral Medicine in Rehabilitation (3 cr.) P: Consent of instructor. The theory and practice of behavioral medicine will be explored. Emphasis is on the application of behavioral principles to individuals suffering from various chronic diseases or disabilities including spinal cord injury, chronic pain, cancer, diabetes, strokes, cardiovascular diseases, and epilepsy.

PSY-I 618 Interventions in Health Psychology (3 cr.) P: consent of instructor. The goal of the course is to familiarize students with clinical interventions and research relevant to health problems and lifestyle. This will enable students to critically evaluate the work that has been accomplished and to design and implement intervention protocols.

PSY-I 643 Field Methods and Experimentation (3 cr.) P: 600. Covers methods appropriate for field experimentation and program evaluation. Topics will include quasi-experimental designs, sampling procedures, and issues associated with program evaluation.

PSY-I 647 Attitudes and Social Cognition (3 cr.) P: Regular graduate standing in Psychology or permission of instructor. This graduate-level seminar provides an overview of contemporary social psychological theory and research, emphasizing the social-cognitive, affective, and motivational processes underlying attitudes, social inference, stereotyping, prejudice, and self-regulation. Class discussion will focus on the application of this research to promote prosocial and prevent antisocial behaviors affecting individuals, organizations, and society.

PSY-I 650 Developmental Psychology (3 cr.) Major concepts, principles, and facts concerning the biological and environmental influences on behavioral and psychological development. Particular emphasis on essential principles of ontogenetic development (lifespan) emerging from current research in genetics and psychology.

PSY-I 664 Psychological Assessment in Rehabilitation I (3 cr.) P: consent of instructor. Presentation of general principles of psychological assessment, professional practice, interviewing, intelligence/cognitive assessment, and psychological report writing. Supervised practice in the development of direct service skills in interviewing, behavioral observation, and psychometric assessment of cognitive abilities. Emphasis on functional implications of test results for rehabilitation populations.

PSY-I 665 Intervention I: Counseling Approaches (3 cr.) P: Consent of instructor. Introduces doctoral students to intervention procedures used in rehabilitation psychology. The course has both didactic and clinical skills components, involving traditional counseling interventions, behavior therapy, and biofeedback. Applications to disabled populations will be emphasized.

PSY-I 666 Intervention II: Cognitive Behavioral Interventions (3 cr.) P: consent of instructor. This course covers the history, theory, research, and clinical application of cognitive-behavioral therapy (CBT). General CBT principles and clinical skills, as well as CBT programs for specific disorders/problems are reviewed. Diversity-related discussions are infused throughout, and general and specific approaches to culturally adapting CBT are presented.

PSY-I 669 Psychological Assessment in Rehabilitation II (3 cr.) P: I664 and consent of instructor. Presentation of psychometric foundations and the basic prediction model in personality/interest assessment. Coverage of the history of personality, assessment, personality development, and supervised clinical practice in personality/interest assessment in rehabilitation. Emphasis on prediction of everyday functioning.

PSY-I 670 Ethical, Legal, and Cultural Issues in Psychology (3 cr.) P: admission to graduate training in psychology or consent of instructor. Exploration of models of ethical decision making. Examination of ethical principles and legal mandates that apply to professional psychology including psychologists' roles in health care service delivery, consultation (clinical and organizational),

research, and teaching. Examination of cultural issues, including issues related to ethnicity, age, gender, religion, and sexual orientation.

PSY-I 675 Human Neuropsychology (3 cr.) P: Admission to graduate training in psychology or consent of instructor. Review of essential neuroanatomy, survey of experimental and correlational research methods in the study of brain-behavior relationships, and overview of the history of neuropsychology. Critical examination of neural models for human behavior: hemispheric specialization and integration, sensation/perception, motor skills, language, spatial processing, attention, memory, executive operations, and gender differences.

PSY-I 676 Principles of Clinical Neuropsychology (2 cr.) P: Addmission to graduate training in clinical psychology or consent of instructor. Application of theoretical models of brain-behavior relationships to evaluation of patients with suspected nervous system disorders. Review of neuropsychological profiles associated with various neurological and psychiatric disorders. Examination of ethical/cultural issues in neuropsychological evaluation. This course does not provide training in test administration (see PSY I677).

PSY-I 677 Neuropsychological Assessment Lab (1 cr.) P: I664 and I669 and admission to graduate training in clinical rehabilitation psychology. Students must register for I676 concurrently with I677. Training and supervised practice in neuropsychological assessment techniques and procedures. Critical review of the psychometric properties of prevailing assessment tools. Review models of interpretation/reporting. Development of proficiencies in administering prominent neuropsychological tests, neuropsychological interviewing, and writing of reports that integrate multidisciplinary data.

PSY-I 685 Professional Seminar in Applied Social and Organizational Psychology (1 cr.) P: Regular graduate standing in the (to be proposed) Applied Social and Organizational Psychology graduate program. This graduate professional seminar is designed to facilitate the professional development of graduate students in the Applied Social and Organizational Psychology program. A presentation or discussion will occur each week although the topics will vary. Presentations will be conducted by outside speakers, faculty and/or graduate students on both applied and research oriented topics. Doctoral candidates will present their dissertation work during the third or fourth year. In addition, during facilitated discussions the students will review newly published research and address ethics in our discipline.

PSY-I 689 Practicum in Clinical Rehabilitation Psychology (3 cr.) P: I549 and consent of instructor. Supervised practice of rehabilitation psychology in a community agency or organization.

PSY-I 691 Seminar in Clinical Rehabilitation Psychology (3 cr.) P: consent of instructor. Current trends, problems, and developments in rehabilitation. Students pursue a special interest and share information and experience with the group. Individual reports and group discussions.

PSY-I 697 Internship in Clinical Psychology (0-9 cr.) P: consent of instructor. Opportunities for application of theory and practice of rehabilitation psychology and case management in a rehabilitation setting under supervision of the Department of Psychology and the agency.

Computer and Information Science

Undergraduate

CSCI-N 100 Introduction to Computers and Computing (3 cr.) P: or C: MATH 001, M001, or equivalent. No computing experience assumed. How computers work, word processing, spreadsheets, file management, and Internet skills. Emphasis on problem-solving techniques. Lecture and laboratory. Credit given for only one of CSCI-N 100, CPT 10600, CIT 10600, or BUS-K 201.

CSCI-N 199 Introductory Computing Topics (topic varies) (1-3 cr.) Seminars in emerging technologies. May be repeated for credit.

CSCI-N 200 Programming Concepts (3 cr.) Explore the Big Ideas of Computer Science (CS) and Computational Thinking (CT) through hands-on explorations with social networking, gaming, big data, robots, programming and more. Learn about the creativity, usefulness and breadth of Computer Science in a fun way that can enhance any field of study.

CSCI-N 201 Programming Concepts (3 cr.) Summary of basic computing topics, problem solving techniques, and their application to computing. Introduction to programming concepts with a focus on language-independent principles, such as algorithm design, debugging strategies, essential control structures, and basic data structure concepts. Lecture and laboratory.

CSCI-N 207 Data Analysis Using Spreadsheets (3 cr.) Summary of basic computing topics. An introduction to data analysis using spreadsheets. Emphasis on the application of computational problem-solving techniques. Lecture and laboratory.

CSCI-N 211 Introduction to Databases (3 cr.) Summary of basic computing topics. Introduction to database design concepts, creation of user forms, development of databases, querying techniques, and building reports. Focus on relational database systems from development and administration point of view. Lecture and laboratory.

CSCI-N 241 Fundamentals of Web Development (3 cr.) Introduction to writing content for the Internet and World Wide Web. Emphasis on servers, hand-coded HTML, Cascading Style Sheets, and extending HTML with other Web technologies. Lecture and laboratory.

CSCI-N 299 Survey of Computing Applications (topic varies) (1-3 cr.) An introduction to an emerging technology in the computing field. It will emphasize the various problems technology helps to solve and specific problem-solving strategies. Lecture and laboratory. May be repeated for credit.

CSCI-N 300 Mobile Computing Fundamentals (3 cr.) Survey of programming and application development for mobile computing devices. Topics include mobile technology, location-based technology, mobile security, mobile platforms, programming languages and application development for mobile devices. Lecture and Laboratory.

CSCI-N 301 Fundamental Computer Science Concepts (3 cr.) P: MATH-M 118. An introduction to fundamental principles of computer science, including hardware

architecture, algorithms, software engineering, and data storage. Lecture and laboratory.

CSCI-N 305 C Language Programming (3 cr.) The basics of computer programming concepts using the C programming language. Emphasis on problem solving and algorithm implementation using a universal subset of the C programming language. Lecture and laboratory.

CSCI-N 307 Introduction to Programming using Java (3 cr.) Introduction of programming concepts focusing on the Java language, Essential algorithm design, basic program control concepts, essential data concepts, debugging and testing programs. The course will also include object oriented programming, creating user interfaces, event handling, and multi-platform programming issues.

CSCI-N 311 Advanced Database Programming, Oracle (3 cr.) P: Recommended CSCI-N 211 or equivalent. Focus on the concepts and skills required for database programming and client server development. Concepts will apply to any modern distributed database management system. Emphasis on developing Oracle SQLPlus scripts, PL/SQL server side programming, and Oracle database architecture. Students with programming experience in ODBC compliant languages will be able to practice connecting such languages to an Oracle database. Lecture and laboratory.

CSCI-N 317 Fundamental Computer Science Concepts (3 cr.) A survey and illustration of popular computational software used in multiple scientific domains to support data processing and scientific research. This class focuses on teaching how to use software to efficiently process data in terms of modeling, simulating, visualizing and data-mining. Fundamental concepts related to scientific computing are introduced briefly. Lecture and Lab.

CSCI-N 321 System and Network Administration (3 cr.) Fundamental concepts of system administration. Design and administration of network servers and workstations. Focus on basic network concepts, such as user account administration, resource allocation, security issues, and Internet service management. Lecture and laboratory.

CSCI-N 331 Visual Basic Programming (3 cr.) An introduction to programming with a focus on rapid application development environments, event-driven programming, and programming in the Windows environment. Course will demonstrate how the major application types (spreadsheets, databases, text editors) are written. Lecture and laboratory.

CSCI-N 335 Advanced Programming, Visual Basic (3 cr.) Databases and VB, object-oriented design and practice, the component object model, interobject communication, related RAD environments such as VB for Applications and ActiveX using the Windows API, and generating online help. Lecture and laboratory.

CSCI-N 341 Introduction to Client-Side Web Programming (3 cr.) P: Recommended CSCI-N 241 or equivalent. Introduction to programming with a focus on the client-side programming environment. Programming using languages commonly embedded in Web browsers. Lecture and laboratory.

CSCI-N 342 Server-Side Programming for the Web (3 cr.) P: Recommended CSCI-N 341. Designing and building applications on a Web server. Focuses on the issues of programming applied to Web servers. Emphasis on relational database concepts, data design, languages used on the server, transaction handling, and integration of data into Web applications.

CSCI-N 343 Object-Oriented Programming for the Web (3 cr.) P: CSCI-N 341 or CSCI-N 307. Algorithm design and development within the object-oriented paradigm. Students will utilize Java to create Web-based application software with strong user interaction and graphics. In addition, students will utilize Oracle and SQL to learn introductory database design principles, coupling back-end database operation to application software. Lecture and laboratory.

CSCI-N 345 Advanced Programming, Java (3 cr.) P: CSCI-N 307 or CSCI-N 331 or CSCI-N 341 or equivalent. A Java language course designed for students familiar with programming and the World Wide Web. Focus on the unique aspects of Java, Applet, and GUI design, object-oriented programming, event-handling, multithreaded applications, animation, and network programming. Lecture and laboratory.

CSCI-N 351 Introduction to Multimedia Programming (3 cr.) An integration of computing concepts and multimedia development tools. An introduction to the science behind multimedia (compression algorithms and digital/audio conversion). Use of authoring tools to create compositions of images, sounds, and video. Special emphasis given to using the Web as a multimedia presentation environment. Lecture and laboratory.

CSCI-N 355 Introduction to Virtual Reality (3 cr.) Explore concepts of 3D imaging and design including primitive shapes, transformations, extrusions, face sets, texture mapping, shading, and scripting. Lecture and laboratory.

CSCI-N 361 Fundamentals of Software Project Management (3 cr.) Tools and techniques used to manage software projects to successful completion. Problem-solving focus to learn specification development and management, program success metrics, UML modeling techniques, code design and review, principles, testing procedures, usability measures, release and revision processes, and project archival. Lecture and laboratory.

CSCI-N 399 Topics in Computing (topic varies) (1-3 cr.) An investigation of an emerging language or topic in computing. May be repeated for credit.

CSCI-N 410 Mobile Computing Application Development (3 cr.) Focus of this course is to give programmers information they need to develop new applications or move existing applications to handheld devices and other resource-constrained hardware. All programming is done via Visual Basic.NET or C#.

CSCI-N 420 Mobile Computing Cross Platform Development (3 cr.) P: CSCI-N 343. Survey of programming & application development for mobile and wireless computing devices. Topics include recommended practices using the J2 platform for micro devices such as

cell phones and PDAs, the implementation of cross-device GUI's, using event handlers and remote server access.

CSCI-N 430 Mobile Computing & Interactive Applications (3 cr.) P: CSCI-N 201. Introduction to programming with emphasis on the Flash ActionScript environment as used in mobile devices. Topics include interface design for mobile devices, use of Flash as an application environment, game and multimedia development, communication with a web server, and parsing XML data.

CSCI-N 431 E-Commerce with ASP.NET (3 cr.) Topics include basic Web controls, form validation, connecting to an Enterprise-level database, SSL, and sending email within an ASP.NET Web page. A significant software development final project creating a functional Web store is featured. Lecture and laboratory.

CSCI-N 435 Data Management Best Practices with ADO.NET (3 cr.) A study of managing data in the .NET environment. Focus on strategies to efficiently manage data for large-scale projects. Topics include XML, DataSets, SQL, and error management. Lecture and laboratory.

CSCI-N 443 XML Programming (3 cr.) P: CSCI-N 241 and a CSCI-N 300-level programming course. Fundamentals of XML programming language. After mastering fundamental XML scripting syntax, the course focuses on narrative-centric and data-centric XML applications. Narrative content includes CSS, DTD and XSLT, and X-path, -link, and -pointer tools; data-centric content includes the DOM, Schemas, and ADO/ASP. A required masterpiece project summarizes course competencies. Lecture and laboratory.

CSCI-N 450 Mobile Computing with Web Services (3 cr.) P: CSCI-N 410 or CSCI-N 420 or CSCI-N 430. Fundamental concepts of data transport between client devices and a server. Topics include web services, SOAP (simple object access protocol), and XML.

CSCI-N 451 Web Game Development (3 cr.) Study of basic game development principles with a focus on client-side web delivery. Topics to include creation of sprite objects, user interaction concepts, basic intelligence concepts, game data structures, and basic game physics. Lecture and laboratory.

CSCI-N 461 Software Engineering for Applied Computer Science (3 cr.) P: CSCI-N 361 or consent of the instructor. This is a survey course covering software engineering concepts, tools, techniques, and methodologies. The topics covered include software engineering, software process and its difficulties, software lifecycle models, project planning including cost estimation, design methodologies including structured design, data structure-oriented design, object-oriented design, and software testing. This course is intended for nonmajors, and credit will not be awarded to computer science majors.

CSCI-N 485 Capstone Project in Applied Computing (3 cr.) P: CSCI-N 301 and CSCI-N 341. This course provides students with a mechanism for producing and integrating technical achievement meritorious of program culmination. The project will demonstrate subject matter mastery within project development guidelines and reflect both a breadth and depth of technically focused problem-solving skills.

CSCI-N 499 Topics in Applied Computing (topic varies) (1-3 cr.) P: CSCI-N 300-level course or equivalent. An investigation and examination of an emerging discipline in applied computer science.

Courses for Majors

CSCI 12000 Windows on Computer Science (1 cr.) A first-year seminar for beginning majors in Computer Science. Open to all beginning IUPUI students and transfer students with fewer than 18 credit hours.

CSCI 23000 Computing I (4 cr.) P: or C: MATH 15300 or MATH 15900. The context of computing in history and society, information representation in digital computers, introduction to programming in a modern high-level language, introduction to algorithm and data structures, their implementation as programs.

CSCI 24000 Computing II (4 cr.) P: CSCI 23000 and MATH 15300 or MATH 15900. Continues the introduction of programming began in CSCI 230, with particular focus on the ideas of data abstraction and object-oriented programming. Topics include programming paradigms, principle of language design, object-oriented programming, programming and debugging tools, documentation, recursion, linked data structures, and introduction to language translation.

CSCI 26500 Advanced Programming (3 cr.) P: or C: ECE 26400 and CSCI 24200 or CSCI 23000. This course is for computer engineering and computer information systems majors. Spring. Learn advanced programming skills and concepts. Introduction to software engineering: problem specification and program design with emphasis on object-oriented programming, programming style, debugging, and documentation. A significant software project's required.

CSCI 30000 Systems Programming (3 cr.) P: CSCI 23000 and CSCI 24000. Assembly language programming and structure of a simple and a typical computer. Pseudo operations, address structure, subroutines, and macros. File I/O and buffering techniques. Interfacing with high-level languages. Assemblers: one- and two-pass assemblers, system dependent and independent assembler features, and design options. Loaders, linkers, and macro processors.

CSCI 34000 Discrete Computational Structures (3 cr.) P: MATH 15300. Fall/Spring. Theory and application of discrete mathematics structures and their relationship to computer science. Topics include mathematical logic, sets, relations, functions, permutations, combinatorics, graphs, Boolean algebra, digital logic, recurrence relations, and finite-state automata.

CSCI 34050 Honors Discrete Computational Structures (3 cr.) P: MATH 15300. Fall/Spring. Discrete structures introduces students to the vocabulary, notation, formalisms, constructs, and methods of abstraction in which almost all of the advanced thinking in and about computer science is carried out. Topics include basic logic, proof techniques, recursion and recurrence relations, sets and combinatorics, probability, relations and functions, graphs and trees, Boolean algebra, and models

of computation. An advanced project is expected in this course.

CSCI 35500 Introduction to Programming Languages (3 cr.) P: CSCI 24000 and CSCI 34000. Programming language concepts and different paradigms of programming. Topics include syntax and semantics of high-level languages, parsing methods, subprograms and their implementation, data abstraction, language translation overview including lexical analysis, syntax-directed translation, symbol table handling, code generation, functional programming, logic programming, and object-oriented programming.

CSCI 36200 Data Structures (3 cr.) P: CSCI 24000 and CSCI 34000. A study of the design and analysis of data structures and algorithms. Abstract data types: arrays, stacks, queues, lists, trees, and graphs. Algorithms: sorting, searching, and hashing. File structures: organization and access methods.

CSCI 36250 Honors Data Structures and Algorithms (3 cr.) P: CSCI 23000, CSCI 24000, and CSCI 34000 or CSCI 34050. This course includes fundamentals of data structures and algorithms, such as algorithm analysis, lists, stacks, and queues, trees, hashing and heaps, sorting, graph algorithms, and file structures. An advanced project is expected.

CSCI 36300 Principles of Software Design (3 cr.) P: CSCI 24000. R: CSCI 36200 (recommended). This course is designed to teach students best practices in designing and implementing object-oriented systems of high quality. To accomplish this task, we start with an overview of software design patterns and their role in developing high-quality software. We then begin surveying different design-level software design patterns, such as the Bridge, Strategy, Wrapper Facade, and Visitor software design patterns. Next, we touch on software design patterns for building distributed systems. Finally, we finish the course by surveying software anti-patterns, which are common design mistakes that negatively impact system quality, such as degrading performance as the system scales in size and complexity. Students will have the opportunity to apply learned techniques on several programming projects throughout the semester.

CSCI 40200 Architecture of Computers (3 cr.) P: CSCI 34000. Basic logic design. Storage systems. Processor organization: instruction formats, addressing modes, subroutines, hardware and microprogramming implementation. Computer arithmetic, fixed and floating point operations. Properties of I/O devices and their controllers. Interrupt structure. Virtual memory structure, cache memory. Examination of architectures such as microcomputers, minicomputers, and vector and array processors.

CSCI 40300 Introduction to Operating Systems (3 cr.) P: CSCI 36200. Operating system concepts; history, evolution and philosophy of operating systems. Concurrent processes, process coordination and synchronization, CPU scheduling, deadlocks, memory management, virtual memory, secondary storage and file management, device management, security and protection, networking, and distributed and real-time systems.

CSCI 41400 Numerical Methods (3 cr.) P: MATH 35100. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, and numerical solution of ordinary differential equations. Not open to students with credit in MATH 51200.

CSCI 43200 Security in Computers (3 cr.) P: CSCI 40300. An introduction to computing security to include cryptography, identity and authentication, software security, operating system security, trusted operating system design and evaluation, network threats and defenses, security management, legal aspects of security, privacy and ethics.

CSCI 43300 Introduction to the Internet of Things (3 cr.) P: CSCI 36200 Data Structures and CSCI 40300 Operating Systems with a grade of C- or better This course provides principles, knowledge and information on the latest technologies about Internet of things, and wireless networks of smart objects. Topics include the concepts and architectures of Internet of things, communication mechanisms, lightweight IP stack, protocols, operating systems, devices, and various applications.

CSCI 43500 Multimedia Information Systems (3 cr.) P: CSCI 36200, MATH 16600. Multimedia information systems concepts, evolution of multimedia information systems, media and supporting device commonly associated, image databases, techniques for presenting visual information, video databases, multimodels, audio databases, text databases, and multimedia information systems architecture.

CSCI 43600 Principles of Computer Networking (3 cr.) P: CSCI 40300. Survey of underlying principles, fundamental problems, and their solutions in designing computer networks. Laboratory projects include using network systems and network simulation environments. Topics include: motivations, networking topologies, layered open systems protocols, transmission capacity, circuit and packet switching, packet framing and error correction, routing, flow and congestion control, and internetworking.

CSCI 43700 Introduction to Computer Graphics (3 cr.) P: CSCI 36200 and MATH 35100/51100. An introduction to 3D programming with emphasis on game engine development using 3D graphics techniques and the standard and platform independent OpenGL library. Topics include lighting, shading, texture mapping, coordinate systems and transformations, collision detection, 3D geometric and physically based modeling and animation.

CSCI 43800 Advanced Game Development (3 cr.) P: CSCI 43700. Advanced game design and development principles and technologies. Students will gain practical experience through extensive game development project. Topics include character animation, special effects, user interface design, networking for computer games, game engine components and variations, game performance considerations, artificial intelligence, and ethics in computer games.

CSCI 44100 Client-Server Database Systems (3 cr.) P: CSCI 36200. Database system concepts, data models database design, CASE tools, SQL, query processing and

query optimization, transaction processing, reliability and security issues, database interactions on the World Wide Web.

CSCI 44300 Database Systems (3 cr.) P: CSCI 36200. Relational database systems: architecture, theory, and application. Relational data structure, integrity rules, mathematical description, data manipulation. Standard SQL and its data manipulation language, engineering aspects of database design in industry, introduction to nonrelational database systems.

CSCI 44600 Introduction to Microprocessor Architecture (3 cr.) P: CSCI 40200. Introduction to programmable logic; elements of microprocessor system design; interrupt structures; interfacing using LSI devices; hardware timers; interactive debugging; physical device I/O programming; vectored and polled service; microprocessor architecture; and self-paced laboratory using A/D converters, D/A converters, etc.

CSCI 44800 Biometric Computing (3 cr.) P: CSCI 24000 and one of the following: STAT 35000 or STAT 41600 or STAT 51100. Biometrics is capturing and using physiological and behavioral characteristics for personal identification. It is set to become the successor to the PIN. This course will introduce computational methods for the implementation of various biometric technologies including face and voice recognition, fingerprint and iris identification, and DNA matching.

CSCI 45000 Principles of Software Engineering (3 cr.) P: CSCI 36300. Tools and techniques used in software development. Lifecycle concepts applied to program specification, development, and maintenance. Topics include overall design principles in software development; the use of structured programming techniques in writing large programs; formal methods of program verification; and techniques and software tools for program testing, maintenance, and documentation. A primary goal of this course is to provide experience in team development of software.

CSCI 45200 Object-Oriented Analysis and Design (3 cr.) P: CSCI 36200. Introduction to the object-oriented paradigm in software development. Basic concepts: objects, classes, messaging, inheritance, and methodologies. Analysis: defining objects, structures, attributes, and services. Design: transforming the analytic model into the design model. Implementation: comparison of the support features provided by languages such as Smalltalk, C++, Eiffel, and CLOS. A significant design project is required.

CSCI 46300 Analysis of Algorithms (3 cr.) P: CSCI 36200. Techniques for analyzing and comparing algorithms. Average case analysis in sorting and searching; dynamic programming: greedy algorithms, amortized analysis, and applications; matrix algorithms: polynomials, discrete Fourier transforms, and fast Fourier transforms, parallel algorithms: examples in sorting, searching, graphs, and matrices, computational complexity, polynomial complexity classes P, NP.

CSCI 47000 Automata and Formal Languages (3 cr.) P: CSCI 36200. Introduction to formal languages and automata theory: finite automata and regular expressions, context-free grammars and languages, pushdown automata, equivalence of CFGs and pushdown automata, application of pushdown automata in parsing, closure properties, pumping lemmas, decision procedures, Turing machines, computability, undecidability, and a brief survey of the Chomsky hierarchy.

CSCI 47500 Scientific Computing I (3 cr.) P: CSCI 23000 and MATH 35100. P or C: MATH 26200. Solving scientific problems on computers. Languages for scientific computing. Software development on workstations: using tools the environment provides, organization of programs. Computer architecture: impact on software and algorithms. Problem formulation: model selection/simplification, relationship to numerical methods. Solution of linear equations: methods and packages. Nonlinear equations and optimization problems.

CSCI 47600 Scientific Computing II (3 cr.) P: CSCI 47500. Elementary statistical computing: time series analysis, model fitting, robust methods, generation of pseudorandom numbers, and Monte Carlo methods. Interpolation and curve fitting; numerical integration. Solving ordinary differential equations. Use of packaged environments and symbolic computation for scientific purposes.

CSCI 47700 High Performance Computing (3 cr.) P: CSCI 47600. Architecture of supercomputers: pipelined, vector, SIMD, MIMD; implications for algorithm and program design; and vectorization, parallelization, loop restructuring, and nonstandard language features. Splitting computation between supercomputers and workstations; interactive analyses of remote machines' output. Numerical methods for large-scale problems: examples from continuum mechanics, graphical visualization, and statistical computing. A project is required.

CSCI 48100 Data Mining (3 cr.) P: CSCI 24000 and MATH 35100 or MATH 51100. Recommended: STAT 30100 or STAT 35000 or STAT 41600 or STAT 51100. An introduction to data warehousing and OLAP technology for data mining, data processing, languages and systems, and descriptive data mining: characterization and comparison, association analysis classification and predication, cluster analysis mining complex types of data, application, and trends in data mining.

CSCI 48400 Theory of Computation (3 cr.) P: CSCI 36200. Introduction to formal languages and automata theory: finite automata, regular expressions, regular languages, context-free languages and pushdown automata, context sensitive languages, Turing machines, undecidability, P and NP. Design and analysis techniques for: divide-and-conquer algorithms, greedy algorithms, dynamic programming, amortized analysis.

CSCI 48500 Expert System Design (3 cr.) P: CSCI 36200. Overview of artificial intelligence; expert system technology; early expert systems: MYCIN, DENDRAL; theoretical foundations, uncertainty measures, knowledge representation, inference engines; reasoning mechanisms: forward and backward chaining; and explanation systems, expert system shells, tools, and intelligent hybrid systems.

CSCI 48700 Artificial Intelligence (3 cr.) P: CSCI 36200. Study of key concepts and applications of artificial intelligence. Problem-solving methods, state space search, heuristic search, knowledge representation: predicate logic, resolution, natural

deduction, nonmonotonic reasoning, semantic networks, conceptual dependency, frames, scripts, and statistical reasoning; advanced AI topics in game playing, planning, learning, and connectionist models.

CSCI 48900 Data Science (3 cr.) P: CSCI 24000 and STAT 30100 or STAT 35000 or STAT 51100 with grades of C- or better Spring. The course will cover data manipulation, analysis, and visualization. Statistical modeling, dimension reduction and techniques of supervised and unsupervised learning. Introduction to software technologies used in data science and applications in science, government and industry.

CSCI 49000 Topics in Computer Sciences for Undergraduates (1-5 cr.) P: Open to students only with the consent of the department. By arrangement. Fall, spring, summer. Supervised reading and reports in various fields.

CSCI 49500 Explorations in Applied Computing (1-6 cr.) Explorations in Applied Computing is an undergraduate capstone experience. Students will work in teams, advised by faculty and external liaisons, to solve real-world computing problems. This hands-on experience will cultivate technical expertise, utilization of analytical thinking, quantitative reasoning, project management skills, and communication skills.

CSCI 49600 Computer Science Internship Capstone (3 cr.) P: CSCI 48400 and senior standing. A professional experience providing students the opportunity to incorporate material learned in CSCI coursework in a supervised internship position. The approved internship position will cultivate technical expertise, utilization of analytical thinking, quantitative reasoning, project management skills, and communication skills.

Advanced Undergraduate and Graduate Level

CSCI 50200 Compiling and Programming Systems (3 cr.) P: CS graduate standing or instructor consent required. Fall. Basic principles of compilers and compiler design; control of translation, loading, and execution; symbolic coding systems; lexical and syntactic analysis; design and operation of assemblers and macroprocessors; and design of interpretive systems. Students are expected to complete a large programming project as part of the course.

CSCI 50300 Operating Systems (3 cr.) P: CS graduate standing or instructor consent required. Spring. Basic principles of operating systems: addressing modes, indexing, relative addressing, indirect addressing, stack maintenance; implementation of multitask systems; control and coordination of tasks, deadlocks, synchronization, and mutual exclusion; storage management, segmentation, paging, virtual memory, protection, sharing, and access control; file systems; resource management; and evaluation and prediction of performance.

CSCI 50400 Concepts in Computer Organization (3 cr.) P: CS graduate standing or instructor consent required. The fundamentals of computer hardware for computer scientists. An overview of the organization of modern computers, ranging from sequential to advanced machines. CISC, RISC, and vector processors; multiprocessors; virtual storage, hierarchical memory; interaction with O/S; connection models; high-level programming support; and cost/performance analysis.

CSCI 50600 Management of the Software Development Process (3 cr.) P: CS graduate standing or instructor consent required. A survey of the fundamental principles and concepts of managing a software project. Topics include life cycle models, standards and goals, cost estimation, risk analysis, tool use, component reuse, traceability, metrics, and process control and improvement. Students are required to apply management concepts using a project-based approach.

CSCI 50700 Object-Oriented Design and Programming (3 cr.) P: CS graduate standing or instructor consent required. An advanced exploration of the object-oriented model and programming. Topics range from a review of the object model to advanced concepts such as abstraction mechanisms, standard library/packages, OO design using an OO language, and the syntax and the semantics of constructs.

CSCI 50900 Software Quality Assurance (3 cr.) P: Graduate Student standing in Department of Computer Information Science. Fall, every other year. This course is designed to teach students best practices in testing different classes of software systems. To accomplish this task, we start with an overview of software testing and its role in developing high-quality software. We then begin studying, in depth, traditional software testing methods, such as functional, structural, and integration testing. Finally, we finish the course by surveying contemporary software testing methods, such as exploratory testing, model-based testing, search-based testing, and non-functional testing. Students will have to opportunity to apply learned techniques on several programming projects throughout the semester.

CSCI 51200 Numerical Methods for Engineers and Scientists (3 cr.) P: MATH 35100 or MATH 51100; MATH 51000; and knowledge of programming. CS graduate standing or instructor consent required. Not open to students with credit in CSCI 41400. Not normally accepted for graduate credit in computer science programs. A survey of the useful methods of computation. Solution of nonlinear equations and systems of nonlinear equations. Numerical methods for systems of linear equations. Approximate differentiation and integration. Numerical solution of ordinary differential equations. Introduction to partial differential equations and elementary approximation methods.

CSCI 51400 Numerical Analysis (3 cr.) P: CSCI 41400 or equivalent. CS graduate standing or instructor consent required. Iterative methods for solving nonlinear equations, linear difference equations, applications to solution of polynomial equations, differentiation and integration formulas, numerical solution of ordinary differential equations, and round-off error bounds.

CSCI 51500 Numerical Analysis of Linear Systems (3 cr.) P: CS graduate standing or instructor consent required. Computational aspects of linear algebra; linear equations and matrices; direct and iterative methods; eigenvalues and eigenvectors of matrices; error analysis.

CSCI 51600 Computational Methods in Applied Mathematics (3 cr.) P: CS graduate standing or instructor consent required. A study of techniques such

as direct integration, shooting, finite difference, finite elements, method of weighted residuals, and methods of characteristics for solving problems in fluid mechanics, solid mechanics, dynamics, and other fields of applied mathematics.

CSCI 52000 Computational Methods in Analysis (3 cr.) P: CS graduate standing or instructor consent required. A treatment of numerical algorithms for solving classical problems in real analysis with primary emphasis on linear and nonlinear systems of equations and on optimization problems; the writing, testing, and comparison of numerical software for solving such problems; and a discussion of the characteristics of quality software for implementing these algorithms.

CSCI 52500 Parallel Computing (3 cr.) P: or C: CSCI 40200 or an equivalent course, some programming experience with C or a similar language. Parallel computing for science and engineering applications: parallel programming and performance evaluation, parallel libraries and problem-solving environments, models of parallel computing and run-time support systems, and selected applications.

CSCI 52600 Information Security (3 cr.) P: CS graduate standing or instructor consent required. Basic notions of confidentiality, integrity, availability; authentication and protection models; security kernels; secure programming; audit; intrusion detection/response; operational security issues; personal security; policy formation/enforcement; access controls; information flow; legal/social issues; identification and authentication in local and distributed systems; classification and trust modeling; risk assessment.

CSCI 53200 Cloud Computing Systems (3 cr.) The course specific topics cover the architectural aspects of modern Cloud systems, focusing on network architecture, by exploring the potentials of applications of cloud systems. The course builds on students' foundational knowledge from studies in computer networks, operating systems and computer architecture. Material covered in the class will include some concepts from several textbooks and research papers. The course is highly interactive, based on class discussions. An important part of the course will be dedicated to improving research skills, such as writing papers and preparing presentations.

CSCI 53300 Wireless Sensor Networks (3 cr.) P: CSCI 53600 Data Communication & Computer Networks or instructor permission This course studies the fundamental principles of wireless sensor networks. The course will expose students to the fundamental issues in designing and analyzing sensor networks and their information processing applications. Topics include sensor network architecture, MAC layer, routing and data dissemination, transport protocols, sensor network operating systems, sensor network programming, querying, network management, and real-world applications.

CSCI 53600 Data Communication and Computer Networks (3 cr.) P: CS graduate standing or instructor consent required. Data communications: communication hardware technologies including local area and long-haul network hardware, circuit and packet switching, interfaces between computer and network hardware, and performance issues. Network architecture: protocol software and conceptual layering, reliable delivery over an unreliable channel, transport protocols, virtual circuits, datagrams, Internet working as a fundamental design concept, the client-server paradigm, naming and name binding, name servers, addressing and address resolution, routing algorithms, congestion and flow control techniques, network file systems, distribution of computation, and DARPA Internet protocols (TCP/IP) as examples of protocol organization.

CSCI 53700 Introduction to Distributed Computing (3 cr.) P: CSCI 50300 and CSCI 53600. CS graduate standing or instructor consent required. Introduction to the principles and methods in the design of distributed computing systems. It covers the fundamentals of distributed computing from four perspectives: underlying communication media, protocols and their implications; operating system issues; high-level language constructs; and distributed algorithms.

CSCI 53800 The Design of Interactive Systems (3 cr.) P: CS graduate standing or instructor consent required. Fundamental concepts and tools employed in designing the interaction between humans and machines and the mediating interfaces. Topics include: design problem, interface design concepts, experimental design and analysis, cognitive and predictive models, the design project, case studies, and applications.

CSCI 53900 Computing with Distributed Objects (3 cr.) P: CS graduate standing or instructor consent required. An introductory treatment of the distributed-object model and programming. The topics range from a review of the distributed and object models of computation to advanced concepts such as remote method invocations, object brokers, object services, open systems, and future trends for distributed-object systems.

CSCI 54100 Database Systems (3 cr.) P: CS graduate standing or instructor consent required. Spring. Fundamentals for the logical design of database systems. The entity-relationship model, semantic model, relational model, hierarchical model, network model. Implementations of the models. Design theory for relational databases. Design of query languages and the use of semantics for query optimization. Design and verification of integrity assertions, and security. Introduction to intelligent query processing and database machines.

CSCI 54300 Introduction to Simulation and Modeling of Computer Systems (3 cr.) P: CS graduate standing or instructor consent required. Simulation: discrete event simulation, process-oriented simulation, generating random numbers, simulation languages, simulation examples of complex systems. Nondeterministic models: random variables, Poisson process, moment generating functions, statistical inference, and data analysis. Modeling: elementary queuing models, network of queues, and applications to performance evaluation of computer systems.

CSCI 54700 Information Storage and Retrieval and Natural Language Processing (3 cr.) P: CSCI 54100. CS graduate standing or instructor consent required. Complex data structures of fields within records, as well as clustered, multilist, and inverted files; key decoding by tree and randomized techniques; overall techniques of classical document retrieval systems, e.g., the MEDLARS and NASA systems; overall techniques of automatic

document retrieval systems, e.g., TIP and SMART, the internal structure of SMART; question answering systems; and natural language translation.

CSCI 54800 Introduction to Bioinformatics (3 cr.) P: CS graduate standing or instructor consent required. Analysis of biological data employing various computational methods to obtain useful information in the emerging area of bioinformatics. Topics include structures, functions and evolution of proteins and nucleic acids, retrieval and interpretation of bioinformation from the Internet, learning principles, algorithms and software for sequence alignment, similarity search of sequence databases, estimation of phylogenetic trees, structural prediction, and functional inference.

CSCI 54900 Intelligent Systems (3 cr.) P: CS graduate standing or instructor consent required. This course will discuss problems in the area of intelligent systems. Topics include the formalisms within which these problems are studied, the computational methods that have been proposed for their solution, and the real-world technological systems to which these methods have been applied.

CSCI 55000 Computer Graphics (3 cr.) P: CS graduate standing or instructor consent required. An introduction to computer graphics. Topics include the concepts, principles, algorithms, and programming techniques in 3D interactive computer graphics. Emphasis is on the development and applications of 3D graphic algorithms and methods.

CSCI 55200 Data Visualization (3 cr.) P: CSCI 55000. CS graduate standing or instructor consent required. Spring. An introduction to data visualization methods and tools, and related graphics techniques. Students will explore a variety of data representation and modeling techniques, their corresponding visualization algorithms, and practical visualization applications in scientific, engineering, and biomedical fields.

CSCI 55500 Cryptography (3 cr.) P: CS graduate standing or instructor consent required. Concepts and principles of cryptography and data security. Cryptography (secret codes): principles of secrecy systems; classical cryptographic systems, privacy enhanced email; digital signatures. Proprietary software protection; information theory and number theory; complexity bounds on encryption; key escrow; traffic analysis; attacks against encryption; basic legal issues; e-commerce; the role of protocols.

CSCI 55600 Fault-Tolerant Computing (3 cr.) P: CS graduate standing or instructor consent required. Concepts of fault-tolerant computing; phases of fault-tolerance; applications to commercial, communication, and aerospace systems; fault-tolerance in multi-processor systems; diagnosis techniques; software fault-tolerance.

CSCI 55700 Image Processing and Computer Vision (3 cr.) P: CS graduate standing or instructor consent required. Topics may include image input and transformation, feature detection and recognition in 2D image processing, as well as 3D dynamic images.

CSCI 55800 Multimedia (3 cr.) Spring. This is a course with emphasis on visual media such as image and video processing, transmission, understanding and retrieval. We discuss various types of media, methods for media creation, editing, and algorithms for media indexing, transmission, and recognition. Students will not only learn fundamental principles of signal, frequency, filtering, and transformation, but also gain hands-on experiences in creating multimedia contents for Internet access, implementing multimedia display for visualization, and developing basic algorithms for information extraction and retrieval for multimedia. This course will have lab training and topic discussion sessions where students will be actively involved in presenting research papers. Several exercises and projects will be assigned in addition to the presentation.

CSCI 55900 Biometric Computing (3 cr.) Spring. This course will discuss theory, applications, and implementation of biometrics. The majority of biometrics systems follow a specific architecture, namely a low-to-high level processing pipeline. For students to understand every component of this pipeline for different trait-specific systems, the course will include image processing, computer vision, and machine learning principles and methods. The course will also include examples of real-world systems, and will discuss how different technical components are applied in practice for different scenarios/ physical conditions.

CSCI 56500 Programming Languages (3 cr.) P: CS graduate standing or instructor consent required. Fall. An exploration of modern or unconventional concepts of programming languages, their semantics, and their implementations; abstract data types; axiomatic semantics using Hoare's logic and Dijkstra's predicate transformers; denotational semantics; functional, object-oriented, and logic programming; concurrency and Owicki-Gries theory. Example languages include ML, Ada, Oberon, LISP, PROLOG, and CSP.

CSCI 57300 Data Mining (3 cr.) P: CS graduate standing or instructor consent required. Data Mining has emerged at the confluence of artificial intelligence, statistics, and databases as a technique for automatically discovering summary knowledge in large datasets. This course introduces students to the process and main techniques in data mining, including classification, clustering, and pattern mining approaches. Data mining systems and applications will also be covered, along with selected topics in current research.

CSCI 57500 Computer Systems Security (3 cr.) P: Graduate student standing in the Department of Computer Science. This course aims at explaining how to build systems to remain dependable in the face of malice, error, or mischance. The course focuses on the tools, processes, and methods needed to design, implement, and test complete systems, and to adapt existing systems as their environment evolves. The course builds on students' prior foundation from studies in computer security, networks, operating systems and computer architecture. The course is highly interactive, based on class discussions. An important part of the course will be dedicated to improving research skills, such as writing papers and preparing presentations.

CSCI 57800 Statistical Machine Learning (3 cr.) P: Calculus, Linear Algebra, Probability and Random Variables, and Basic knowledge of optimization techniques. Spring. This course will provide an

introductory to mid-level coverage of concepts and techniques in machine learning with emphasis given on statistical aspect of machine learning. Topics to be discussed include: Generative and discriminative models for classification and regression, posterior distributions and inference, conjugate distributions, model generalizability, kernel machines, dimensionality reduction, introduction to probabilistic topic models, graphical models and belief propogation, expectation-maximization, deterministic and stochastic inference.

CSCI 57900 Bioinformatics Algorithms (3 cr.) Fall. This course teaches algorithms for solving important computation problems in the field of bioinformatics. String data structures such as hash table suffix tree, and suffix arrays, and popular algorithm design techniques, such as dynamic programming, greedy algorithms, divide & conquer, and graph based algorithms are covered. Data analysis methods such as clustering, and hidden Markov model (HMM) are also covered. Application of these algorithmic methods for solving several bioinformatics computation problems, such as sequence alignment, motif discovery, and DNA sequencing are demonstrated.

CSCI 58000 Algorithm Design, Analysis, and Implementation (3 cr.) P: CS graduate standing or instructor consent required. Basic techniques for designing and analyzing algorithms: dynamic programming, divide-and-conquer, balancing, upper and lower bounds on time and space costs, worst case and expected cost measures. A selection of applications such as disjoint set union/find, graph algorithms, search trees, pattern matching. The polynomial complexity classes P, NP, and co-NP; intractable problems.

CSCI 58200 Automata and Formal Languages (3 cr.) P: CS graduate standing or instructor consent required. Spring. Finite automata, regular expressions; push-down automata, context-free grammars; and languages and behaviors. Closure properties, pumping lemmas, and decision procedures. Deterministic context-free languages and LR(k) parsing; brief survey of the Chomsky hierarchy.

CSCI 59000 Topics in Computer Science (3 cr.) P: CS graduate standing or instructor consent required. Fall, spring. Directed study for students who wish to undertake individual reading and study on approved topics.

Graduate

CSCI 60300 Advanced Topics in Distributed Systems (3 cr.) P: CSCI 53700. CS graduate standing or instructor consent required. Design and control of distributed computing systems (operating systems and database systems). Topics include principles of namings and location, atomicity, resources sharing, concurrency control and other synchronization, deadlock detection and avoidance, security, distributed data access and control, integration of operating systems and computer networks, distributed systems design, consistency control, and fault tolerance.

CSCI 61400 Numerical Solution of Ordinary Differential Equations (3 cr.) P: CSCI 51400. CS graduate standing or instructor consent required. Numerical solution of initial-value problems by Runge-Kutta methods, general one-step methods, and multistep methods. Analysis of truncation error, discretization error, and rounding error. Stability of multistep methods. Numerical solution of boundary-value and eigenvalue problems by initial-value techniques and finite difference methods.

CSCI 61500 Numerical Solution of Partial Differential Equations (3 cr.) P: CSCI 51500 and MATH 52300. CS graduate standing or instructor consent required. The numerical solution of hyperbolic, parabolic, and elliptic equations by finite difference methods; iterative methods (Gauss-Seidel, overrelaxation, alternating direction) for solving elliptic equations; discretization and round-off errors; explicit and implicit methods for parabolic and hyperbolic systems; the method of characteristics; the concept of stability for initial value problems.

CSCI 62600 Advanced Information Assurance (3 cr.) P: CSCI 55500 (Cryptography) or instructor permission. Spring. Advanced and emerging topics in information assurance, including selections from the following: penetration testing, formal verification of systems, formal models of information flow and protection, distributed system authentication, protocol design and attack, computer viruses and malware, intrusion and anomaly detection models, multi-level security, active defenses, investigation and forensics, network firewalls, anonymity and identity, e-commerce support, database security models and mechanisms, secure group communication, wireless/sensor network security, cryptographic access control, secure multiple party computation, zero-knowledge proof, oblivious transfer, emerging security techniques such as digital provenance and moving target defense.

CSCI 66000 Design of Translating Systems (3 cr.) P: CS graduate standing or consent of instructor required. Systems design of higher-level programming languages and their processors; symbol tables, lexical scan, syntax scan, object code generation and optimization; boot-strapping techniques, higher-level translators, self-compilers, and decompilers; and heuristic generators.

CSCI 66100 Formal Compiling Methods (3 cr.) P: CSCI 50200. CS graduate standing or instructor consent required. Application of concepts developed in formal language and automata theory to the design of programming languages and their processors. Models of syntactic analysis, including canonical precedence, LR(k) and LL(k) parsing methods and variants; efficiency of each. Synthesis techniques, including symbol tables, storage administration, parameter mechanisms, garbage collection; optimization considerations. Models of synthesis, including level, affix, attributed grammars; prospects of fully automating compiler design. Applicative vs. procedural languages and their implementations based on semantic definition of a language (LISP, Lucid) and on proof-like techniques (PROLOG, equational systems); merits of such approaches.

CSCI 69500 M.S. Project (1-9 cr.) P: Consent of instructor. Maximum of 6 credit hours apply to degree. The student integrates and applies the knowledge gained from the formal course work to formulate and execute a solution to a problem of practical importance. The faculty advisor and the sponsoring organization mentor, if applicable, provide guidance and evaluation.

CSCI 69800 Research M.S. Thesis (1-18 cr.) P: Consent of instructor. Formal research on M.S. Thesis supervised by the faculty advisor.

CSCI 69900 Research Ph.D. Thesis (1-9 cr.) P: Consent of instructor. Formal research on Ph.D. Thesis supervised by the faculty advisor.

CSCI-C 591 Research Seminar (0-1 cr.) P: CS graduate standing or instructor consent required. First-year seminar in research methods and current research directions of the faculty. Repeatable.

Forensic and Investigative Sciences

Undergraduate

FIS 10100 Investigating Forensic Science Lecture (1 cr.) Fall, Spring, Summer. Forensic science is the application of scientific methods to matters involving the public. Crime scene investigation will be taught so students will have general knowledge on techniques used in the field. Students will also be exposed to basic understanding of common forensic science concepts and learn how analysis of specific types of evidence is analyzed in a forensic science laboratory. Topics will include but are not limited to crime scene, hairs, explosives, fire debris, serology, DNA, illicit drugs, fingerprints, footwear, questioned documents, inks, glass, paints, blood spatter, and soils.

FIS 10101 Investigating Forensic Science (2 cr.) Fall, Spring, Summer. Forensic science is the application of scientific methods to matters involving the public. One of its principle applications is the scientific analysis of physical evidence generated by criminal activity. During this laboratory course you will learn basic techniques used to analyze forensic evidence. This will start with concepts in evidence documentation and collection. You will then learn concepts used in pattern recognition, forensic chemistry and biology, and trace evidence. There will be hands on activities in all these disciplines. Topics will include but are not limited to crime scene, fibers, hairs, explosives, fire debris, serology, DNA, illicit drugs, fingerprints, footwear, questioned documents, inks, glass, paints, blood spatter, and soils.

FIS 20500 Concepts of Forensic Science I (3 cr.) Fall, Summer Session I. Forensic science is the application of scientific methods to matters involving the public. One of its principle applications is the scientific analysis of physical evidence generated by criminal activity. During this course students will learn basic concepts in forensic science and criminal justice system and apply the basic concepts towards evidence collection and analysis. Topics will include fingerprints, impression evidence, firearms, questioned documents, pathology, entomology, anthropology, and forensic science and the law and ethics.

FIS 20600 Concepts of Forensic Science II (3 cr.) P: FIS 20500 and either CHEM-C101 or CHEM-C105 or FIS 10101. Spring, Summer Session II. Continuation of FIS 20500. Students will learn basic concepts in forensic chemistry and forensic biology and apply the basic concepts towards evidence analysis. Students will learn instrumental procedures and methods used in forensic chemistry and forensic biology to analyze and evaluate evidence. Topics will include microscopy, spectroscopy, chromatography, hairs and fibers, arson and explosions, soils, glass, paints and inks, serology and DNA, blood splatter, illicit drugs and toxicology.

FIS 30100 Forensic Microscopy Lecture (1 cr.) P: FIS 20500 and FIS 20600 Fall, Spring. Discuss techniques used in the analysis of forensic trace evidence, such as impressions, glass, biological materials, hairs, and fibers. Topics include properties of light, compound microscopy, micrometry, refraction, dispersion, stereomicroscopy, and polarizing light microscopy.

FIS 30101 Forensic Microscopy Laboratory (1 cr.) P: P: FIS 20500 and FIS 20600 and CHEM-C126 C: 30100 Fall, Spring. Students will learn techniques in the analysis of forensic microscopic evidence. Topics include the use of common forensic microscopes such as compound microscopy, stereomicroscopy, and polarizing light microscopy. Students will also prepare and examine multiple types of trace evidence such as impressions, glass, hairs, biological materials, and fibers.

FIS 30500 Professional Issues in Forensic Science (3 cr.) P: FIS 20500, FIS 20600. Fall, Spring. Ethics in forensic science. Crime laboratory culture. Recent issues in forensic science, quality assurance and control in a crime lab.

FIS 40100 Forensic Chemistry I (3 cr.) P: CHEM-C 310, CHEM-C 311, CHEM-C 342, CHEM-C 344, CHEM-C 325. Fall. This course will cover the major techniques and instruments used in the analysis of chemical and pattern evidence commonly encountered at crime scenes. The techniques of instrumental microscopy, gas, thin layer and liquid chromatography, and UV-visible and infrared spectrophotometry will be studied and used extensively. There will be lecture components for each of the type of instrumental analysis covered in the course.

FIS 40101 Forensic Chemistry I Laboratory (1 cr.) P: CHEM-C 310, CHEM-C 311, CHEM-C325, CHEM-C 342, CHEM-C 344, or instructor consent. P: or C: FIS 40100. Fall. This course will cover the major techniques and instruments used in the analysis of chemical and pattern evidence commonly encountered at crime scenes. The techniques of instrumental microscopy, gas, thin layer and liquid chromatography, and UV-visible and infrared spectrophotometry will be studied and used extensively. There will be lab components for each of the type of instrumental analysis covered in the course.

FIS 40200 Forensic Biology (3 cr.) P: BIOL-K 322, BIOL-K 324. Fall. This course is an introduction to the use of biological materials to assign identity to persons associated with a crime. The course will introduce methods for the preliminary detection of biological evidence and introduce the use of DNA. The materials learned will encompass broader topics such as immunology, molecular biology, and genetics.

FIS 40201 Forensic Biology Laboratory (1 cr.) P: or C: FIS 40200. Only open to students admitted to the FIS Program. Fall. This laboratory section includes practical exercises that reflect common practice in forensic science laboratories, including but not limited to collection and preservation of biological evidence, presumptive and confirmatory tests, DNA extraction, and PCR amplification.

FIS 40300 Forensic Genetics (3 cr.) P: FIS 40200 or instructor consent. Spring. This course is a continuation

of FIS 40200 and will go into more detail about the structure of DNA, the application of molecular biology techniques for the determination of individual identity. The materials learned will encompass broader topics such as immunology, molecular biology, genetics, population genetics and statistics.

FIS 40400 Forensic Chemistry II (3 cr.) P: FIS 40100 or instructor consent. Spring. Continuation of FIS 40100. This course will cover the major techniques used in the analysis of chemical and trace evidence commonly encountered at crime scenes. This course will be broken down into 2 modules. The overall course will cover techniques used during the analysis of trace and chemical evidence in a forensic laboratory.

FIS 40900 Forensic Science Research (1-4 cr.) P: Requires application and approval of faculty member supervising the research. Forensic science or literature research with a report.

FIS 41500 Forensic Science and the Law (3 cr.) Fall, Spring. Application of various laws and rules of evidence to the forensic sciences and how the admission of evidence derived from forensic sciences can impact the administration of justice in the United States. Topics include preparation for testimony, expert testimony, subpoenas, basic judicial processes, admissibility of scientific evidence.

FIS 43000 Population Genetics (3 cr.) P: BIOL-K 322, BIOL-K 323, STAT 30100. Spring. This course will serve as an introduction to the principles of population genetics. The course will cover the theory behind population genetics that includes a historical perspective to the current accepted models of population theory; examine the relationships between allele and genotype frequencies, and the fundamentals of molecular evolutionary genetics.

FIS 48000 Forensic Science Professional Capstone I (1 cr.) P: FIS majors only. This course for Forensic Science majors only is preparation for the next professional step. We will examine skills needed to become a forensic scientist including resume, cover letter, personal statements, interviewing practices, letters of recommendation, references, professional workplace behavior, employer expectations during the interview process, and job searching.

FIS 49000 Forensic Science Capstone II (1 cr.) P: Must be a major in Forensic and Investigative Sciences. Fall. One of the following: internship at approved forensic science or other organization, library research or laboratory reearch supervised by FIS faculty. Final paper required i all cases.

FIS 49001 Forensic Biology Practical Capstone III (1 cr.) P: Must be a major in Forensic and Investigative Sciences Spring. This laboratory section includes practical exercises that reflect common practice in forensic science laboratories. This laboratory is a continuation of FIS 40201.

FIS 49002 Forensic Chemistry Practical Capstone III (1 cr.) P: Must be a major in Forensic and Investigative Sciences Spring. This laboratory (taken with the lecture course FIS 40400) is a continuation FIS 40101 laboratory course, with additional instruction in advanced instrumentation for the analysis of trace and chemical evidence, and their interpretation. The laboratory course is capped with a mock case that includes report writing and testimony to culminate practical experiences for a forensic scientist with a concentration in forensic chemistry.

FIS 49500 Internship in Forensic Science (0 - 5 cr.) P: Completion of application and permission of instructor. The internship experience is designed to bring together the diverse areas of knowledge that the student has gained during the pursuit of a Bachelor of Science in Forensic Science. It is a synthesis of knowledge; where the student takes what they learn in the classroom and translates that to the real world of forensic science. This is usually completed at the end of the student's undergraduate career in Forensic Science. The experience of an internship can aid with the transition to a crime laboratory. However, students have the opportunity to complete an internship at any time during their undergraduate career. The internships should be related to forensics and have ranged from a variety of experiences. Internship location must be approved by the instructor.

FIS 49600 Special Topics in Forensic Science (1 - 6 cr.) This is a variable topic course. Repeatable with different topics.

Graduate

FIS 50100 Advanced Forensic Microscopy Lecture (1 cr.) Spring. Discussion of advanced topics in forensic microscopy. This will include review of common forensic laboratory microscopes such as, stereomicroscope, compound light microscope, and polarizing light microscope. The course will include the fundamentals of light, matter, and optics common to microscopy. Introduction to the application of spectroscopy to microscopy will be examined as well as thermal microscopy and comparison microscopy. Discussion on advanced trace evidence analysis will be covered; including impression evidence, plant material, feathers, polymers, and minerals.

FIS 50101 Advanced Forensic Microscopy Laboratory (2 cr.) This will be a hands-on laboratory course. During this course, students will perform analysis of trace evidence. This will include a more complex use of light and comparison microscopes and instrumental microscopes. Topics will include; mineral content in soil, dispersion of glass particles, physical matches and impressions of trace evidence, polymer identification and microspectrophotoscopy. Students will also participate in a mock case and trial at the conclusion of the course.

FIS 50500 Current Issues in Forensic Science (3 cr.) Open only to graduate students in the Forensic and Investigative Sciences program. Fall. This course will discuss recent developments in forensic science including the following topics: introduction to ethics, quality assurance and control, and use of scientific evidence in the legal system.

FIS 50800 Forensic Science Laboratory Management (2 cr.) Summer. This course focuses on management of forensic science laboratories: various organizational models, budgeting and common laboratory policies. Differences in the management style for public and private

sector laboratories, strategies for employee recruitment, training and retention, managing workflow and maintaining compliance with accreditation bodies.

FIS 51100 Forensic Chemistry I (3 cr.) P: or C: FIS 50500 or Chemistry graduate student. Fall. This course will focus on the analysis and identification of commonly abused chemicals such as ethanol, controlled substances and prescription drugs. The history, legal issues, synthesis, chemical/physical properties, and laboratory analysis of these materials will be discussed. Special topics of the students' choosing will also be included in the form of student presentations. A separate laboratory section will also be offered in which students will complete practical exercises utilizing spectroscopy, chromatography and mass spectrometry that reflect common practice in forensic science laboratories.

FIS 51101 Forensic Chemistry I Lab (1 cr.) P: or C: 50500 and 51100 or instructor consent. Fall. This laboratory section includes practical exercises utilizing spectroscopy, chromatography and mass spectrometry that reflect common practice in forensic science laboratories.

FIS 51200 Forensic Chemistry II (3 cr.) P: FIS 51100. Spring. This course will focus on the use of instrumental techniques to analyze trace evidence types such as ink, fibers, paint, adhesives, tape, ignitable liquids, and explosives. A separate lab section will include practical laboratory exercises utilizing spectroscopy, chromatography and mass spectrometry that reflect common practice in forensic science laboratories. Special topics will also include current research such as pattern recognition techniques, novel sampling methods, and provenance determination.

FIS 51201 Forensic Chemistry II Lab (1 cr.) P: FIS 51101 or instructor consent. P or C: FIS 51200. Spring. This laboratory section will include practical laboratory exercises utilizing spectroscopy, chromatography and mass spectrometry that reflect common practice in forensic science laboratories.

FIS 51500 Forensic Science and the Law (3 cr.) P: Open only to graduate students in the Forensic and Investigative Sciences program, students enrolled in the IU School of Law, or by instructor permission. Application of various laws and rules of evidence to the forensic sciences and how the admission of evidence derived from forensic sciences can impact the administration of justice in the United States. Topics include preparation for testimony, expert testimony, subpoenas, basic judicial processes, admissibility of scientific evidence.

FIS 52100 Forensic Biology I (3 cr.) P: or C: FIS 50500 or Biology graduate student. Fall. This course is an introduction to the use of biological materials to assign identity to persons associated with a crime. The course will introduce methods for the preliminary detection of biological evidence and introduce the use of DNA. The materials learned will encompass broader topics such as immunology, molecular biology, and genetics.

FIS 52101 Forensic Biology I Lab (2 cr.) P: or C: FIS 52100. Fall. This laboratory section includes practical exercises that reflect common practice in forensic science laboratories, including but not limited to collection and preservation of biological evidence, presumptive and confirmatory tests, DNA extraction, and PCR amplification. Open only to graduate students in the Forensic and Investigative Sciences program or by instructor permission.

FIS 53000 Population Genetics (3 cr.) P: Undergraduate genetics lecture and laboratory, Undergraduate statistics. Spring. This course will serve as an introduction to the principles of population genetics. The course will cover the theory behind population genetics that includes a historical perspective to the current accepted models of population theory; examine the relationships between allele and genotype frequencies, and the fundamentals of molecular evolutionary genetics.

FIS 59000 Special Topics: Forensic and Investigative Sciences (1-6 cr.) Lecture or lecture/lab courses offered on topic areas that are not part of the regular M.S. #curriculum. These topics may include: firearms and tool marks, questioned documents, forensic #pathology, fingerprints, and others. They are electives in the M.S. in Forensic Sciences program.

FIS 59400 Internship to Forensic Science (1 - 6 cr.) The internship provides students with an opportunity to experience the workings of a practicing forensic science laboratory. Although a research project is usually the centerpiece of the internship experience, students will be given an exposure to all sections of the laboratory including case management. Students will also have an opportunity to attend a crime scene as an observer and to attend court to observe a forensic scientist offer expert testimony.

FIS 59700 Laboratory Project Design (2 cr.) P: FIS 50500. C: FIS 50500.
Design of a laboratory study to include a literature search, experimental plan, and final presentation and proposal.

FIS 69500 Seminar (0-1 cr.) Fall. Weekly seminars presented by FIS faculty, visiting faculty and FIS graduate students. Required for graduate students admitted into the M.S. in Forensic Science Program.

FIS 69800 Research M.S. Thesis (1-10 cr.) P: Consent of instructor. Credit hours arranged.

Mathematical Sciences

Undergraduate

Lower-Division

MATH 00100 Introduction to Algebra (4 cr.) Covers the material taught in the first year of high school algebra. Numbers and algebra, integers, rational numbers, equations, polynomials, graphs, systems of equations, inequalities, radicals. Credit does not apply toward any degree. This course is no longer offered at IUPUI.

MATH 11000 Fundamentals of Algebra (4 cr.) P: An appropriate ALEKS placement score taken within the last 12 months. Intended primarily for liberal arts and business majors. Integers, rational and real numbers, exponents, decimals, polynomials, equations, word problems, factoring, roots and radicals, logarithms, quadratic equations, graphing, linear equations in more than one variable, and inequalities. This course satisfies the prerequisites needed for MATH-M 118, MATH-M 119, MATH 13000, MATH 13600, and STAT 30100.

MATH 11100 Algebra (4 cr.) Real numbers, linear equations and inequalities, systems of equations, polynomials, exponents, and logarithmic functions. Covers material in the second year of high school algebra. This course satisfies the prerequisites needed for MATH-M 118, MATH-M 119, MATH 13000, MATH 13600, MATH 15300, MATH 15400, and STAT 30100. MATH 00100 (with a minimum grade of C) or placement.

MATH-M 118 Finite Mathematics (3 cr.) P: MATH 11100 or MATH 11000 (with a minimum grade of C-) or placement. Set theory, logic, permutations, combinations, simple probability, conditional probability, Markov chains.

MATH-M 119 Brief Survey of Calculus I (3 cr.) P: MATH 11100 or MATH 11000 (with a minimum grade of C-) or placement. Sets, limits, derivatives, integrals, and applications.

MATH 12300 Elementary Concepts of Mathematics (3 cr.) Mathematics for liberal arts students; experiments and activities that provide an introduction to inductive and deductive reasoning, number sequences, functions and curves, probability, statistics, topology, metric measurement, and computers. This course is not offered through IUPUI.

MATH 13000 Mathematics for Elementary Teachers I (3 cr.) P: MATH 11000 or MATH 11100 taken within the last 3 terms with a grade of C- or better or an appropriate ALEKS placement score taken within last 12 months. Numeration systems, mathematical reasoning, integers, rationals, reals, properties of number systems, decimal and fractional notations, and problem solving.

MATH 13100 Mathematics for Elementary Teachers II (3 cr.) P: MATH 13000 or MATH 13600 taken within the last 3 terms with a grade of C- or better or an appropriate ALEKS placement score taken within last 12 months. Number systems: numbers of arithmetic, integers, rationals, reals, mathematical systems, decimal and fractional notations; probability, simple and compound events, algebra review.

MATH 13200 Mathematics for Elementary Teachers III (3 cr.) P: MATH 13000 taken within the last 3 terms with a minimum grade of C- or better or an appropriate ALEKS placement score taken within last 12 months. Rationals, reals, geometric relationships, properties of geometric figures, one-, two-, and three-dimensional measurement, and problem solving.

MATH 13600 Mathematics for Elementary Teachers (6 cr.) P: MATH 11000 or MATH 11100 taken within the last 3 terms with a grade of C- or better or an appropriate ALEKS placement score taken within last 12 months. MATH 13600 is a one-semester version of MATH 13000 and MATH 13200. Not open to students with credit in MATH 13000 or MATH 13200.

MATH 15300 College Algebra (3 cr.) P: MATH 11100 (not MATH 11000) taken within last 3 terms with a grade of C or better or an appropriate ALEKS placement score taken within last 12 months. MATH 15300-15400 is a two-semester version of MATH 15900. Not open to students with credit in MATH 15900. This course covers college-level algebra and, together with MATH 15400, provides preparation for MATH 16500, MATH 22100, and MATH 23100.

MATH 15400 Trigonometry (3 cr.) P: MATH 15300 with a grade of C or better taken within the last 3 terms. MATH 15300-15400 is a two-semester version of MATH 15900. Not open to students with credit in MATH 15900. This course covers college-level trigonometry and, together with MATH 15300, provides preparation for MATH 16500, MATH 22100, and MATH 23100.

MATH 15900 Precalculus (5 cr.) P: MATH 11100 (not MATH 11000) taken within the last 3 terms with a grade of B or better or an appropriate ALEKS placement score taken within the last 12 months.
MATH 15900 is a one-semester version of MATH 15300-15400. Not open to students with credit in MATH 15300 or MATH 15400. This course covers college-level algebra and trigonometry and provides preparation for MATH 16500, MATH 22100, and MATH 23100.

MATH 16500 Analytic Geometry and Calculus I (4 cr.) P: MATH 15900 (or MATH 15300 and MATH 15400) taken within the last 3 terms with a grade of C or better or an appropriate ALEKS placement score taken within last 12 months. Introduction to differential and integral calculus of one variable, with applications.

MATH-S 165 Honors Analytic Geometry and Calculus I (4 cr.) P: Precalculus or trigonometry and consent of instructor. This course covers the same topics as MATH 16500. However, it is intended for students having a strong background in mathematics who wish to study the concepts of calculus in more depth and who are seeking mathematical challenge.

MATH 16600 Analytic Geometry and Calculus II (4 cr.) P: MATH 16500 taken within the last 3 terms with a grade of C- or better. Continuation of MATH 16500. Inverse functions, exponential, logarithmic, and inverse trigonometric functions. Techniques of integration, applications of integration, differential equations, and infinite series.

MATH-S 166 Honors Analytic Geometry and Calculus II (4 cr.) P: MATH-S 165 (with a minimum grade of B-) or MATH 16500 (with a minimum grade of A-), and consent of instructor. This course covers the same topics as MATH 16600. However, it is intended for students having a strong interest in mathematics who wish to study the concepts of calculus in more depth and who are seeking mathematical challenge.

MATH 17100 Multidimensional Mathematics (3 cr.) P: MATH 15900 or (MATH 15300 and MATH 15400) taken within the last 3 terms with a grade of C or better or an appropriate ALEKS score taken within last 12 months. An introduction to mathematics in more than two dimensions. Graphing of curves, surfaces and functions in three dimensions. Two and three dimensional vector spaces with vector operations. Solving systems of linear equations using matrices. Basic matrix operations and determinants.

MATH 19000 Topics in Applied Mathematics for Freshmen (1 - 3 cr.) P: Prerequisites and course material vary with the applications. Treats applied topics in mathematics at the freshman level.

MATH 22100 Calculus for Technology I (3 cr.) P: MATH 15900 (or MATH 15300 and MATH 15400) taken within last 3 terms with a grade of C or better or an appropriate ALEKS score taken within last 12 months. Analytic

geometry, the derivative and applications, and the integral and applications.

MATH 22200 Calculus for Technology II (3 cr.) P: MATH 22100 or equivalent taken within the last 3 terms with a grade of C- or better. Differentiation of transcendental functions, methods of integration, power series, Fourier series, and differential equations.

MATH 23100 Calculus for Life Sciences I (3 cr.) P: MATH 15900 (or MATH 15300 and MATH 15400) taken within last 3 terms with a grade of C or better or an appropriate ALEKS score taken within last 12 months. Limits, derivatives and applications. Exponential and logarithmic functions. Integrals, antiderivatives, and the Fundamental Theorem of Calculus. Examples and applications are drawn from the life sciences.

MATH 23200 Calculus for Life Sciences II (3 cr.) P: MATH 23100 or equivalent taken within the last 3 terms with a grade of C- or better. Matrices, functions of several variables, differential equations and solutions with applications. Examples and applications are drawn from the life sciences.

MATH 24100 Mathematics for Data Science I (3 cr.) P: College algebra and trigonometry, or pre-calculus, with a grade of C or better, taken within the past 12 months; or a recent proficiency/placement test indicating placement into a trigonometry-based calculus course This is the first course in a three course sequence for data science majors. Topics include: functions, limits, epsilon-delta argument, differentiation and applications to data science, anti-derivatives, Fundamental Theorem of Calculus, introduction to integration, and inverse functions.

MATH 24200 Mathematics for Data Science II (3 cr.) P: MATH 24100 or equivalent Calculus I course with a grade of C- or better. This is the second course in a three course sequence for data science majors. Topics include: transcendental functions, techniques of integration, improper integrals, applications to data science, probability and expected value, introduction to differential equations, infinite series and power series, and partial derivatives.

MATH 24300 Mathematics for Data Science III (3 cr.) P: MATH 24200 or equivalent Calculus II course with a grade of C- or better. This is the third course in a three course sequence for data science majors. Topics include: vectors, multiple integrals, systems of linear equations, matrices, vector spaces, linear transformations, determinants, eigenvalues and eigenvectors, and applications to data science.

MATH 26100 Multivariate Calculus (4 cr.) P: MATH 16500, MATH 16600 and MATH 17100 taken within the last 3 terms with grades of C- or better. Spatial analytic geometry, vectors, space curves, partial differentiation, applications, multiple integration, vector fields, line integrals, Green's theorem, Stoke's theorem, and the Divergence Theorem. An honors option may be available in this course.

MATH-S 261 Honors Multivariate Calculus (4 cr.) P: MATH 16600 or MATH-S 166 with a minimum grade of B and MATH 17100 and permission of the instructor. This is an honors level version of third semester calculus (MATH 26100). It is intended for students who have strong motivation and a desire for additional challenge. The theory of multivariate calculus is developed as rigorously as possible and studied in greater depth than in MATH 26100.

MATH 26600 Ordinary Differential Equations (3 cr.) P: MATH 16500, MATH 16600 and MATH 17100 taken within the last 3 terms with grades of C- or better. First order equations, second and n-th order linear equations, series solutions, solution by Laplace transform, systems of linear equations.

MATH 27600 Discrete Math (3 cr.) P: or C: MATH 16500. Logic, sets, functions, integer algorithms, applications of number theory, mathematical induction, recurrence relations, permutations, combinations, finite probability, relations and partial ordering, and graph algorithms.

MATH 29000 Topics in Applied Mathematics for Sophomores (1 - 3 cr.) P: Prerequisites and course material vary with the applications. Applied topics in mathematics at the sophomore level.

Upper-Division

MATH 30000 Logic and the Foundations of Algebra (3 cr.) P: or C: MATH 16600 and MATH 17100. MATH 27600 is recommended. Logic and the rules of reasoning, theorem proving. Applications to the study of the integers; rational, real, and complex numbers; and polynomials. Bridges the gap between elementary and advanced courses. This is a prerequisite for 300-level and 400-level pure mathematics courses.

MATH 32101 Elementary Topology (3 cr.) P: MATH 26100. Introduction to topology, including metric spaces, abstract topological spaces, continuous functions, connectedness, compactness, curves, Cantor sets, continua, and the Baire Category Theorem. Also, an introduction to surfaces, including spheres, tori, the Mobius band, the Klein bottle and a description of their classification.

MATH 33300 Chaotic Dynamical Systems (3 cr.) P: MATH 16600 or MATH 22200 or MATH 23200. The goal of the course is to introduce some of the spectacular new discoveries that have been made in the past twenty years in the field of mathematics known as dynamical systems. It is intended for undergraduate students in mathematics, science, or engineering. It will include a variety of computer experiments using software that is posted on the Web.

MATH 35100 Elementary Linear Algebra (3 cr.) P: MATH 16600 and MATH 17100. Not open to students with credit in MATH 51100. Systems of linear equations, matrices, vector spaces, linear transformations, determinants, inner product spaces, eigenvalues, and applications.

MATH 35300 Linear Algebra II with Applications (3 cr.) P: MATH 35100 or MATH 51100. This course involves the development of mathematics with theorems and their proofs. This course also includes several important applications, which will be used to create a mathematical model, prove theorems that lead to the solution of problems in the model, and interpret the results in terms of the original problem.

MATH 35400 Linear Algebra II for Data Science (3 cr.) P: MATH 35100 or MATH 51100 or Instructor Consent. In this course, we will explore a number of contemporary

applications of linear algebra (all of which have arisen since the dawn of the Internet Age and most are still under development) in information retrieval, website ranking, text processing, community detection, pattern recognition, and recommender systems for e-commerce, all largely based on matrix factorizations, that should be of interest to students in pure and applied mathematics, actuarial science, computer & information science, and engineering.

MATH 37300 Financial Mathematics (3 cr.) P: MATH 26100. Fundamental concepts of financial mathematics and economics, and their application to business situations and risk management. Valuing investments, capital budgeting, valuing contingent cash flows, modified duration, convexity, immunization, financial derivatives. Provides preparation for the SOA/CAS Exam FM/2.

MATH 39000 Topics in Applied Mathematics for Juniors (1 - 3 cr.) P: Prerequisites and course material vary with the applications. Applied topics in mathematics at the junior level.

MATH 39800 Internship in Professional Practice (0-3 cr.) P: Approval of Department of Mathematical Sciences. Professional work experience involving significant use of mathematics or statistics. Evaluation of performance by employer and Department of Mathematical Sciences. May count toward major requirements with approval of the Department of Mathematical Sciences for a total of 6 credits.

MATH 41400 Numerical Methods (3 cr.) P: MATH 26600 and a course in a high-level programming language. Not open to students with credit in CSCI 51200. Error analysis, solution of nonlinear equations, direct and iterative methods for solving linear systems, approximation of functions, numerical differentiation and integration, and numerical solution of ordinary differential equations.

MATH 42100 Linear Programming and Optimization Techniques (3 cr.) P: MATH 26100 and MATH 35100. This course covers a variety of topics in operations research, including solution of linear programming problems by the simplex method, duality theory, transportation problems, assignment problems, network analysis, dynamic programming.

MATH 42300 Discrete Modeling (3 cr.) P: MATH 26600 and MATH 35100 or MATH 51100 or consent of instructor. Linear programming, mathematical modeling of problems in economics, management, urban administration, and the behavioral sciences.

MATH 42500 Elements of Complex Analysis (3 cr.) P: MATH 26100. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; elementary conformal mapping.

MATH 42600 Introduction to Applied Mathematics and Modeling (3 cr.) P: MATH 26600 and PHYS 15200. Introduction to problems and methods in applied mathematics and modeling. Formulation of models for phenomena in science and engineering, their solutions, and physical interpretation of results. Examples chosen from solid and fluid mechanics, mechanical systems, diffusion phenomena, traffic flow, and biological processes.

MATH 44400 Foundations of Analysis (3 cr.) P: MATH 26100. Set theory, mathematical induction, real numbers, completeness axiom, open and closed sets in Rm, sequences, limits, continuity and uniform continuity, inverse functions, differentiation of functions of one and several variables.

MATH 44500 Foundations of Analysis II (3 cr.) P: MATH 44400. Continuation of differentiation, the mean value theorem and applications, the inverse and implicit function theorems, the Riemann integral, the fundamental theorem of calculus, point-wise and uniform convergence, convergence of infinite series, and series of functions.

MATH 45300 Beginning Abstract Algebra (3 cr.) P: MATH 35100. Basic properties of groups, rings,and fields, with special emphasis on polynomial rings.

MATH 45400 Galois Theory (3 cr.) P: MATH 45300. An introduction to Galois Theory, covering both its origins in the theory of roots of polynomial equation and its modern formulation in terms of abstract algebra. Topics include field extensions and their symmetries, ruler and compass constructions, solvable groups, and the solvability of polynomial equations by radical operations.

MATH 45600 Introduction to the Theory of Numbers (3 cr.) P: MATH 26100. Divisibility, congruences, quadratic residues, Diophantine equations, and the sequence of primes.

EDUC-M 457 Methods of Teaching Senior High/Junior High/Middle School Mathematics (3 cr.) P: 30 credit hours of mathematics. Study of methodology, heuristics of problem solving, curriculum design, instructional computing, professional affiliations, and teaching of daily lessons in the domain of secondary and/or junior high/ middle school mathematics.

MATH 46200 Elementary Differential Geometry (3 cr.) P: MATH 35100. Calculus and linear algebra applied to the study of curves and surfaces. Curvature and torsion, Frenet-Serret apparatus and theorem, and fundamental theorem of curves. Transformation of R2, first and second fundamental forms of surfaces, geodesics, parallel translation, isometries, and fundamental theorem of surfaces.

MATH 46300 Intermediate Euclidean Geometry for Secondary Teachers (3 cr.) P: MATH 30000. History of geometry. Ruler and compass constructions, and a critique of Euclid. The axiomatic method, models, and incidence geometry. Presentation, discussion and comparison of Hilbert's, Birkhoff's, and SMSG's axiomatic developments. Discussion of the teaching of Euclidean geometry.

MATH 49000 Topics in Mathematics for Undergraduates (1-5 cr.) P: By arrangement. Open to students only with the consent of the department. Supervised reading and reports in various fields.

MATH 49100 Seminar in Competitive Math Problem-Solving (1-3 cr.) P: Approval of the director of undergraduate programs is required. This seminar is designed to prepare students for various national and regional mathematics contests and examinations such as the Putnam Mathematical Competition, the Indiana College Mathematical Competition and the Mathematical

Contest in Modeling (MCM), among others. May be repeated twice for credit.

MATH 49200 Capstone Experience (1-3 cr.) By arrangement. Must submit Course Request Form.

MATH 49500 TA Instruction (0 cr.) For teaching assistants. Intended to help prepare TAs to teach by giving them the opportunity to present elementary topics in a classroom setting under the supervision of an experienced teacher who critiques the presentations.

Advanced Undergraduate and Graduate

MATH 50400 Real Analysis (3 cr.) P: MATH 44400 Completeness of the real number system, basic topological properties, compactness, sequences and series, absolute convergence of series, rearrangement of series, properties of continuous functions, the Riemann-Stieltjes integral, sequences and series of functions, uniform convergence, the Stone-Weierstrass theorem, equicontinuity, and the Arzela-Ascoli theorem.

MATH 50500 Intermediate Abstract Algebra (3 cr.) P: 45300. Group theory with emphasis on concrete examples and applications. Field theory: ruler and compass constructions, Galois theory, and solvability of equations by radicals.

MATH 51000 Vector Calculus (3 cr.) P: 26100. Calculus of functions of several variables and of vector fields in orthogonal coordinate systems. Optimization problems, implicit function theorem, Green's theorem, Stokes's theorem, divergence theorems, and applications to engineering and the physical sciences.

MATH 51100 Linear Algebra with Applications (3 cr.) P: 26100. Not open to students with credit in MATH 35100. Matrices, rank and inverse of a matrix, decomposition theorems, eigenvectors, unitary and similarity transformations on matrices.

MATH 51400 Numerical Analysis (3 cr.) P: MATH 26600 and MATH 35100 or MATH 51100, or consent of instructor and familiarity with one of the high-level programming languages: Fortran 77/90/95, C, C++, Matlab. Numerical Analysis is concerned with finding numerical solutions to problems, especially those for which analytical solutions do not exist or are not readily obtainable. This course provides an introduction to the subject and treats the topics of approximating functions by polynomials, solving linear systems of equations, and of solving nonlinear equations. These topics are of great practical importance in science, engineering and finance, and also have intrinsic mathematical interest. The course concentrates on theoretical analysis and on the development of practical algorithms.

MATH 51800 Advanced Discrete Mathematics (3 cr.) P: 26600. This course covers mathematics useful in analyzing computer algorithms. Topics include recurrence relations, evaluation of sums, integer functions, elementary number theory, binomial coefficients, generating functions, discrete probability, and asymptotic methods.

MATH 52000 Boundary Value Problems of Differential Equations (3 cr.) P: 26100 and 26600. Sturm-Liouville theory, singular boundary conditions, orthogonal expansions, separation of variables in partial differential equations, and spherical harmonics.

MATH 52200 Qualitative Theory of Differential Equations (3 cr.) P: 26600 and 35100. Nonlinear ODEs, critical points, stability and bifurcations, perturbations, averaging, nonlinear oscillations and chaos, and Hamiltonian systems.

MATH 52300 Introduction to Partial Differential Equations (3 cr.) P: 26600 and 26100 or 51000. Method of characteristics for quasilinear first-order equations, complete integral, Cauchy-Kowalewsky theory, classification of second-order equations in two variables, canonical forms, difference methods of hyperbolic and parabolic equations, and Poisson integral method for elliptic equations.

MATH 52500 Introduction to Complex Analysis (3 cr.) P: MATH 26100 and MATH 26600. Instructor consent required for any undergraduate student. Complex numbers and complex-valued functions; differentiation of complex functions; power series, uniform convergence; integration, contour integrals; and elementary conformal mapping.

MATH 52600 Principles of Mathematical Modeling (3 cr.) P: MATH 26600 and MATH 42600 Ordinary and partial differential equations of physical problems, simplification, dimensional analysis, scaling, regular and singular perturbation theory, variational formulation of physical problems, continuum mechanics, and fluid flow.

MATH 52800 Advanced Mathematics for Engineering and Physics II (3 cr.) P: MATH 53700 Divergence theorem, Stokes' Theorem, complex variables, contour integration, calculus of residues and applications, conformal mapping, and potential theory.

MATH 53000 Functions of a Complex Variable I (3 cr.) P or C: MATH 54400. Complex numbers, holomorphic functions, harmonic functions, and linear transformations. Power series, elementary functions, Riemann surfaces, contour integration, Cauchy's theorem, Taylor and Laurent series, and residues. Maximum and argument principles. Special topics.

MATH 53100 Functions of a Complex Variable II (3 cr.) P: MATH 53000 Compactness and convergence in the space of analytic functions, Riemann mapping theorem, Weierstrass factorization theorem, Runge's theorem, Mittag-Leffler theorem, analytic continuation and Riemann surfaces, and Picard theorems.

MATH 53500 Theoretical Mechanics (3 cr.) P: MATH 26600 and MATH 35100 or MATH 51100 or consent of the instructor. Continuum mechanics deals with the analysis of the motion of materials modeled as a continuous mass rather than as discrete particles. Applications of continuum mechanics are ubiquitous in science and engineering, and are getting more and more popular in medicine too. The goal of this course is to study the basic principles of continuum mechanics for deformable bodies, including conservation laws and constitutive equations, while discussing the mathematical challenges in solving these equations analytically and/or numerically.

MATH 53700 Applied Mathematics for Scientists and Engineers I (3 cr.) P: MATH 26100 and MATH 26600. Covers theories, techniques, and applications of partial

differential equations, Fourier transforms, and Laplace transforms. Overall emphasis is on applications to physical problems.

MATH 54400 Real Analysis and Measure Theory (3 cr.) P: MATH 44400 Algebras of sets, real number system, Lebesgue measure, measurable functions, Lebesgue integration, differentiation, absolute continuity, Banach spaces, metric spaces, general measure and integration theory, and Riesz representation theorem.

MATH 54500 Principles of Analysis II (3 cr.) P: MATH 54400 Continues the study of measure theory begun in 54400.

MATH 54600 Introduction to Functional Analysis (3 cr.) P: MATH 54500 Banach spaces, Hahn-Banach theorem, uniform boundedness principle, closed graph theorem, open mapping theorem, weak topology, and Hilbert spaces.

MATH 54700 Analysis for Teachers I (3 cr.) P: MATH 26100 Set theory, logic, relations, functions, Cauchy's inequality, metric spaces, neighborhoods, and Cauchy sequence.

MATH 54900 Applied Mathematics for Secondary School Teachers (3 cr.) P: MATH 26600 and MATH 35100. Applications of mathematics to problems in the physical sciences, social sciences, and the arts. Content varies. May be repeated for credit with the consent of the instructor. Course is offered on an as needed basis.

MATH 55200 Applied Computational Methods II (3 cr.) P: 55900 and consent of instructor. The first part of the course focuses on numerical integration techniques and methods for ODEs. The second part concentrates on numerical methods for PDEs based on finite difference techniques with brief surveys of finite element and spectral methods.

MATH 55300 Introduction to Abstract Algebra (3 cr.) P: 45300 Group theory: finite abelian groups, symmetric groups, Sylow theorems, solvable groups, Jordan-Holder theorem. Ring theory: prime and maximal ideals, unique factorization rings, principal ideal domains, Euclidean rings, and factorization in polynomial and Euclidean rings. Field theory: finite fields, Galois theory, and solvability by radicals.

MATH 55400 Linear Algebra (3 cr.) P: 35100. Review of basics: vector spaces, dimension, linear maps, matrices, determinants, and linear equations. Bilinear forms, inner product spaces, spectral theory, and eigenvalues. Modules over principal ideal domain, finitely generated abelian groups, and Jordan and rational canonical forms for a linear transformation.

MATH 55555 Introduction to Biomathematics (3 cr.) P: MATH 26600, MATH 35100 (or MATH 51100), MATH 42600, or consent of instructor. The class will explore how mathematical methods can be applied to study problems in life-sciences. No prior knowledge of life-sciences is required. Wide areas of mathematical biology will be covered at an introductory level. Several selected topics, such as dynamical systems and partial differential equations in neuroscience and physiology, and mathematical modeling of biological flows and tissues, will be explored in depth.

MATH 55900 Applied Computational Methods I (3 cr.) P: 26600 and 35100 or 51100. Computer arithmetic, interpolation methods, methods for nonlinear equations, methods for solving linear systems, special methods for special matrices, linear least square methods, methods for computing eigenvalues, iterative methods for linear systems; methods for systems of nonlinear equations.

MATH 56100 Projective Geometry (3 cr.) P: 35100. Projective invariants, Desargues' theorem, cross-ratio, axiomatic foundation, duality, consistency, independence, coordinates, and conics.

MATH 56200 Introduction to Differential Geometry and Topology (3 cr.) P: 35100 and 44500. Smooth manifolds, tangent vectors, inverse and implicit function theorems, submanifolds, vector fields, integral curves, differential forms, the exterior derivative, DeRham cohomology groups, surfaces in E3, Gaussian curvature, two-dimensional Riemannian geometry, and Gauss-Bonnet and Poincare theorems on vector fields.

MATH 56300 Advanced Geometry (3 cr.) P: 30000 or consent of instructor. Topics in Euclidean and non-Euclidean geometry.

MATH 56700 Dynamical Systems I (3 cr.) P: 54500 and 57100. Covers the basic notions and theorems of the theory of dynamical systems and their connections with other branches of mathematics. Topics covered include fundamental concepts and examples, one-dimensional systems, symbolic dynamics, topological entropy, hyperbolicity, structural stability, bifurcations, invariant measures, and ergodicity.

MATH 57100 Elementary Topology (3 cr.) P: 44400. Topological spaces, metric spaces, continuity, compactness, connectedness, separation axioms, nets, and function spaces.

MATH 57200 Introduction to Algebraic Topology (3 cr.) P: 57100. Singular homology theory, Ellenberg-Steenrod axioms, simplicial and cell complexes, elementary homotopy theory, and Lefschetz fixed point theorem.

MATH 57400 Mathematical Physics I (1-3 cr.) P: 53000 and 54500. Covers the basic concepts and theorems of mathematical theories that have direct applications to physics. Topics to be covered include special functions ODEs and PDEs of mathematical physics, groups and manifolds, mathematical foundations of statistical physics.

MATH 57800 Mathematical Modeling of Physical Systems I (3 cr.) P: 26600, PHYS 15200, PHYS 25100, and consent of instructor. Linear systems modeling, mass-spring-damper systems, free and forced vibrations, applications to automobile suspension, accelerometer, seismograph, etc., RLC circuits, passive and active filters, applications to crossover networks and equalizers, nonlinear systems, stability and bifurcation, dynamics of a nonlinear pendulum, van der Pol oscillator, chemical reactor, etc., introduction to chaotic dynamics, identifying chaos, chaos suppression and control, computer simulations, and laboratory experiments.

MATH 58100 Introduction to Logic for Teachers (3 cr.) P: 35100. Logical connectives, rules of sentential inference, quantifiers, bound and free variables, rules of

inference, interpretations and validity, theorems in group theory, and introduction to set theory.

MATH 58300 History of Elementary Mathematics (3 cr.) P: 26100. A survey and treatment of the content of major developments of mathematics through the eighteenth century, with selected topics from more recent mathematics, including non-Euclidean geometry and the axiomatic method.

MATH 58500 Mathematical Logic I (3 cr.) P: MATH 35100 or an undergraduate proof course; MATH 58700 recommended. Formal theories for propositional and predicate calculus with study of models, completeness, and compactness. Formalization of elementary number theory; Turing machines, halting problem, and the undecidability of arithmetic.

MATH 58700 General Set Theory (3 cr.) P: MATH 35100 or equivalent proof course in Linear Algebra. An introduction to set theory, including both so-called "naive" and formal approaches, leading to a careful development using the Zermelo-Fraenkel axioms for set theory and an in-depth discussion of cardinal and ordinal numbers, the Axiom of Choice, and the Continuum Hypothesis.

MATH 58800 Mathematical Modeling of Physical Systems II (3 cr.) P: 57800. Depending on the interests of the students, the content may vary from year to year. Emphasis will be on mathematical modeling of a variety of physical systems. Topics will be chosen from the volumes Mathematics in Industrial Problems by Avner Friedman. Researchers from local industries will be invited to present real-world applications. Each student will undertake a project in consultation with one of the instructors or an industrial researcher.

MATH 59800 Topics in Mathematics (1 - 6 cr.) By arrangement. Directed study and reports for students who wish to undertake individual reading and study on approved topics.

Graduate

MATH 61100 Methods of Applied Mathematics I (3 cr.) P: consent of instructor. Introduction to Banach and Hilbert spaces, linear integral equations with Hilbert-Schmidt kernels, eigenfunction expansions, and Fourier transforms.

MATH 61200 Methods of Applied Mathematics II (3 cr.) P: 61100. Continuation of theory of linear integral equations; Sturm-Liouville and Weyl theory for second-order differential operators, distributions in n dimensions, and Fourier transforms.

MATH 62600 Mathematical Formulation of Physical Problems I (3 cr.) P: Advanced calculus or vector calculus, partial differential equations, linear algebra. Nature of applied mathematics, deterministic systems and ordinary differential equations, random processes and partial differential equations, Fourier analysis, dimensional analysis and scaling.

MATH 62700 Mathematical Formulation of Physical Problems II (3 cr.) P: MATH 62600 Theories of continuous fields, continuous medium, field equations of continuum mechanics, inviscid fluid flow, viscous flow, turbulence. Additional topics to be discussed include application of the theory of dynamical systems, methods for analysis of nonlinear ordinary and partial differential equations, and others. This course is an advancement of topics covered in MATH 62600.

MATH 64600 Functional Analysis (3 cr.) P: 54600. Advanced topics in functional analysis, varying from year to year at the discretion of the instructor.

MATH 66700 Dynamical Systems II (3 cr.) P: 56700. Topics in dynamics. Continuation of MATH 56700.

MATH 67200 Algebraic Topology I (3 cr.) P: 57200. Continuation of 57200; cohomology, homotopy groups, fibrations, and further topics.

MATH 67300 Algebraic Topology II (3 cr.) P: 67200. continuation of 67200, covering further advanced topics in algebraic and differential topology such as K-theory and characteristic classes.

MATH 67400 Mathematical Physics II (3 cr.) P: 57400. MATH 67400 is a continuation of MATH 57400, Mathematical Physics I. Students should learn more advanced notions and theorems of various mathematical theories that have direct applications to physics.

MATH 69200 Topics in Applied Mathematics (1-3 cr.) Research topics of current interest in applied mathematics to be chosen by the instructor.

MATH 69300 Topics in Analysis (1-3 cr.) P: Department consent required. Research topics in analysis and their relationships to other branches of mathematics. Topics of current interest will be chosen by the instructor.

MATH 69400 Topics in Differential Equations (1-3 cr.) P: MATH 55400 and MATH 53000. Department consent required. Research topics in differential equations related to physics and engineering. Topics of current interest will be chosen by the instructor.

MATH 69700 Topics in Topology (1-3 cr.) Research topics in topology and their relationships to other branches of mathematics. Topics of current interest will be chosen by the instructor.

MATH 69900 Research Ph.D. Thesis (Arr. cr.)

Neuroscience

NSCI-B 101 Exploring the Brain: Introduction to Neuroscience for Non-Majors (3 cr.) This course will help students understand normal brain function and the diseased, drug affected, damaged or cognitively compromised brain. Emphasis is placed on maintaining healthy brain function and maximizing performance. NSCI-B101 is a non-majors introductory course for first-year and sophomore students. Students planning to major/minor in neuroscience must take NSCI-B201.

NSCI-B 201 Foundations of Neuroscience (3 cr.) P: PSY-B110 or BIOL-K101. An introduction to Neuroscience that explores how our brains develop, how they work and how they are changed by life experiences. Topics include neural communication, localization of brain function, neural systems and control behavior.

NSCI-B 201 Foundations of Neuroscience (3 cr.) P: PSY-B110 or BIOL-K101. An introduction to Neuroscience that explores how our brains develop, how they work and how they are changed by life experiences. Topics include neural communication, localization of brain function, neural systems and control behavior.

NSCI-B 394 Drugs and Behavior (3 cr.) P: PSY-B110 or equivalent ntroduction to the use and abuse of alcohol and other psychoactive drugs. Topics include theories of alcohol and other drug use, neurobiology and the factors that influence use, abuse, and addiction. Addiction assessment, recovery, treatment, relapse and prevention are also covered.

NSCI-N 397 Understanding Drug Culture Study Abroad (0-3 cr.) C: PSY-B394 Introduction to issues surrounding substance use and mental health in a host country. Emphasis on low-and middle-income countries. Investigate barriers to solving problems of alcohol/drug abuse, mental health treatment and economic and social causal factors. Research addiction issues, examine roles of local and national governments, international agencies, and third-party interventionists.

NSCI-B 398 Brain Mechanisms of Behavior (3 cr.) P: PSY-B301 or PSY-B320 or equivalent An advanced topical survey of the neurobiological basis of behavior, focusing on the neural substrates and the cellular and neurochemical processes underlying emotions, motivation and goal-directed behavior, hedonic experience, learning, and cognitive function. Integrates experimental research across different levels of analysis (genetic, molecular, cellular, neural systems).

NSCI-K 416 Cellular and Molecular Neuroscience (3 cr.) P: BIOL-K324 Course provides an in-depth analysis of topics within the field of cellular and molecular neuroscience. It will cover invertebrate and vertebrate neurobiology, cell and molecular biology of the neuron, neurophysiology, neuroanatomy, developmental neurobiology, regeneration and degeneration, learning and memory, and will include comparisons of neural mechanisms throughout the animal kingdom.

NSCI-K 451 Neuropharmacology (3 cr.) P: BIOL-K324 recommended or completion of upper-level biochemistry course. Focuses on molecular underpinnings of neuropharmacology. Basic principles of neuropharmacology. How drugs bind to their targets. Evaluate how neurons communicate with each other and how those signals are transduced on a molecular level. Evaluate drugs actions in the brain and major neurotransmitters. Neuronal dysfunction in various disorders and pharmacological treatments.

NSCI-K 488 Endocrinology in Health and Disease (3 cr.) P: BIOL-K103 and BIOL-K324 and BIOL-K322 or equivalent. An introduction to human endocrinology, including the biology of the major endocrine organs and the roles of the hormones that they release. Both normal endocrine function and common diseases involving hormone physiology are examined. In addition, the course examines how endocrinology impacts everyday life.

NSCI-N 491 Capstone Laboratory in Behavioral Neuroscience (3 cr.) P: NSCI-B201 or NSCI-B301 Senior neuroscience majors. Enhance critical thinking skills in experimental approaches to behavioral neuroscience, understand translational neuroscience through model systems, advance understanding of quantitative and analytic approaches studying the links between brain and behavior, ability to evaluate and communicate knowledge about neuroscience, develop skills in collaborative learning, generate career development tools.

NSCI-N 492 Capstone in Computational Neuroscience (3 cr.) P: (NSCI-B301 or PSY-B301) and PSY-B305 and (MATH 16600 or MATH-S166 or MATH 22200 or MATH 23200) and (CSCI-N200 or CSCI-N201 or CSCI-N207 or CSCI 23000) How does the brain perform the computations necessary to facilitate the vast array of experiences and cognitive functions that we are capable of? Discussion of approaches used to measure neural activity and an introduction to neural computation. Topics will have broad application across numerous scientific fields from medicine to computing.

NSCI-I 535 Clinical Neuroscience (3 cr.) P: Consent of instructor. Course will examine how psychology, neuroscience, pharmacology, and medicine come together to manage mental illness. Systematic examination of mental illness and the nature of how biological alterations lead to aberrant behaviors that define psychopathology. The course will heavily discuss the ethics involved in the field of Clinical Neuroscience.

NSCI-I 545 Psychopharmacology (3 cr.) P: PSY 61500 or consent of instructor. A survey of the effects of drugs on behavior, cognitive functioning and emotions. Emphasis on the practical advantages of understanding how psychotropic drugs work, and on how the brain functions in health and disease. Students will be exposed to the most current theories and research in the field.

NSCI-I 560 Behavioral Genetics (3 cr.) Surveys techniques to assess quantitative genetic influences on behavior of animals and humans; presents an overview of knowledge from studies. Emphasis on phenotypes relevant to the addictions and traits like intelligence and personality. Students critically evaluate and synthesize literature to become educated consumers and potentially researchers in this emerging area.

NSCI 54410 Sensory Systems (3 cr.) P: BIOL-K324 Students will gain an undertanding of the mechanims that underlie sensory perception at the moleular, cellular, and systems level. Examination of how forms of energy are transduced into the electrochemical messages of the nervous system, pathways the information travels within the nervous system and how this information is processed/perceived.

NSCI 55900 Endocrinology (3 cr.) P: BIOL 55600 or equivalent and CHEM-C342. The study of hormone function. Consideration will be given to the role of hormones in growth, development, metabolism, homeostasis, and reproduction.

NSCI 56010 Clinical and Molecular Aspects of Neurodegenerative Diseases (3 cr.) P: BIOL-K416 or BIOL-K451 or equivalent or consent of instructor. The molecular and clinical aspects of neurodegenerative diseases. Introduction of critical brain structures, with a focus on neurons and glia and evaluation of molecular mechanisms that underlie protein aggregation and cell death. The remainder of the course will focus on the multiple aspects of specific neurodegenerative diseases.

NSCI 56100 Immunology (3 cr.) P: BIOL-K103 and CHEM-C341. Introduction to the basic principles and experimentation in cellular and humoral immunology.

NSCI 57100 Developmental Neurobiology (3 cr.) P: Consent of instructor. The major phases of nervous

system development beginning with neurolation and neurogenesis and ending with the onset of physiological actiity will be studied in a variety of animals, mainly avians and mammals (including man). Neural developmental disorders and behavioral ontogeny will also be considered.

Statistics

Undergraduate

STAT 19000 Topics in Statistics for Undergraduates (1-5 cr.) Supervised reading course or special topics course at the freshman level. Prerequisites and course material vary with the topic.

STAT 29000 Topics in Statistics for Undergraduates (3 cr.) Supervised reading course or special topics course at the sophomore level. Prerequisites and course material vary with the topic.

STAT 30100 Elementary Statistical Methods I (3 cr.) P: MATH 11000 or 11100 taken within last 3 terms with a grade of C or better or an appropriate ALEKS placement score. Not open to students in the Department of Mathematical Sciences. Introduction to statistical methods with applications to diverse fields. Emphasis on understanding and interpreting standard techniques. Data analysis for one and several variables, design of samples and experiments, basic probability, sampling distributions, confidence intervals and significance tests for means and proportions, and correlation and regression. Software is used throughout.

STAT 35000 Introduction to Statistics (3 cr.) P: MATH 16600. A data-oriented introduction to the fundamental concepts and methods of applied statistics. The course is intended primarily for majors in the mathematical sciences (mathematics, actuarial sciences, mathematics education). The objective is to acquaint the students with the essential ideas and methods of statistical analysis for data in simple settings. It covers material similar to that of 51100 but with emphasis on more data-analytic material. Includes a weekly computing laboratory using Minitab.

STAT 37100 Prep for Actuarial Exam I (2 cr.) This course is intended to help actuarial students prepare for the SOA/CAS Exam P/1.

STAT 39000 Topics in Statistics for Undergraduates (3 cr.) Supervised reading course or special topics course at the junior level. Prerequisites and course material vary with the topic.

STAT 41600 Probability (3 cr.) P: MATH 26100. An introduction to mathematical probability suitable as preparation for actuarial science, statistical theory, and mathematical modeling. General probability rules, conditional probability, Bayes theorem, discrete and continuous random variables, moments and moment generating functions, continuous distributions and their properties, law of large numbers, and central limit theorem.

STAT 41700 Statistical Theory (3 cr.) P: STAT 41600. C: STAT 35000. An introduction to the mathematical theory of statistical inference, emphasizing inference for standard parametric families of distributions. Properties of estimators. Bayes and maximum likelihood estimation. Sufficient statistics. Properties of test of hypotheses. Most powerful and likelihood-ratio tests. Distribution theory for common statistics based on normal distributions.

STAT 42100 Modern Statistical Modeling Using R and SAS (3 cr.) P: STAT 41700 or equivalent. An introductory course on statistical computation. The primary goals of this course are (i) to introduce popular statistical software SAS and R and to develop basic data analysis skills, and (ii) to introduce basic statistical computation methods used in applications.

STAT 43200 Introduction to Stochastic Process and Probability Modeling (3 cr.) P: STAT 41600 or equivalent. The course builds on elementary probability theory and introduces stochastic processes applied to the study of phenomena in fields such as engineering, computer science, management science, the life, physical and social sciences, and operations research. The approach is heuristic and non-rigorous. It develops students' intuitive feel for the subject and enables them to think probabilistically. Computation is emphasized and requires use of software such as Excel, MINITAB, and R.

STAT 43301 Introduction to Nonparametric Statistics (3 cr.) P: STAT 41700 and STAT 42100 or equivalents. The course acquaints students with rank-based, permutation-based and resampling-based methods of statistical analysis used in widely applicable settings where the data do not follow parametric models. It extends techniques taught in STAT 35000/51100, where the normal theory is assumed, to situations where the normal theory does not hold. It includes computer projects which use statistical software such as R and SAS.

STAT 47200 Actuarial Models I (3 cr.) P: STAT 41700 or equivalent. Mathematical foundations of actuarial science emphasizing probability models for life contingencies as the basis for analyzing life insurance and life annuities and determining premiums. This course, together with its sequel, STAT 47300, provides most of the background for Exams MLC and MFE of the Society of Actuaries.

STAT 47300 Actuarial Models II (3 cr.) P: STAT 47200. Continuation of 47200. Together, these courses cover contingent payment models, survival models, frequency and severity models, compound distribution models, simulation models, stochastic process models, and ruin models.

STAT 47900 Loss Models (3 cr.) P: STAT 41700 and STAT 47200 and STAT 47300. This material provides an introduction to modeling and covers important actuarial methods that are useful in modeling. Students will be introduced to survival, severity, frequency and aggregate models, and use statistical methods to estimate parameters of such models given sample data. The student will further learn to identify steps in the modeling process, understand the underlying assumptions implicit in each family of models, recognize which assumptions are applicable in a given business application, and appropriately adjust the models for impact of insurance coverage modifications. The student will be introduced to a variety of tools for the calibration and evaluation of the models. Permission of instructor required.

STAT 48000 Credibility and Simulation (3 cr.) P: STAT 47900 A continuation of the material covered in STAT 47900, including Credibility Theory and Simulation calibration and evaluation of the models.

STAT 49000 Topics in Statistics for Undergraduates (1-5 cr.) Supervised reading and reports in various fields.

STAT N501 Statistical Methods for Health Sciences (3 cr.) P: MATH 15300 An introductory statistical methods course, with emphasis on applications in the health sciences. Topics include descriptive statistics, probability distributions, sampling distributions, confidence interval estimation, hypothesis testing, analysis of variance, linear regression, goodness-of-fit tests, and contingency tables.

STAT-S 351 Honors Introduction to Statistics (3 cr.) P: MATH 16600 This course introduces the basic concepts and methods of applied statistics in all areas of science and engineering. Three distinctive features of this honors course are: (1) self-learning and discovery of concepts and methods of statistical analysis through guided instructions, literature search, derivation and simulation; (2) classroom participation - both individually and collaboratively - in active learning of difficult concepts; and (3) communicating such learning to general readers. Students will acquire a basic competence in using statistical freeware R, in presenting data visually, in analyzing data appropriately, in interpreting the results in the context of research problems, and in communicating findings in plain but impactful language to readers not trained in Statistics. STAT-S351 extends all material covered in STAT 35000 to a deeper level, and gives glimpses into some methodologies delegated to advanced courses, thereby motivating and preparing students to take advanced undergraduate statistics courses.

Advanced Undergraduate and Graduate

STAT 51100 Statistical Methods I (3 cr.) P: MATH 16500. Descriptive statistics; elementary probability; random variables and their distributions; expectation; normal, binomial, Poisson, and hypergeometric distributions; sampling distributions; estimation and testing of hypotheses; one-way analysis of variance; and correlation and regression.

STAT 51200 Applied Regression Analysis (3 cr.) P: STAT 51100. Inference in simple and multiple linear regression, estimation of model parameters, testing, and prediction. Residual analysis, diagnostics and remedial measures. Multicollinearity. Model building, stepwise, and other model selection methods. Weighted least squares. Nonlinear regression. Models with qualitative independent variables. One-way analysis of variance. Orthogonal contrasts and multiple comparison tests. Use of existing statistical computing package.

STAT 51300 Statistical Quality Control (3 cr.) P: STAT 51100. Control charts and acceptance sampling, standard acceptance plans, continuous sampling plans, sequential analysis, and response surface analysis. Use of existing statistical computing packages.

STAT 51400 Designs of Experiments (3 cr.) Fundamentals, completely randomized design, and randomized complete blocks. Latin squares, multiclassification, factorial, nested factorial, incom-plete blocks, fractional replications, confounding, general mixed factorial, split-plot, and optimum design. Use of existing statistical computing packages.

STAT 51500 Statistical Consulting Problems (1-3 cr.) P: Consent of advisor. Consultation on real-world problems involving statistical analysis under the guidance of a faculty member. A detailed written report and an oral presentation are required.

STAT 51600 Basic Probability and Applications (3 cr.) P: MATH 26100. Instructor consent required for any undergraduate student. A first course in probability intended to serve as a foundation for statistics and other applications. Intuitive background; sample spaces and random variables; joint, conditional, and marginal distributions; special distributions of statistical importance; moments and moment generating functions; statement and application of limit theorems; and introduction to Markov chains.

STAT 51700 Statistical Inference (3 cr.) P: STAT 51100 or STAT 51600. A basic course in statistical theory covering standard statistical methods and their applications. Includes unbiased, maximum likelihood, and moment estimation; confidence intervals and regions; testing hypotheses for standard distributions and contingency tables; and introduction to nonparametric tests and linear regression.

STAT 51900 Introduction to Probability (3 cr.) P: MATH 26100. Sample spaces and axioms of probability, conditional probability, independence, random variables, distribution functions, moment generating and characteristics functions, special discrete and continuous distributions--univariate and multivariate cases, normal multivariate distributions, distribution of functions of random variables, modes of convergence and limit theorems, including laws of large numbers and central limit theorem.

STAT 52000 Time Series and Applications (3 cr.) P: STAT 51900. A first course in stationary time series with applications in engineering, economics, and physical sciences. Stationarity, autocovariance function and spectrum; integral representation of a stationary time series and interpretation; linear filtering; transfer function models; estimation of spectrum; and multivariate time series. Use of existing statistical computing packages.

STAT 52100 Statistical Computing (3 cr.) C: STAT 51200 or equivalent. A broad range of topics involving the use of computers in statistical methods. Collection and organization of data for statistical analysis; transferring data between statistical applications and computing platforms; techniques in exploratory data analysis; and comparison of statistical packages.

STAT 52200 Sampling and Survey Techniques (3 cr.) P: STAT 51200. Survey designs; simple random, stratified, and systematic samples; systems of sampling; methods of estimation; ratio and regression estimates; and costs. Other related topics as time permits.

STAT 52300 Categorical Data Analysis (3 cr.) P: STAT 52800. Models generating binary and categorical response data, two-way classification tables, measures of association and agreement, goodness-of-fit tests, testing independence, large sample properties. General linear models, logistic regression, and probit and extreme value models. Loglinear models in two and higher dimensions; maximum likelihood estimation, testing goodness-of-fit, partitioning chi-square, and models for ordinal data. Model building, selection, and diagnostics. Other related topics

as time permits. Computer applications using existing statistical software.

STAT 52400 Applied Multivariate Analysis (3 cr.) Extension of univariate tests in normal populations to the multivariate case, equality of covariance matrices, multivariate analysis of variance, discriminant analysis and misclassification errors, canonical correlation, principal components, and factor analysis. Strong emphasis on the use of existing computer programs.

STAT 52500 Intermediate Statistical Methodology (3 cr.) C: STAT 52800 or equivalent, or consent of instructor. Generalized linear models, likelihood methods for data analysis, and diagnostic methods for assessing model assumptions. Methods covered include multiple regression, analysis of variance for completely randomized designs, binary and categorical response models, and hierarchical loglinear models for contingency tables.

STAT 52501 Generalized Linear Models (3 cr.) P: STAT 52800 or equivalent, or consent of instructor. Generalized linear models, likelihood methods for data analysis, and diagnostic methods for assessing model assumptions. Methods covered include multiple regression, analysis of variance for completely randomized designs, binary and categorical response models, and hierarchical loglinear models for contingency tables.

STAT 52800 Mathematical Statistics (3 cr.) P: STAT 51900. Sufficiency and completeness, the exponential family of distributions, theory of point estimation, Cramer-Rao inequality, Rao-Blackwell Theorem with applications, maximum likelihood estimation, asymptotic distributions of ML estimators, hypothesis testing, Neyman-Pearson Lemma, UMP tests, generalized likelihood ratio test, asymptotic distribution of the GLR test, and sequential probability ratio test.

STAT 52900 Applied Decision Theory and Bayesian Analysis (3 cr.) P: STAT 52800. Foundation of statistical analysis, Bayesian and decision theoretic formulation of problems; construction of utility functions and quantifications of prior information; methods of Bayesian decision and inference, with applications; empirical Bayes; combination of evidence; and game theory and minimax rules, Bayesian design, and sequential analysis. Comparison of statistical paradigms.

STAT 53200 Elements of Stochastic Processes (3 cr.) P: STAT 51900. A basic course in stochastic models including discrete and continuous time processes, Markov chains, and Brownian motion. Introduction to topics such as Gaussian processes, queues and renewal processes, and Poisson processes. Application to economic models, epidemic models, and reliability problems.

STAT 53300 Nonparametric Statistics (3 cr.) P: STAT 51600. Binomial test for dichotomous data, confidence intervals for proportions, order statistics, one-sample signed Wilcoxon rank test, two-sample Wilcoxon test, two-sample rank tests for dispersion, and Kruskal-Wallis test for one-way layout. Runs test and Kendall test for independence, one- and two-sample Kolmogorov-Smirnov tests, and nonparametric regression.

STAT 53600 Introduction to Survival Analysis (3 cr.) P: STAT 51700. Deals with the modern statistical methods for analyzing time-to-event data. Background theory is provided, but the emphasis is on the applications and the interpretations of results. Provides coverage of survivorship functions and censoring patterns; parametric models and likelihood methods, special life-time distributions; nonparametric inference, life tables, estimation of cumulative hazard functions, and the Kaplan-Meier estimator; one- and two-sample nonparametric tests for censored data; and semiparametric proportional hazards regression (Cox Regression), parameters' estimation, stratification, model fitting strategies, and model interpretations. Heavy use of statistical software such as Splus and SAS.

STAT 59800 Topics in Statistical Methods (0 - 6 cr.) P: consent of instructor. Directed study and reports for students who wish to undertake individual reading and study on approved topics.

STAT 61900 Probability Theory (3 cr.) P: STAT 51900 Probability Theory is the foundation of statistical methodologies, which is fundamental in the practice of science. From this course students will get a precise mathematical understanding of probabilities and sigma-algebras, random weak convergence, characteristic functions, the central limit theorem, Lebesgue decomposition, conditioning and martingales.

STAT 62800 Advanced Statistical Inference (3 cr.) P: STAT 51900, 52800, C: STAT 61900. Real analysis for inference, statistics and subfields, conditional expectations and probability distributions, UMP tests with applications to normal distributions and confidence sets, invariance, asymptotic theory of estimation and likelihood based inference, U-statistics, Edgeworth expansions, saddle point method.

STAT 69800 Research M.S. Thesis (6 cr.) P: Consent of advisor. M.S. thesis in Applied Statistics.

Physics

Astronomy

AST-A 100 The Solar System (3 cr.) Fall. Survey of the solar system, including the Earth, sun, moon, eclipses, planets and their satellites, comets, laws of planetary motion, etc. Discussion of the origin of the solar system, life on earth, and the possibilities of extraterrestrial life. Also astronomical instruments and celestial coordinates.

AST-A 103 Search for Life in the Universe (3 cr.) Spring. Explores the origin, nature, and history of life on Earth, prospects for life in our own and other planetary systems, extra solar planet detection, and the possibility of other technological civilizations.

AST-A 105 Stars and Galaxies (3 cr.) Spring. Survey of the universe beyond the solar system, including stars, pulsars, black holes, principles of spectroscopy and the H-R diagram, nebulae, the Milky Way, other galaxies, quasars, expanding universe, cosmology, and extraterrestrial life.

AST-A 130 Short Courses in Astronomy (1 cr.) Five-week short courses on a variety of topics in astronomy. Examples of topics include: the Big Bang, Black Holes, Astronomy from your Backyard, How to See Stars, and The Birth and Death of Our Sun.

AST-A 205 Quasars, Pulsars, Black Holes (3 cr.) P: Introductory High School mathematics. Fall, day.

For both science and non-science majors interested in astronomy. Surveys stars of all types and their life cycles. Includes the H-R diagram, star clusters, and exploration of our own sun. Discussion of relativistic effects on certain astronomical objects and on human space exploration.

Undergraduate

PHYS 01000 Pre-Physics (3 cr.) P: MATH 15900, or MATH 15300 and MATH 15400, or equivalent. Fall, Spring. For students not ready to take the algebra- and trigonometry-based courses in physics (PHYS 21800 and PHYS-P 201). Basic concepts of physics. Methods of analyzing physics problems. Setting up equations for physics problems. Interpreting information in physics problems. Analyzing and presenting the results of laboratory measurements. Extensive drill in these topics.

PHYS 10000 Physics in the Modern World (5 cr.) P: Introductory high school mathematics. Spring, day. Ideas, language, methods, and impact of physics today.

PHYS 12100 How to Solve a Problem without Solving the problem (2 cr.) P: Consent of instructor. Fall. This course teaches students how to formulate a research question and start doing research with their current knowledge. Enrollment with permission of the instructor.

PHYS 12200 How To Know When You Are Right (2 cr.) P: PHYS 12100 or consent of instructor. Spring. This course continues developing students' capabilities to perform research. Prerequisite PHYS 12100. Enrollment with the permission of the instructor.

PHYS 14000 Short Courses in Physics (1 cr.) Five-week courses on a variety of topics related to the physical world. Examples of topics include: Waves and Particles Are the Same Thing, Relativity, Quarks and Other Inhabitants of the Zoo, Why Things Work and Why They Don't, Lasers and Holography, and Physics of Star Trek.

PHYS 15200 Mechanics (4 cr.) P: or C: MATH 16600. Equiv. IU PHYS-P 221. Fall, day; Spring, day, night; Summer, day. Statics, uniform and accelerated motion; Newton's laws; circular motion; energy, momentum, and conservation principles; dynamics of rotation; gravitation and planetary motion; properties of matter; and simple harmonic and wave motion.

PHYS 15250 Honors Mechanics Seminar (1 cr.) P: Department consent. C: PHYS 15200. The primary goal of the course is to enrich the student's experience in PHYS 15200 by presenting a topic not traditionally covered in first-year physics, such as special relativity, quantum mechanics, or particle physics. The course will meet weekly for 50 minutes, during which time there will be a lecture and/or a class discussion. The course will carry honor's credit.

PHYS 20000 Our Physical Environment (3 cr.) Fall, night; Spring, night. A nonmathematical introduction to physical concepts and methods by means of examples from daily life and current technological applications.

PHYS 21800 General Physics (4 cr.) P: MATH 15900 or equivalent. Fall, night; Spring, night; Summer, day. Mechanics, conservation laws, gravitation; simple harmonic motion and waves; kinetic theory, heat, and thermodynamics for students in technology fields.

PHYS 21900 General Physics (4 cr.) P: PHYS 21800. Fall, night; Spring, night; Summer, day. Electricity, light, and modern physics.

PHYS 25100 Heat, Electricity, and Optics (5 cr.) P: Either PHYS-P 201 or PHYS 15200 and MATH 16500, MATH 16600 and MATH 17100. P or C: MATH 26100 or MATH 26600. Equiv. IU PHYS-P 222. Fall, day, night; spring, day; summer, day. Heat, kinetic theory, elementary thermodynamics, and heat transfer. Electrostatics, electrical currents and devices. Magnetism, electromagnetic radiation, optics.

PHYS 28500 Introduction to Biophysics (3 cr.) P: MATH 16600 or MATH 22200 or MATH 23200. This course is an introduction to biophysics. The goal is to present important biological phenomena from a physics perspective. Briefly, we will begin with a review of biology from single molecules to cells with an emphasis on time scales and length scales. We will subsequently explore both static and dynamical phenomena in biology.

PHYS 29000 Special Assignments (0 - 3 cr.) P: Permission of instructor required. Readings, discussions, written reports, or laboratory work selected for enrichment in special areas of physics.

PHYS 29900 Introduction to Computational Physics (2 cr.) P: PHYS 15200. Fall. Application of computational techniques to physical concepts. Topics include mechanics, oscillations, chaos, random processes, etc.

PHYS 30000 Introduction to Elementary Mathematical Physics (3 cr.) P: MATH 26100 and (PHYS-P202 or PHYS 25100) minimum grade of C-. Spring. Brief but practical introduction to various mathematical methods used in intermediate-level physics courses. Vector analysis, orthogonal coordinate systems, matrices, Fourier methods, complex numbers, special functions, and computational methods. Emphasis will be on examples and the application of these methods to physics problems.

PHYS 31000 Intermediate Mechanics (4 cr.) P: PHYS-P 202 or PHYS 25100 and PHYS 30000 or MATH 26600. Fall. For students familiar with calculus. Elements of vector algebra; statics of particles and rigid bodies; theory of couples; principle of virtual work; kinematics; dynamics of particles and rigid bodies; work, power, and energy; and elements of hydromechanics and elasticity.

PHYS 33000 Intermediate Electricity and Magnetism (3 cr.) P: PHYS-P 202 or PHYS 25100 and PHYS 30000 or MATH 26600. Spring. Electrostatics; electric currents; magnetostatics; electromagnetic induction; Maxwell's equations; electromagnetic waves.

PHYS 34200 Modern Physics (3 cr.) P: PHYS-P 202 or PHYS 25100 and MATH 26100. Equiv. IU PHYS-P 301. Spring. A survey of basic concepts and phenomena in atomic, nuclear, and solid state physics.

PHYS 35300 Advanced Physics Laboratory I: Modern Physics and Electronics (2 cr.) P: PHYS 25100. Spring. Experiments associated with advances in the early part of the 20th century to accompany PHYS 34200 and an introduction to electronic circuits and test equipment for scientists.

PHYS 40000 Physical Optics (3 cr.) P: PHYS 33000. Fall. Electromagnetic waves; wave theory of reflection,

refraction, diffraction, and interference. Spatial and temporal coherence. Fourier optics, coherent imaging, and holography. Polarization phenomena; Jones vectors and matrices.

PHYS 40100 Physical Optics Laboratory (2 cr.) P: PHYS 33000. C: PYHS 40000 (majors). Experiments to accompany PHYS 40000 in reflection, refraction, and interference using lasers. Interferometry. Diffraction patterns with emphasis on Fourier analysis and Fourier transformations. Polarization, Brewster's angle. Coherence length of lasers.

PHYS 41800 Thermal and Statistical Physics (3 cr.) P: PHYS 34200, and PHYS 31000 or PHYS 33000. Replaces PHYS 41600. Spring. Temperature, equations of state, first and second laws of thermodynamics, entropy and applications, kinetic theory, transport processes, statistical mechanics.

PHYS 44200 Quantum Mechanics (3 cr.) P: PHYS 34200, and PHYS 31000 or PHYS 33000. Fall. Inadequacies of classical physics; wave packets and Schrodinger equation, one-dimensional problems; operator formulation of quantum mechanics; linear harmonic oscillator; angular momentum; hydrogen atom; and Pauli principle and application to helium atom.

PHYS 47000 Reading in Special Topics (1-3 cr.)

PHYS 48000 Solar Energy Usage (3 cr.) P: MATH 16600 or equivalent, and two courses in general physics. Theoretical and practical aspects, including collector design, modeling of solar systems, economic evaluation of solar alternatives, and photovoltaics.

PHYS 49000 Undergraduate Reading and Research (1-3 cr.) Independent study for undergraduates.

PHYS-P 201 General Physics I (5 cr.) P: MATH 15900 or equivalent. Fall, day; Spring, night; Summer, day. Newtonian mechanics, wave motion, heat, and thermodynamics. Application of physical principles to related scientific disciplines, especially life sciences. Intended for students preparing for careers in the life sciences and the health professions. Three lectures, one discussion section, and one two-hour laboratory period each week.

PHYS-P 202 General Physics II (5 cr.) P: PHYS-P 201. Fall, night; Spring, day; Summer, day. Electricity and magnetism; geometrical and physical optics; introduction to concepts of relativity, quantum theory, and atomic and nuclear physics. Three lectures, one discussion section, and one two-hour laboratory period each week.

Advanced Undergraduate and Graduate

PHYS 50100 Physical Science (3 cr.) Fall, Spring. Survey of the physical sciences with emphasis on methods of presentation appropriate to the elementary school. Graduate credit is extended only for elementary school teacher programs.

PHYS 51000 Physical Mechanics (3 cr.) P: PHYS 31000 or equivalent, and courses in calculus and differential equations. Mechanics of particles, rigid bodies, and vibrating systems.

PHYS 51000 Thermodynamics (3 cr.) P: PHYS 31000 and PHYS 33000 and a course in differential equations or advanced calculus. Equilibrium states, the concept of heat, and the laws of thermodynamics; the existence and properties of the entropy; different thermodynamic potentials and their uses; phase diagrams; introduction of statistical mechanics and its relation to thermodynamics; and treatment of ideal gases.

PHYS 51700 Statistical Physics (3 cr.) P: PHYS 34200, PHYS 51000, and PHYS 51500 or equivalent. Laws of thermodynamics; Boltzmann and quantum statistical distributions, with applications to properties of gases, specific heats of solids, paramagnetism, black-body radiation, and Bose-Einstein condensation; Boltzmann transport equation and transport properties of gases; and Brownian motion and fluctuation phenomena.

PHYS 52000 Mathematical Physics (3 cr.) P: PHYS 31000, PHYS 32200, PHYS 33000, or consent of instructor. Vectors and vector operators, tensors, infinite series, analytic functions and the calculus of residues, partial differential equations, and special functions of mathematical physics. When interests and preparation of students permit, calculus of variations and/or group theory are covered.

PHYS 52200 Coherent Optics and Quantum Electronics (3 cr.) P: PHYS 33000, PHYS 44200, and PHYS 55000, or ME 58700. Recent experimental and theoretical developments in optics, emphasizing concepts of coherence. Fourier optics and the quantum theory of radiation. Applications to lasers and masers, nonlinear optics, holography, and quantum electronics.

PHYS 52301 Nanosystems Principles (3 cr.) P: Graduate students in Science or Engineering or undergraduate students in senior standing in Science or Engineering or instructor consent. This is the introductory course in the nanosystems area. It introduces students to the principles and applications of nanosystems. The course begins with an introduction to the nanometer scale phenomena. It then introduces students to the basic elements resulting in nanosystems: nanoscale materials, processes, and devices. It also provides students with a basic understanding of the tools and approaches that are used for the measurement and characterization of nanosystems, and their modeling and simulation. Moreover, the course covers the applications of nanosystems in a wide range of industries, including information technology, energy, medicine, and consumer goods. The course concludes with a discussion of the societal and economical significance of these applications, including benefits and potential risks.

PHYS 52601 Integrated Nanosystems Processes and Devices (3 cr.) P: PHYS 52301 This course covers processes and devices associated with integrated nanosystems. Integrated nanosystems refer to the systems that consist of integrated micro-, meso-, and/or macro-scale parts, and their core components, realized by nano-scale materials, processes, and devices.
The course, while covering processes which result in integrated nanosystems, will focus on the theory and operation of select electronic, electromechanical, and biomedical devices which are used for information technology, sensing, medical, and other applications. The lectures will be complemented by hands-on laboratory experience.

PHYS 53000 Electricity and Magnetism (3 cr.) P: PHYS 33000 or equivalent. Electrostatic problems; theory of dielectrics; theory of electric conduction; electromagnetic effects due to steady and changing currents; magnetic properties of matter; Maxwell's equations; and electromagnetic radiation.

PHYS 53300 Principles of Magnetic Resonance (3 cr.) P: PHYS 55000 or equivalent. Magnetic resonance in bulk matter; classical and quantum descriptions, relaxation, CW and pulse experiments, interactions and Hamiltonians. Magnetic interactions between electrons and nuclei; nuclear quadrupole interaction, crystal field interactions, and effect of molecular motion. High-resolution NMR spectra; EPR of free-radical solutions; and powder patterns.

PHYS 54500 Solid-State Physics (3 cr.) P: An undergraduate course in modern physics. Crystal structure; lattice vibrations; free electron theory of solids; band theory of solids; semiconductors; superconductivity; magnetism; and magnetic resonance.

PHYS 55000 Introduction to Quantum Mechanics (3 cr.) P: PHYS 34200 and at least one other junior-level course in each of mathematics and physics or equivalent. Brief historical survey; waves in classical physics; wavepackets; uncertainty principle; operators and wave functions; Schrodinger equation and application to one-dimensional problems; the hydrogen atom; electron spin; multielectron atoms; periodic table; molecules; periodic potentials; and Bloch wave functions.

PHYS 55600 Introductory Nuclear Physics (3 cr.) P: PHYS 55000 or equivalent. Theory of relativity; brief survey of systematics of nuclei and elementary particles; structure of stable nuclei; radioactivity; interaction of nuclear radiation with matter; nuclear reactions; particle accelerators; nuclear instruments; fission; and nuclear reactors.

PHYS 57000 Selected Topics in Physics (3 cr.) Specialized topics in physics selected from time to time.

PHYS 59000 Reading and Research (1-3 cr.)

PHYS 59300 Advanced Physics Laboratory (3 cr.)

Graduate

PHYS 58500 Introduction to Molecular Biophysics (3 cr.) Application concepts and methods from physics to the understanding of biological systems with a focus on proteins, lipids and nucleic acids. Introduction of experimental and theoretical techniques, including X-ray crystallography, nuclear magnetic resonance and molecular dynamics simulations in the investigation of structures, forces, dynamics and energetics of these biological molecules.

PHYS 60000 Methods of Theoretical Physics (3 cr.) P: Graduate standing in physics or consent of instructor. 600 is designed to provide first-year physics graduate students with the mathematical background for subsequent studies of advanced mechanics, electrodynamics, and quantum theory. Topics include functions of a complex variable, ordinary and partial differential equations, eigenvalue problems, and orthogonal functions. Green's functions, matrix theory, and tensor analysis in three and four dimensions.

PHYS 60100 Methods of Theoretical Physics II (3 cr.) P: PHYS 60000 or equivalent. A continuation of PHYS 60000.

PHYS 61000 Advanced Theoretical Mechanics (3 cr.) P: PHYS 51000 or equivalent. Lagrangian and Hamiltonian mechanics; variational principles; canonical transformations; Hamilton-Jacobi theory; theory of small oscillations; and Lagrangian formulation for continuous systems and field.

PHYS 61700 Statistical Mechanics (3 cr.) P: PHYS 66000 or equivalent. Classical and quantum statistical mechanics.

PHYS 63000 Advanced Theory of Electricity and Magnetism (3 cr.) P: PHYS 53000 and PHYS 60000, or equivalent. The experimental origins of Maxwell's equations. Electrostatics and magnetostatics; solution of boundary value problems. Quasistatic currents. Electromagnetic energy and momentum and the Maxwell stress tensor. Foundations of optics. Radiation from antennae, multipole expansion; waveguides.

PHYS 63100 Advanced Theory of Electricity and Magnetism (3 cr.) P: PHYS 63000 or equivalent. Covariant formulation of electrodynamics; Lienard-Wiechert potentials; radiation from accelerated particles; Cerenkov radiation; dynamics of relativistic particles; radiation damping; and introduction to magnetohydrodynamics.

PHYS 63300 Advanced Topics in Magnetic Resonance (3 cr.) P: PHYS 53300 or consent of instructor. Rotation operators, coupling of angular momenta, Wigner-Eckhart theorem, and density matrix; theory of magnetic resonance, relaxation in liquids, chemical exchange, double resonance, cross-polarization, and magic angle spinning; two-dimensional NMR, correlation spectroscopy, and exchange and NOE spectroscopies; application to biological macromolecules; time domain EPR; and lineshape under slow motion.

PHYS 66000 Quantum Mechanics I (3 cr.) P: PHYS 53000, PHYS 55000, PHYS 60000, and PHYS 61000, or equivalent. Origins of the quantum theory, the uncertainty and complementarity principles. The Schrodinger equation and its solutions for simple physical systems. Mathematical formulation of the quantum theory. Applications: simple harmonic oscillator, theory of angular momentum, and hydrogen atom. Time-independent and time-dependent perturbation theory. The Pauli exclusion principle. Spin of the electron. Elementary theory of scattering.

PHYS 66100 Quantum Mechanics II (3 cr.) P: PHYS 60100, PHYS 63000, and PHYS 66000, or equivalent. Symmetry and conservation laws. The Klein-Gordon and Dirac equations. Interaction of radiation with matter. Applications of quantum mechanics to atomic structure. Scattering theory.

PHYS 67000 Selected Topics in Physics (1-3 cr.) P: Consent of instructor. Specialized topics in physics, varied from time to time.

PHYS 68500 Physics Seminar (0-1 cr.) Offered on Pass/Fail basis only. Weekly physics seminar presented by

faculty and invited speakers from outside the department. May be repeated for credit.

PHYS 69800 Research M.S. Thesis (Arr. cr.) Research M.S. Thesis.

PHYS 69900 Research (Arr. cr.) Ph.D. thesis.

PHYS-G 901 Advanced Research (6 cr.)

Science - General

Graduate Level

SCI-I 590 Topics in Science (1-3 cr.) Consent of instructor. Directed study for students who wish to undertake individual reading and study on approved topics.

Undergraduate Level

SCI-I 120 Windows on Science (1 cr.) Fall, spring. Designed for new and prospective science majors, the course covers an integrative overview of science, examining science and society, the scientific method and community of scientists, undergraduate research, professional ethics, an exploration of science-based careers, and strategies for success as a science major.

SCI-I 190 Topics in Science (1-3 cr.) P: Prerequisites and course material vary with the topic. Fall, Spring, Summer. Topics in science and interdisciplinary fields.

SCI-I 197 Exploring Health Professions (1 cr.) Fall, Spring. Exploring Health Professions is designed to help students gain a wider and deeper understanding of the variety of health professions and how to most effectively prepare for entry into the professions. Guest speakers, readings, and class discussions provide opportunities for students to explore a variety of health fields, network with current health professionals, reflect on their interests and values, and learn ways to stand out in a competitive field.

SCI-I 200 Tutorial in Interdisciplinary Studies (1 cr.) Fall, Spring. Tutorial under the supervision of a faculty mentor to develop a proposal to pursue a plan of study focused on a science-based, interdisciplinary area. The proposal is to be submitted to the review committee for approval. Each student will maintain a journal on the progress on the plan of study.

SCI-I 220 Introduction to Research Methods (1 cr.) This course is an introduction to research. Topics include learning the language of scholarly research; research ethics; laboratory safety; and research approval processes. Students will learn how to design, write, and present research for a variety of audiences and disciplines.

SCI-I 225 Mentor-Based Research Experience (0-3 cr.) This course is designed to introduce a student to fundamental research. It will link to a program through which the student is participating, e.g. Diversity Research Scholars Program (DSRP) or Multidisciplinary Undergraduate Research Institute (MURI). May be eligible for other programs.

SCI-I 290 Intermediate Topics in Science (1-3 cr.) P: Prerequisites and course material vary with the topic. Fall, Spring, Summer. Intermediate topics in science and interdisciplinary fields.

SCI-I 294 Beginning Science-Based Internship (0-3 cr.) P: Sophomore or junior standing and program advisor approval. Fall, Spring, Summer. A semester of full- or part-time beginning internship experience in an industrial, government, or business setting matching the student's academic and career objectives. A comprehensive written report on the experience is required. Yes.

SCI-I 296 Career Planning & Success Strategies (1 cr.) This course is designed to provide tools for the student who is interested in seeking an internship or career employment after college graduation. This course will explore personal values and strategies for finding the ideal career paths based on abilities, skills, and interests. Students will explore the value of internships, and tactics for identifying and securing internship opportunities. Practical strategies for approaching the art of networking and its impact on the success of career planning and securing opportunities will be examined.

SCI-I 297 Health Professions Shadowing (1 cr.) Fall, Spring, Summer. The Health Professions Shadowing course exposes students to the healthcare field through shadowing and being mentored by a healthcare professional. Students gain hands on experience, basic healthcare knowledge and insights into the careers of medical professionals.

SCI-I 390 Advanced Topics in Science (0-3 cr.) P: Prerequisites and course material vary with the topic. Fall, Spring, Summer. Advanced topics in science and interdisciplinary fields. Prerequisites and course material vary with the topic. Yes.

SCI-I 395 Science and Health Professions Study Abroad (0-3 cr.) Fall, Spring, Summer, as needed to be scheduled with a study abroad trip. This course will provide students with a culturally rich experience. There will be two components to this class: 1. Learning about the cultural, political, historical, and science or health-related aspects of the host community through pre-trip, on-site, and post-trip mandatory classes. 2. Engaging with professionals, translators, fellow participants, and local residents/patients on the service trip to the host community focusing on science or health issues. Yes.

SCI-I 397 Pre-Professional Planning Seminar (1 cr.) Fall, Spring. This course will help sophomores and juniors prepare to apply for professional school. Topics covered will include: school selection; application overview; personal statement development; requesting letters of recommendation; interviewing; financing professional school; professionalism; and parallel planning.

SCI-I 398 Medical School Application Preparation (1 cr.) Spring. The course will prepare students for the medical school application process, including the MCAT and the application process. The application portion of the course will cover the AMCAS/AACOMAS application overview, developing and editing a personal statement, identifying and soliciting letters of recommendation, constructing experience descriptions, and interviewing. The MCAT preparation portion will focus on the four main areas of the MCAT, which include: Critical Analysis and Reasoning, Chemistry and Physics, Biology and Biochemistry, and Psychology and Sociology.

SCI-I 494 Internship in Science-Based Fields (0-6 cr.) P: Junior or senior standing and program advisor approval. Fall, Spring, Summer. A semester of full-time or part-time internship experience in an industrial,

government, or business setting matching the student's academic or career objective. A comprehensive written report on the experience is required. Yes.

SCI-I 495 Readings and Research in Science (1-3 cr.) P: Junior or senior standing, consent of instructor(s), and approval of review committee. Every semester, time arranged. Independent, interdisciplinary study and research in science and science-related fields. A major paper must be submitted. May be repeated for a maximum of 6 credit hours.

Candidate

CAND 99100 Candidate (0 cr.) If you are an undergraduate, you will be given permission to register for CAND 99100 within one week of applying for graduation. Graduate students do not require course permission to register.

Earth Science

Undergraduate Courses

GEOL-G 107 Earth and Our Environment (3 cr.) Fall, Spring, Summer. An introduction to geology through discussion of geological topics that show the influence of geology on modern society. Topics include mineral and energy resources, water resources, geologic hazards and problems, geology and health, and land use.

GEOL-G 109 Fundamentals of Earth History (3 cr.) Fall, Spring, Summer. Basic principles of earth history: geologic time, basic rock types, reconstructing past environments. Physical development of the earth: its interior, mountain formation, plate tectonics. Origin and development of life: evolution, the fossil record.

GEOL-G 110 How the Earth Works (3 cr.) Fall, Spring, Summer. Introduction to processes within and at the surface of the earth. Description, classification, and origin of minerals and rocks. The rock cycle. Internal processes: volcanism, earthquakes, crustal deformation, mountain building, plate tectonics. External processes: weathering, mass wasting, streams, glaciers, ground water, deserts, coasts.

GEOL-G 115 Oceanography (3 cr.) Fall, Spring, Summer. Nonmathematical introduction to the geology, biology, and physical characteristics of the ocean. Includes waves, tides, and currents of the world ocean, the adaptations and distribution of marine animals, pollution of the marine ecosystem, and an introduction to the global ocean/atmosphere system.

GEOL-G 117 Lab: Earth and Our Environment (1 cr.) P: or C: GEOL-G 107. Fall, Spring, Summer. Laboratory exercises in environmental aspects of the geosciences. To accompany GEOL-G 107.

GEOL-G 119 Fundamentals of Earth History Laboratory (1 cr.) P: or C: GEOL-G109 Fall, Spring. Laboratory studies of rocks, fossils, and stratigraphic principles to reconstruct past environments and interpret Earth history. To accompany GEOL-G 109.

GEOL-G 120 Lab: How the Earth Works (1 cr.) P: or C: GEOL-G 110. Fall, Spring, Summer. Laboratory studies of minerals and rocks, landscapes, and earth structures. To accompany GEOL-G 110.

GEOL-G 130 Short Courses in Earth Science (topic varies) (1 cr.) Five-week courses on a variety of topics in the earth sciences. Examples of topics include lunar and planetary geology; geology of Indiana; geology of national parks; glaciers; water; gemstones; geology of art; earthquakes and volcanoes; dinosaurs. Each short course is one credit; no topic may be taken for credit more than once.

GEOL-G 132 Environmental Issues and Solutions (3 cr.) This course is offered via the Internet, and provides experience in addressing some of the kinds of problems that arise in studies of the environment. Particular attention is given to developing skills in evaluating scientific articles; specifically, the relevance of the information in an article, the credibility of the author, and the accuracy and usefulness of the quantitative information provided. The kinds of problems considered in this course will vary from semester to semester, but will be chosen from a list that includes global warming, tropical rain forests, acid rain, water pollution, solid waste disposal, appropriate use of land, and the ability of regulations to protect the environment. Three or four such topics will be covered each semester.

GEOL-G 135 Indiana Rocks! (3 cr.) Fall, Spring, Summer. An in-depth investigation of Indiana's geology, including minerals and rocks, geologic time, mineral resources, fossils, topography, soil, water resources, and special geologic features such as the Falls of the Ohio River and Indiana Dunes.

GEOL-G 136 Lab: Indiana Rocks! (1 cr.) P: or C: GEOL-G 107 or GEOL-G 110, or GEOL-G 135. Fall, Spring, Summer. Field experiences and practical exercises in applying geologic principles and observing the geologic phenomena of Indiana. Topics may include sedimentary rocks and fossils, soils, mineral resources, hydrology, glacial history, and karst topography. Students will visit multiple park areas, complete problem solving or hands-on exercises, and submit written reports.

GEOL-G 180 Dinosaurs (3 cr.) Spring. Topics include: geologic time and the fossil record, preservation of vertebrate fossils, and how to "read" the fossil record. Dinosaur anatomy is surveyed in terms of evolutional changes. Controversies such as evolutionary paths are considered and extinction of dinosaurs is placed in the context of other mass extinctions.

GEOL-G 199 Service Learning in Geology (1 cr.) P: or C: GEOL-G 107, or GEOL-G 110, or GEOL-G 115, or GEOL-G 135. Students participate in community service projects. Completion of the project includes a paper reflecting on how the service experience contributed to their application of the principles of general education.

GEOL-G 205 Reporting Skills in Geoscience (3 cr.) P: GEOL-G 107 or GEOL-G1110 and ENG-W 131 with a minimum grade of C-. C: P or C: COMM-R110 Spring and Fall. Techniques of presenting written and oral reports from the geoscience approach. The written report: mechanics of format and illustrations, proper citation of geoscience literature, the abstract, proofreading, and editing. The oral report: effective presentation and response to audience questions, simulating a professional science meeting.

GEOL-G 221 Introductory Mineralogy (5 cr.) P: GEOL-G 110 or GEOL-G107 and CHEM-C 105 with a minimum grade of C- in each course.. Fall. Credit not given for both

GEOL-G 221 and GEOL-G 306. The assembly of minerals from atoms in nature. Atomic bonding, structures and symmetry. Control of physical properties by symmetry. Interaction of light with crystals. Crystal fields and forces driving the growth of crystals from melts to aqueous solutions. The chemistry of silicates and other minerals.

GEOL-G 222 Introductory Petrology (5 cr.) P: GEOL-G 221 with a minimum grade of C-. Spring. Credit not given for both GEOL-G 222 and GEOL-G 306. Study of the principal representatives of the major chemical groups of minerals. Emphasis on rock-forming and useful minerals, their crystal structure, chemistry, physical properties, association, and occurrence. Study of major rock types.

GEOL-G 304 Principles of Paleontology (3 cr.) P: GEOL-G 109 or GEOL-G 110 or GEOL-G335 with a minimum grade of C- or instructor consent. Spring. Biological principles applied to the fossil record. Examination of the quality of the fossil record, taxonomic principles and procedures, analytical techniques, evolutionary theory, evolution and paleoecology of species, populations and communities, diversification and extinction, paleogeography. Laboratories: systematics, stratigraphic distribution, and ecology of major fossilized invertebrate phyla.

GEOL-G 306 Earth Materials (4 cr.) P: GEOL-G 110/120 or GEOL-G 107/117, and CHEM-C 105. Spring. Credit not given for both GEOL-G 221 and GEOL-G 306 or GEOL-G 222 and GEOL-G 306. The physical and chemical properties of Earth materials, and the chemical processes that have altered them to cause Earth to evolve to its present state. This course covers properties of minerals and their identification, genesis of igneous, metamorphic and sedimentary rocks, interactions between solid Earth and the hydrosphere, and interactions between humans and the solid Earth.

GEOL-G 323 Structural Geology (5 cr.) P: GEOL-G 205 and GEOL-G 222, and GEOL-G 335 with a minimum grade of C- in each course. Fall. Nature and origin of primary and secondary structural features of the earth's crust, with emphasis on mechanics of deformation and origin, and three-dimensional problems illustrating structural concepts. Laboratory.

GEOL-G 334 Principles of Sedimentation and Stratigraphy (5 cr.) P: GEOL-G 205 and GEOL-G 222 or GEOL-G 306, and (GEOL-G 335 for Geology BA and Geology BS majors only). All prerequisite courses require a minimum grade of C-. Fall. Processes and factors influencing genesis of sedimentary particles and their deposition. Interpretation of depositional environments. Sedimentary facies and interpretation of stratigraphic record from outcrop, core sequence, and remote sensing. Laboratory. Field trip.

GEOL-G 335 Evolution of the Earth and Life (4 cr.) P: GEOL-G 110/120 or GEOL-G107/117 with a minimum grade of C- in each course. Spring. Evidence for evolution of the Earth and life in the rock record, Sequence of events, time of occurrence, rates of change. Interrelationships of principal themes: chemical evolution of the planet, evolution of the biosphere, plate tectonics, mountain building, and sea level changes. Bearing of evolution on human welfare.

GEOL-G 403 Optical Mineralogy and Petrography (3 cr.) P: GEOL-G 205 and GEOL-G 222 with a minimum grade of C- in each course. Identification of rock-forming minerals in fragments and thin sections using principles of optical crystallography and the petrographic microscope. Description of common igneous, sedimentary, and metamorphic rocks and interpretation of their genesis using hand specimens and thin sections.

GEOL-G 406 Introduction to Geochemistry (3 cr.) P: CHEM-C 106 with a minimum grade of C-, or consent of instructor. Fall. Interactions between geology, chemistry, and biology in natural systems. Explores biogeochemical processes on small scales and in terms of global cycles, as well as human impacts on biogeochemical cycling.

GEOL-G 410 Undergraduate Research in Geology (1-3 cr.) P: GEOL-G 205, junior standing, and consent of faculty mentor. Fall. Spring, Summer. Field and laboratory research in selected problems in geology. May be repeated. A total of 3 credit hours may be applied toward the degree. May be repeated. A total of 3 credit hours may be applied toward the degree.

GEOL-G 413 Introduction to Geophysics (3 cr.) Fall. Application of physics in the study of geologic and environmental problems. Theory and application of seismic, gravity, magnetic and electric methods in exploration of the Earth's subsurface, with emphasis on near-surface processes. May be repeated. A total of 3 credit hours may be applied toward the degree.

GEOL-G 415 Principles of Geomorphology (3 cr.) P: GEOL-G 205 and GEOL-G334 and (GEOL-G221 or GEOL-G306) with a minimum grade of C- in each course. Spring. Natural processes that create landforms and land-scapes. Physics and chemistry of weathering and soil formation. Dynamics of mass wasting, streams, and glaciers. Includes field and laboratory investigations.

GEOL-G 416 Economic Geology (3 cr.) P: GEOL-G 205 and GEOL-G 222, or consent of instructor. Origin, geologic occurrence, distribution, use, and conservation of important geologic natural resources: metallic minerals; industrial minerals and rocks; coal, petroleum, natural gas, and other energy resources.

GEOL-G 418 Igneous and Metamorphic Petrology (3 cr.) P: G222 or equivalent. The petrogenesis of igneous and metamorphic rocks. Both lecture and laboratory portions of the course will stress the application of modern petrographic, mineralogic, geochemical, and phase equilibria techniques to the solution of relevant petrologic problems.

GEOL-G 420 Regional Geology Field Trip (1-3 cr.) P: Consent of instructor. Summer. Field trip to selected regions for study of mineralogic, lithologic, stratigraphic, structural, paleontologic, geomorphologic, or other geological relationships.

GEOL-G 430 Principles of Hydrology (3 cr.) P: GEOL-G205 and GEOL-G117 or GEOL-G120 and MATH 15400 or MATH 15900 or MATH 16500 (or equivalent course) with a minimum grade of C- in each course and introductory Biology course. C: CHEM-C106 and PHYS-P201 or PHYS 15200 or PHYS 21800 with a minimum grade of C- in each course. Fall. An introduction

to the hydrologic cycle, reviewing processes such as precipitation, evaporation and transpiration, infiltration, runoff, streamflow and watersheds, and groundwater.

GEOL-G 431 Wetland Ecosystems (3 cr.) P: GEOL-G 430 or GEOL-G 451 with a minimum grade of C-. Fall. Wetland ecosystems will explore wetlands and their role in ecosystem function. Topics will encompass wetland definitions, geomorphic setting, functions and values, hydrology, vegetation and soils, wetland biogeochemistry, and wetland mitigation and the regulatory framework in which wetlands are treated. The course evaluates the status and trends of Indiana wetlands and types of wetlands common in Indiana.

GEOL-G 432 Stream Ecosystems (3 cr.) P: GEOL-G205 and GEOL-G117 and MATH 15400 or MATH 15900 or MATH 16500 (or equivalent) and PHYS-P201 or PHYS 15200 or PHYS 21800 and introductory Biology and CHEM-C106 with a minimum grade of C- in each course. Fall. An examination of the physical, chemical, and biological components of stream ecosystems. Fundamentals of ecosystems science are introduced. Methods for measurement, characterization, and evaluation of the physical, chemical, and biological components of stream ecosystems are taught in field and laboratory applications. Topics include fluvial geomorphology, streamflow, stream chemistry, ecosystem dynamics, water use and management, human impacts, and stream restoration.

GEOL-G 436 Earth Observation from Space (3 cr.) P: PHYS-P 202 with a minimum grade of C- or consent of instructor. Fall. This course is designed to introduce Earth observation with remote sensing. Basic knowledge and history of remote sensing are described. Elements of airborne and satellite remote sensing images necessary for basic data analysis and qualitative image interpretation are covered. Remaining lectures are dedicated to classical applications of airborne and satellite remote sensing in exploring natural world and physical Earth. The class explores in greater detail how space observation can be used to monitor and assess environmental change and to address society need. The class includes lab assignments on basic remote sensing and data interpretation.

GEOL-G 447 Planetary Geology (3 cr.) P: GEOL-G 110 with a minimum grade of C- or consent of instructor. Origin and evolution of planets. The roles of impacts and volcanism in surface dynamics, and the role of water in planetary climates.

GEOL-G 451 Principles of Hydrogeology (3 cr.) P: GEOL-G 205 and GEOL-G 117 or GEOL-G120 and MATH 16600 or MATH 22200 or MATH 23200 and PHYS-P201 or PHYS 15200 or PHYS 21800 and CHEM-C106 with a minimum grade of C- in each course.CHEM-C 106 and PHYS 15200 or PHYS-P 201 or PHYS 21800. Spring. Physical and chemical properties of water; chemical equilibria and stable isotopes in groundwaters; acid drainage, landfills, and agricultural pollution; Darcy's Law, fluid potential, unsaturated flow; fluid and aquifer properties affecting groundwater flow; fluid mass-balance equation and its application; contaminant transport.

GEOL-G 457 Paleoclimatology (3 cr.) P: GEOL-G110 or GEOL-G107 or GEOL-G115 or equivalent introductory Geology course and GEOL-G334. GEOL-G406 is recommended. Fall. A firm understanding of Earth's climatic history, including the range of natural variability and forces that drive climatic change, has become increasingly important as anthropogenic activities continue to affect this delicate system. In this class, we will learn about the fundamentals of the global climate system, how and why Earth's climate has changed through time, and the tools and methods that paleoclimatologists use to reconstruct past climates and environmental change.

GEOL-G 460 Internship in Geology (3 cr.) P: GEOL-G205 and junior or senior standing, and consent of faculty mentor. Fall, Spring, Summer. Industrial or similar experiences in geologically oriented employment. Projects jointly arranged, coordinated, and evaluated by faculty and industrial/governmental supervisors.

GEOL-G 467 Medical Geology (3 cr.) P: Senior or Graduate-Level standing in Environmental Science, Geology, Public Health, Public and Environmental Affairs, Medical Fields, Chemistry or Biology and Instructor consent. Spring. Medical Geology is the study of the interrelationship between earth processes and human health. The spatial distribution and specific processes that can change exposure to certain materials can affect human health, this class will take a detailed look at these scientific issues.

GEOL-G 477 Climate Change and Society (3 cr.) P: GEOL-G107 or GEOL-G110 and GEOL-G205 or COMM-R110 with a minimum grade of C- in each course. Spring. This course will introduce observations, physical mechanisms and consequences of climate change. Particularly, we will discuss the impacts of climate change on the nexus of food, energy and water systems.

GEOL-G 482 Environmental Microbiology (3 cr.) P: BIOL-K 101, BIOL-K 103 or consent of instructor. Spring. This class will cover basic concepts in microbiology, such as the taxonomy and cell structure of Bacteria and Archaea, microbial growth and energetics, biochemical pathways essential for the metabolism of carbon and nutrients by heterotrophs and autotrophs, and how these pathways then control global biogeochemical cycling of carbon, nitrogen, sulfur and various metals in terrestrial and aqueous environments.

GEOL-G 483 Isotope Geochemistry (3 cr.) P: CHEM-C106 with a minimum grade of C- or consent of instructor. Spring. Introduction to the theory and application of radiogenic and stable isotopes to a variety of subdisciplines in the earth sciences. Topics include geochronology, tracers, mass balance and mixing, hydrology and environmental applications, water-rock interaction, and biogeochemical cycles.

GEOL-G 486 Soil Biogeochemistry (3 cr.) P: CHEM-C106 with a minimum grade of C- or consent of instructor. Fall. Biological and geochemical processes controlling the cycling of elements in soils and freshwater sediments with emphasis on cycles of carbon, nitrogen and phosphorous.

GEOL-G 487 Remote Sensing of Global Change (3 cr.) P: PHYS-P 202 with a minimum grade of C- or instructor consent.. Spring. This course is designed to introduce the methods and strategies underlying the application of hyperspectral remote sensing in solving environmental problems in the context of global change. Basic physics for remote sensing is described. Terminologies for spectroscopic analysis and image

interpretation of environment changes variables with visible and near-infrared wavelengths and thermal infrared data are introduced. Classical examples on applications of hyperspectral remote sensing in agricultural and forest ecology, hydrology and soil sciences, terrestrial and aquatic ecology, atmosphere and urban landscapes will be discussed.

GEOL-G 488 Global Cycles (3 cr.) P: GEOL-G205 and GEOL-G221 or GEOL-G306 and BIOL-K101 or BIOL-K102 or BIOL-K103 or BIOL-K104 or BIOL-N107 or BIOL-N251 or BIOL-K341 with a minimum grade of C- in each course. Spring. The global environment is dominated by interlinking cycles of earth materials, chemicals, and biological components. This course will explore the major elements of the geochemical cycles found in the atmosphere, land, lakes, river, biota, and oceans, as well as the human impacts on these cycles. This course will take a global approach to geochemistry and environmental problems and will introduce fundamental concepts of meteorology, surficial geology (weathering, erosion, and sedimentation), biogeochemistry, limnology, and oceanography.

GEOL-G 490 Undergraduate Seminar in Geology (1-3 cr.) P: GEOL-G205 with a minimum grade of C- and junior or senior standing and consent of instructor. Readings and discussion of selected topics. May be repeated, provided different topics are studied, for a maximum of 6 credit hours.

GEOL-G 495 Senior Thesis in Geology (1 - 3 cr.) P: GEOL-G205 with a minimum grade of C- and senior standing and consent of faculty mentor. Capstone experience involving a research project. Written report required.

GEOL-G 499 Honors Research in Geology (3 cr.) P: Approval of departmental Honors Committee.

Graduate Courses

GEOL-G 502 Trace Element and Isotope Geochemistry (3 cr.) P: CHEM-C 360 or CHEM-C 361 or GEOL-G 406, or consent of instructor. Principles governing the distributions of trace elements, radioisotopes, and stable isotopes in igneous, metamorphic, or sedimentary environments. Emphasis on applications to petrology and geochronology.

GEOL-G 519 Principles of Geomorphology (3 cr.) P: GEOL-G110 or GEOL-G107 or GEOL-G115 or equivalent introductory Geology course, and GEOL-G334. GEOL-G406 is recommended. Spring. An understanding of surficial processes is critical to understanding the interaction between humans and their environment. In addition, an understanding of the connection between modern processes and modern deposits is essential to deciphering the geologic record. This course explores the link between geomorphic processes landforms and deposits. Using the scientific method, we will systematically consider fluvial (river), colluvial, aeolian, glacial, slope, weather, tectonic and karst processes; the landforms that they produce and the deposits left behind. The lab component of the course will include a mixture of in-clas and field assignments. When appropriate, students are required to process their field data, make graphs and interpret their results. A final fieldtrip will be conducted toward the end of the semester as a capstone experience.

GEOL-G 525 Glacial Geology (3 cr.) P: GEOL-G 415 or consent of instructor. Formation, dynamics, and regimen of glaciers. Erosional and depositional processes and landforms. Glaciation of North America with emphasis on stratigraphy, soils, climates, and physical changes resulting from glacial processes and environments. Field investigations and a student research project required.

GEOL-G 527 Geological Oceanography (3 cr.) P: Graduate standing, GEOL-G 334, or consent of instructor. Geological features and processes operating in the oceans; continental shelf, slope and ocean-basin geomorphology, sedimentology, structure, and composition; origin and geologic history of seawater and ocean basins; tools applied to marine geological studies.

GEOL-G 535 Quaternary Geology (3 cr.) P: GEOL-G 415 or consent of instructor. Characteristics, distribution, and origin of Pleistocene and recent deposits, stratigraphy and chronology; formation of associated landforms, landscapes, paleosols, and soils; Quaternary environments and paleoclimatic interpretation.

GEOL-G 536 Earth Observation from Space (3 cr.) P: GEOL-G222 and GEOG-G336 and PHYS-P202 This course is designed to introduce undergraduate/graduate students to the physical principles and strategies underlying the spectrocsopic analysis of remotely-sensed data. Spectral characteristcs of geologic materials at visible, near-infrared and shortwave infrared wavelengths are covered. Imaging spectroscopy is introduced and examples of appling hyperspectral remote sensing data for geologic mapping are decribed. The course includes lab assignments on reflectance spectrocsopy and image processing.

GEOL-G 545 Applied Analytical Techniques in Geology (3 cr.) P: GEOL-G 221, CHEM-C 105-106, and consent of instructor. Principles of advanced analytical techniques, including X-ray analysis, electron beam imaging and analysis, and mass spectrometry, with applications in geosciences. Lectures on theory followed by laboratory exercises. Students will complete individual or collaborative research projects.

GEOL-G 546 Planetary Remote Sensing (3 cr.) P: Previous course work in remote sensing, or consent of instructor. Application of multi-spectral data for exploration and mapping of planetary surfaces.

GEOL-G 550 Surface-Water Hydrology (3 cr.) P: GEOL-G 430 or GEOL-G 451. In-depth analysis of surface water components of hydrologic cycle: hydrometeorology, evaporation/transpiration, rainfall-runoff relationships, open-channel flow, flood hydrology, and statistical and probabilistic methods in hydrology.

GEOL-G 551 Advanced Hydrogeology (3 cr.) P: GEOL-G 430 or GEOL-G 451. Advanced treatment of concepts fundamental to subsurface hydrologic processes. Applications to groundwater resource development and environmental protection such as aquifer mechanics and well hydraulics, heterogeneity and anisotropy, ground water and surface water interactions, unsaturated flow, and tracer and contaminant transport.

GEOL-G 557 Paleoclimatology (3 cr.) P: GEOL-G110 or GEOL-G107 or GEOL-G115 or equivalent introductory geology course and GEOL-G334. GEOL-

G406 is recommended. Fall. A firm understanding of Earth's climatic history, including the range of natural variability and the forces that drive climatic change, has become increasingly important as anthropogenic activities continue to affect this delicate system. In this class, we will learn about the fundamentals of the global climate system, how and why Earth's climate has changed through time, and the tools and methods that paleoclimatologists use to reconstruct past climates and environmental change.

GEOL-G 567 Medical Geology (3 cr.) P: Senior or graduate level standing and instructor consent. Medical Geology is the study of the interrelationship between earth processes and human health. The spatial distribution and specific processes that can change exposure to certain materials can affect human health. This class will take a detailed look at these scientific issues.

GEOL-G 583 Isotope Geochemistry (3 cr.) Introduction to the theory of radiogenic and stable isotopes to a variety of subdisciplines in the earth sciences. Topics include geochronology, tracers, mass balance and mixing, hydrology and environmental applications, water-rock interaction, and biogeochemical cycles.

GEOL-G 585 Environmental Geochemistry (3 cr.) P: GEOL-G 406 or consent of instructor. Aquatic and environmental geochemistry, including freshwater and marine systems, natural and human-induced changes to geochemical systems, and the geochemical record of paleoceanographic and paleoclimatic variations.

GEOL-G 595 Data Analysis Techniques in Geoscience (3 cr.) P: STAT 30100 and CSCI-N 207, or equivalent. Application of statistical and numerical analysis techniques to geoscience data, including sampling methods, confidence intervals, least squares methods, correlation, time series analysis, and multivariate techniques. Emphasis on using a computer to solve geoscience problems.

GEOL-G 596 Topics in Applied Environmental Geology (3 cr.) P: Consent of instructor. Application of geologic principles to common environmental problems. Topics covered include waste site assessment, flood hazard analysis and mitigation, slope stability, and hydrogeology. Application of principles to problems pertaining to urban planning, earthquake-resistant design, and waste site/landfill development.

GEOL-G 621 Modeling Hydrological Systems (3 cr.) P: GEOL-G 430 or GEOL-G 451 and consent of instructor. Introduction to groundwater flow and solute transport modeling. Includes development of equations describing ground water flow and applied ground water/contaminant transport modeling, using a variety of current software packages.

GEOL-G 635 Soil Geomorphology (3 cr.) P: GEOL-G 415. Application of geomorphic principles in evaluation of weathering and soil formation; systems analysis of soil-landscape models; paleogeomorphology and paleopedology. Lectures and discussion; field and laboratory problems.

GEOL-G 640 Fluvial Geomorphology (3 cr.) P: GEOL-G 415 or consent of instructor. Survey of fluvial processes including sediment transport, bed and bank erosion, and river metamorphosis. Examination of the controls on channel form. Analysis of landform genesis with an emphasis on feature sedimentology and stratigraphy. Application of fluvial geomorphic principles to land management and restoration of riparian ecosystems.

GEOL-G 645 Carbonate Sedimentology (3 cr.) P: GEOL-G334 or consent of instructor Spring. Course focuses on origin and generation of carbonate grains, description of modern carbonate depositional environments, interpretation of ancient limestone and dolomite sequences, and carbonate diagensis.

GEOL-G 677 Climate Change and Society (3 cr.) Spring. This course will introduce observations, physical mechanisms and consequences of climate change. Particularly, we will discuss the impacts of climate change on the nexus of food, energy and water systems.

GEOL-G 686 Advanced Soil Biochemistry (3 cr.) P: GEOL-G406 Fall. This course examines the chemical, biological and physical factors controlling the weathering of minerals and the formation of soils. Topics covered include: biological and chemical properties of soils, soil classification, carbon, nitrogen and phosphorus cycling in relation to food production and environmental quality.

GEOL-G 690 Advanced Geology Seminar (Arr. cr.) P: Consent of instructor.

GEOL-G 700 Geologic Problems (1-5 cr.) P: Consent of faculty mentor. Consideration of special geologic problems.

GEOL-G 810 Thesis Research (6 cr.) P: Consent of faculty mentor. Thesis Research.