

# INDIANA UNIVERSITY

University Graduate School  
2005-2006  
Academic Bulletin

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## Biochemistry

### Indianapolis

#### Chairman

Dr. Zhong-Yin Zhang

#### Graduate Advisor

Professor Mark Goebel\*

#### Director of Biotechnology Certificate Program

Professor William Bosron\*

#### Departmental E-mail

[biochem@iupui.edu](mailto:biochem@iupui.edu)

#### Departmental URL

[www.biochemistry.iu.edu](http://www.biochemistry.iu.edu)

## Graduate Faculty

(An asterisk [\*] denotes membership in the University Graduate School faculty with the endorsement to direct doctoral dissertations.)

#### Showalter Professor

Robert A. Harris\*

#### Distinguished Professor

Robert A. Harris\*

#### Professors

David W. Allmann\*, W. Marshall Anderson\*, William F. Bosron\*, Anna A. DePaoli-Roach\*, Keith Dunker\*, Howard J. Edenberg\*, Mark G. Goebel\*, Jean Hamilton-Steinrauf\* (Emeritus), Edwin Harper\* (Emeritus), Maureen A. Harrington\*, Thomas D. Hurley\*, Hiremagalur N. Jayaram\*, Michael W. King\*, Suk-Hee Lee\*, Barth Ragatz, Roger W. Roeske\*, Arthur Schulz\* (Emeritus), Godfrey Tunnicliff\*, Ronald C. Wek\*

#### Associate Professors

Millie M. Georgiadis\*, Edward E. McKee\*, Lawrence A. Quilliam\*, Kent L. Redman,

#### Assistant Professors

Matthew S. Grow, Dipika Gupta, David Ingram, Reuben Kapur, Gattadahall Seetharamaiah, Debbie C. Thurmond, Mu Wang

#### Associate Scientist

Alexander Skurat

**Assistant Scientist**

Paresh Sanghani

**Associate Biochemistry Faculty****Distinguished Professor**

Ting Kai Li\* (Emeritus, Medicine)

**Professors**

Martin Bard\* (Biology), David Crabb\* (Medicine), Timothy DeGrado\* (Radiology), Rose Fife\* (Medicine), Larry Jones\* (Medicine), Mark Kelley\* (Pediatrics), Lawrence Lumeng\* (Medicine), William McBride Jr.\* (Neurobiology), Byron Olson\* (Dentistry), John Richardson\* (Emeritus, Chemistry, Bloomington), Christian Maxmillian Schmidt\* (Surgery), Jay Simon\* (Neurobiology), David Skalnik\* (Pediatrics), Frank Witzmann\* (Physiology), Mervin Yoder Jr.\* (Pediatrics)

**Associate Professors**

Simon Atkinson\* (Medicine), Dring Crowell\* (Biology), David Daleke\* (Bloomington), Mark Deeg\* (Medicine), Kenneth W. Dunn (Physiology), Joseph Dynlacht (Radiation Oncology), Shao-Ling Fong\* (Ophthalmology), Harikrishna Nakshatri (Surgery), David Potter (Medicine), Stephen Randall\* (Biology), Simon Rhodes (Biology), Weinian Shou (Pediatrics), James P. Walsh (Medicine), Theodore Widlanski\* (Chemistry, Bloomington)

**Adjunct Associate Professors**

Robert A. Dean (Pathology), Thomas Stephens\* (Affiliate Graduate Faculty Status), Terry Vik (Pediatrics)

**Assistant Professors**

Kristin Chun (Pediatrics), Jeffrey S. Elmendorf (Physiology), Mark Wagner, Claire E. Walczak (Bloomington)

**Assistant Scientist**

Dan Spandau (Medicine), Richard Thielen (Psychiatry)

**Adjunct Assistant Professors**

Ronald R. Bowsher\* (Affiliate Graduate Faculty Status), John W. Hawes, David Timm

**Graduate Advisor**

Professor Mark Goebel\*

**Director of Biotechnology Certificate Program**

William Bosron

**Degrees Offered**

Master of Science and Doctor of Philosophy

**Special Departmental Requirements**

(See also general University Graduate School requirements and departmental brochure.)

**Admission Requirements**

Typically, a baccalaureate degree in biology, chemistry, or physics that includes calculus and organic chemistry is required for admission. The General Test of the Graduate Record Examination is required.

## Master of Science Degree

### Course Requirements

A minimum of 30 credit hours, including the core curriculum courses B807, B810, G817, and G865 or any three core courses plus G841, G890 or G910; and at least 6 credit hours, but not more than 9 credit hours, in research. Participation in student seminar B890 is required. G505 Responsible Conduct in Research is also required.

### Final Examination

Oral, covering thesis and course work.

## Doctor of Philosophy Degree

### Course Requirements

A total of 90 credit hours, of which a minimum of 32 credit hours must be in courses other than research, including the core curriculum courses B807, B810, G817, and G865. Participation in student seminar B890 is required every semester of residence. G504 Introduction to Research Ethics is also required.

### Grades

A minimum grade point average of 3.0 (B) must be maintained in all nonresearch course work.

### Minor

A minimum of 12 credit hours in one of the following programs: life science, physical science, anatomy, biophysics, cancer biology, chemistry, diabetes, medical genetics, microbiology, neurobiology, pathology, pharmacology, physics, physiology, or toxicology.

### Qualifying Examinations

Students meet once every six months with an advisory committee to review progress in course work and the dissertation research proposal. Usually, at the completion of the second semester of study, students sit for a written qualifying examination. The final examination in the series is an oral defense of a written research proposal. The nature of the examination over the minor is determined by the member of the advisory committee representing that area. It may consist of a separate examination but is usually part of the written and oral examinations. Continuation of a student in the program depends upon satisfactory performance and progress in each phase of the program.

### Dissertation

A minimum of 45 credit hours in research, completed with a grade point average of 3.0 (B) or above. It is expected that the dissertation will qualify for publication in a recognized journal.

### Final Examination

Oral, covering dissertation, major, and minor.

### Minor in Molecular Biology

See entry under Microbiology and Immunology.

### Minor in Life Science

A minimum of 12 credit hours outside the student's major department, chosen from the biological sciences or from the following departments: anatomy, biochemistry, biophysics, dental sciences, medical genetics, microbiology, pathology, pharmacology, physiology, toxicology. At least 6 credit hours must be taken in one of the listed departments or in the biological sciences. The minor program must be approved by the student's advisory committee, the minor representative on which must be selected from one of the departments in which courses for the minor are taken.

### Minor in Cancer Biology

Cancer Biology Training Program (CBTP) faculty are members of the Indiana University Cancer Center, the matrix organization for an extensive range of cancer efforts and activities. Ongoing NIH- and ACS-funded

research programs focus on Regulation of Cell Growth, Hematopoiesis, Experimental Therapeutics, Adult Oncology, and Pediatric Oncology. CBTP students will fulfill the requirements of their individual basic science departments and complete the cancer biology minor.

### **Minor in Diabetes and Obesity**

Preceptors with diabetes-related projects are selected from the basic science department graduate programs or interdisciplinary programs. A minimum of 12 credit hours outside of the student's major department including G805 Diabetes and Obesity. At least one credit of G504 Introduction to Research Ethics must also be taken. Other courses are selected from the following list:

**B800 Medical Biochemistry (3 cr.)**  
**B807 Protein Structure and Function (3 cr.)**  
**B810 Cellular Biochemistry and Regulation (3 cr.)**  
**C603 General Pathology (6 cr.)**  
**G817 Cell Biology (2 cr.)**  
**G818 Cellular and Integrative Physiology (3 cr.)**  
**G706 Cell-Cell Communication (3 cr.)**  
**G865 Fundamental Molecular Biology (3 cr.)**  
**G910 Advanced Molecular Biology Methods (3 cr.)**  
**G804 Cellular and Molecular Biology (3 cr.)**  
**J840 Mechanisms of Immune Regulation (3 cr.)**  
**J805 Molecular Immunology (3 cr.)**  
**J807 Seminar in Immunology (2 cr.)**  
**F598 Drugs, Diseases and Poisons (3 cr.)**  
**F804 Introduction to Pharmacology and Toxicology I (3 cr.)**  
**F814 Introduction to Pharmacology and Toxicology II (3 cr.)**  
**F809 Neuropharmacology (3 cr.)**  
**F810 Pharmacology of Autonomic Cardiovascular Control (3 cr.)**  
**Q580 Basic Human Genetics (3 cr.)**  
**BIOL564 Molecular Genetics of Development (3 cr.)**

The minor program must be approved by the student's Advisory Committee, which will take into consideration the student's total didactic experience. In the case of combined M.D./Ph.D. students, the committee may approve substitution of appropriate medical school courses for the electives. The minor representative will be selected from outside the student's major department and must be approved by the Diabetes and Obesity Training Program.

## **Certificate in Biotechnology**

### **Admission Requirements**

A baccalaureate degree in a scientific field with a minimum science GPA of 3.0/4.0. Proficiency in English by obtaining a degree from a certified American University or a minimum score of 550 on the TOEFL.

### **Specific Requirements**

A fixed curriculum of 17 credits. This will include one introductory course in biochemistry, such as B500 Introductory Biochemistry. This course should be completed before enrolling in the laboratory courses. If a student has taken a recent biochemistry survey course, the student must substitute an advanced graduate lecture course that is relevant to biotechnology. Such courses may include G865 Fundamental Molecular Biology, B807 Protein Structure and Function, G817 Eukaryotic Cell Biology, K540 Topics in Biotechnology, or C636 Biochemistry Structural Aspects. Students may take the remaining courses in any order. Three laboratory courses in biotechnology: G841 Methods in Proteomics (2 credits), G890 Methods in Molecular Biology and Pathology (3 credits), G823 Methods Cell Biology (3 credits). An ethics course, G505 Responsible Conduct in Research (1 credit), is required, as well as two semesters of a problem-based learning course in biotechnology G828 Concepts in Biotechnology (2 credits). Students will be required to have an overall GPA of 3.0 or higher and a minimum grade of B– in each of the required courses for the certificate, except for the B500 Introductory Biochemistry, which may be completed with a C+. Students who receive a grade of C in B500 will be required to

do additional work in an Advanced Biochemistry tutorial course (e.g. B803) to bring them up to an acceptable level in basic biochemistry and biotechnology.

### **Advisory Committee**

The program and student advisory committee will include the program director, directors of the core courses, laboratory director for the program, and one or more representatives from a biotechnology-related company.

### **Competency Requirements**

In the laboratory and problem-based learning courses, students will be required to demonstrate basic competencies necessary for success as a researcher in industry or academia. These competencies include general skills in communication, problem-solving, and lifelong learning, as well as specific biotechnology skills in good laboratory conduct, laboratory units of measure, computational and statistical analysis, and biotechnology instrumentation.

## **Courses**

**B500 Introductory Biochemistry (3 cr.)** P: C341 or equivalent. Structures of carbohydrates, proteins, lipids, and nucleic acids. Basic principles of enzyme catalysis, protein synthesis, intermediary metabolism, and nutrition.

**B800 Medical Biochemistry (3 cr.)** P: one semester of organic chemistry. Structure and function of biological molecules, regulation of cellular processes by nutrients and hormones, biochemical and molecular basis of disease.

**B803 Advanced Biochemistry (cr. arr., max. of 3 cr.)** Tutorial instruction in biochemistry.

**B805 Diabetes and Obesity (3 cr.)** P: one semester of biochemistry. Biochemistry, cell biology, molecular biology, genetics, immunology, and pathophysiology of diabetes and obesity. Topics include metabolic regulation, signal transduction, insulin resistance, insulin production, beta-cell function, edu models, complications, nutrition, prevention, and therapy.

**B807 Protein Structure and Function (3 cr.)** P: two semesters of organic chemistry; one semester of biochemistry. Physical forces stabilizing protein structure; protein folding. Essential features of macromolecular interactions. Introduction to enzyme kinetics and chemical mechanism in enzyme reactions.

**B808 Physical Biochemistry (3 cr.)** P: two semesters of physical chemistry; two semesters of calculus; one semester of biochemistry. Thermodynamics and biophysical chemistry of protein, enzymes, nucleic acids, and membranes.

**B809 Advanced Organic Chemistry (1-3 cr.)** P: two semesters of organic chemistry; two semesters of physical chemistry; B807 or consent of instructor. Tutorial instruction in organic chemistry, as applied to biochemistry.

**B810 Cellular Biochemistry and Regulation (3 cr.)** P: two semesters of organic chemistry; one semester of biochemistry. Fundamental pathways of metabolism, with emphasis on the mechanisms of metabolic regulation. Mechanisms of signal transduction and the control of cellular function by hormones, growth factors, and other extracellular regulators.

**B811 Advanced Intermediary Metabolism (1-3 cr.)** P: B810. Tutorial instruction in specialized areas of metabolism.

**B814 Advanced Enzymology (1-3 cr.)** P: B807 or B810. Tutorial instruction in enzyme isolation and kinetics.

**B835 Neurochemistry (3 cr.)** P: two semesters of organic chemistry; one semester of biochemistry, or consent of instructor. Metabolism of nervous system tissue. Neurochemical techniques.

**B836 Advanced Topics in Neurochemistry (2 cr.)** P: B835 or equivalent. Selected topics in neurochemistry dealing with specialized functions of the nervous system.

**B842 Instrumentation and Methods of Analysis II (3 cr.)** P: two semesters of organic chemistry; one semester of biochemistry.

**B854 Introduction to Research (1 cr.)** P: two semesters of organic chemistry; two semesters of physical chemistry, one semester of biochemistry, or consent of instructors. Tutorial and laboratory instruction in biochemistry. Purpose is to introduce students in biochemistry to three different research programs.

**B855 Research (cr. arr.)**

**B868 Advanced Molecular Biology (1-3 cr.)** P: G865 or equivalent. Tutorial instruction in specialized area of molecular biology.

**B890 Seminar (1 cr.)**

**G804 Cellular and Molecular Biology (3 cr.)** P: one semester of organic chemistry. Cellular and molecular biology that emphasizes the structural organization, biochemistry and molecular biology of cells. Includes cellular processes, development, and differentiation and their relationship to medicine.

**G805 Diabetes and Obesity (3 cr.)** P: one semester of biochemistry. Biochemistry, cell biology, molecular biology, genetics, immunology and pathophysiology of diabetes and obesity. Topics include metabolic regulation, signal transduction, insulin resistance, insulin production, beta-cell function, edu models, complications, nutrition, prevention and therapy.

**G817 Eukaryotic Cell Biology (2 cr.)** P: one semester of biochemistry. Organization and function of subcellular structures. Intracellular coordination of cell activity: protein and RNA trafficking, chromatin dynamics, and intracellular processing of receptor mediated signals.

**G823 Concepts in Biotechnology (1 cr.)** P: B500 or equivalent. Discussion and laboratory instruction in modern methods for cell culture, microscopy, flow cytometry and the use of cell culture to study cellular metabolism.

**G828 Concepts in Biotechnology (1 cr.)** P: B500 or equivalent. Case studies exploring topics on the cutting edge of biotechnology and tutorials in biotechnology calculations.

**G841 Methods of Proteomics (2 cr.)** P: B500 or equivalent. Discussion and laboratory instruction in modern methods for protein purification, analysis of purity, peptide mapping, and amino acid sequencing.

**G865 Fundamental Molecular Biology (3 cr.)** P: B800 or equivalent. Principles of molecular structure, function, and biosynthesis; core information regarding procaryotic and eukaryotic gene continuity and metabolic coordination; introduction to multicellular systems and problems. (Joint program: biochemistry, medical genetics, microbiology.)

**G890 Methods in Molecular Biology and Pathology (3 cr.)** P: G865 and/or J838, and consent of instructor. Basic principles and techniques in molecular biology and pathology. Particular emphasis will be on molecular techniques that can be used to study problems related to biochemistry and pathology.

**G910 Advanced Molecular Biology Methods (3 cr.)** P: G865 and/or G890 and consent of instructor. Advanced theory and techniques in molecular biology. The focus of the course will be on techniques related to manipulation of cloned DNA to study their expression, structure and function.