

## Medical Sciences

### Bloomington

**Assistant Dean/Director**

John B. Watkins III\*, Ph.D.

**Departmental E-mail**[msggrad@indiana.edu](mailto:msggrad@indiana.edu)**Departmental URL**[www.bloomington.medicine.iu.edu/](http://www.bloomington.medicine.iu.edu/)

### Graduate Faculty

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

**Professors**

Mark Braun (Pathology), Bruce Joseph Martin\* (Physiology), Anthony L. Mescher\* (Anatomy and Cell Biology), Kenneth Nephew\* (Physiology), Roderick Suthers\* (Physiology), Claire E. Walczak\* (Biochemistry and Molecular Biology), John B. Watkins III\* (Pharmacology)

**Adjunct Professor**

Robert De Voe\* (Emeritus)

**Associate Professors**

David L. Daleke\* (Biochemistry and Molecular Biology), John G. Foley\* (Anatomy and Cell Biology), Valerie O'Loughlin (Anatomy and Cell Biology)

**Adjunct Associate Professor**

Ann Carmichael\* (History, History and Philosophy of Science)

**Assistant Professor**

Manjari Mazumdar (Biochemistry),

**Program Information**

Each of the four basic medical sciences disciplines—anatomy, pathology, pharmacology, and physiology—administered by the Medical Sciences program of the School of Medicine on the Bloomington campus offers work leading to the M.S. and Ph.D. degrees.

The program also accepts medical students who wish to take

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advantage of small classes. The first two years of basic medical instruction include gross anatomy, microscopic anatomy, neuroanatomy, biochemistry, microbiology, physiology, emergency medicine, immunology, pharmacology, pathology, physical diagnosis, and introduction to medicine (the latter two taught at Bloomington Hospital). The curriculum is drawn from the many courses offered jointly through the School of Medicine and the University Graduate School. At a time when many medical schools are reducing their basic science offerings to medical students, the program at Bloomington should be of significant interest to those who seek a more rigorous training in the physical and biological sciences.

Complete information for the Doctor of Medicine program is provided in the School of Medicine Bulletin.

### Anatomy and Cell Biology<sup>1</sup>

**Graduate Advisor**Professor Anthony Mescher, [mescher@indiana.edu](mailto:mescher@indiana.edu), (812) 855-4693

### Degrees Offered

Master of Science and Doctor of Philosophy

### Special Program Requirements

(See also general University Graduate School requirements.)

**Admission Requirements**

Applicants should have a bachelor's degree in the sciences or a substantial knowledge base in these disciplines. The Graduate Record Examination General Test is required. The Test of English as a Foreign Language (TOEFL) is required of international applicants.

### Master of Science Degree

**Course Requirements**

A total of 30 credit hours, of which 20 credit hours must be in anatomy and cell biology or related courses other than research. A850 seminar must be taken each semester.

**Thesis**

Required.

### Doctor of Philosophy Degree

**Course Requirements**

A total of 90 credit hours, including courses in anatomy and cell biology, a basic course in both physiology and biochemis-

try, and dissertation. A minimum of 40 credit hours must be in courses other than research. A850 must be taken each semester.

### Minors

Minors may be in a variety of disciplines subject to approval of the student's advisory committee.

### Qualifying Examination

Written and oral, designed to test student's knowledge in anatomical sciences. Examination in the minor area may be required.

### Final Examination

Oral defense of dissertation.

### Other Provision

One year of supervised teaching experience is encouraged.

## Courses

**A460 Anatomy of the Ear and Vocal Organs (3 cr.)**

**A464 Human Tissue Biology (4 cr.)**

**A505 Human Development (2 cr.)** P: Z315 or equivalent and consent of instructor. Normal and abnormal human development. General considerations of development from embryonic through early neonatal period. Emphasis on understanding basis for morphological conditions found in the adult.

**A512 Introduction to Research in Anatomy (1 cr.)** Lectures and demonstrations in current research interests of faculty. Required of all new graduate students.

**A513 Introduction to Research Techniques (1 cr.)** P: A512. Individual work on a research problem. Required of all new graduate students.

**A530 Special Topics (cr. arr.)\*\*** P: Consent of instructor. Work in advanced areas in anatomy.

**A550-A551 Gross Human Anatomy I-II (4-4 cr.)** P: Consent of instructor.<sup>2</sup> Detailed study of the gross anatomy of the human, including a complete dissection. Systemic anatomy, anatomy of the thorax, abdomen, pelvis, and perineum (Sem. I). Anatomy of the head and neck, extremities (Sem. II).

**A560 Cell Biology and Histology (4 cr.)** P: Consent of instructor.<sup>2</sup> Detailed study of the microscopic anatomy of the human. Emphasis on structure-function relationships and laboratory identification of tissues and organs. Material presented at optical and electron microscopic level. Sem. I.

**A566 Human Neuroanatomy (3 cr.)** P: Consent of instructor.<sup>2</sup> Basic human central nervous system will be covered. Interrelationships between structure and function in the nervous system. Thorough foundation for further study in neurophysiology, neuroanatomy, or neurology. Sem. II.

**A601-A602-A603 Advanced Gross Anatomy I-II-III (4-4-4 cr.)**

P: A550-A551, consent of instructor. I. Structure of the upper and lower extremity. II. Thorax, abdomen, and pelvis. III. Head, neck, and gross brain. All include detailed dissection, lectures, and discussion on current literature to determine relation of structure to function.

**A610 Comparative Neuroanatomy (2 cr.)** P: Consent of instructor; graduate standing; one neuroscience course or equivalent. A comparison of the central nervous system of mammalian and nonmammalian vertebrates, including a laboratory study of representative specimens.

**A664 Selected Topics in Advanced Microscopic Anatomy (3 cr.)**

P: A560 or consent of instructor; graduate standing. Advanced instruction in the microscopic structure of selected animal cell systems, involving discussion and review of current literature and research dealing with these systems. Topics will change with each offering.

**A800 Research in Anatomy (cr. arr.)\*\***

**A850 Topical Seminar in Anatomy (1 cr.)** Topics of current interest discussed in seminar format.

**A878 Anatomy Teaching Practicum (2 cr.)** P: Consent of instructor. This course is designed to provide the student with supervised teaching experiences in Gross Anatomy, Histology and Neuroscience, as well as critical Reviews of all teaching duties. May be repeated for credit.

**BIOL L500 Independent Study (cr. arr.)** P: Must have written consent of faculty member supervising research.

**M555 Medical Neuroscience (5 cr.)** An interdisciplinary study of the morphological, functional, and clinical aspects of the human nervous system.

**M570 Mechanisms of Human Disease (1-6 cr.)** Intensive study of selected topics of human disease and pathological processes.

**M620 Pedagogical Methods in the Health Sciences (3 cr.)** This course is for biomedical sciences graduate students who want to be excellent instructors and classroom researchers. Students will learn about pedagogical methods, student learning styles and methods of instructional delivery. Students also will learn about the scholarship of teaching and develop a foundation for implementing classroom research and assessment.

\*\*These courses are eligible for a deferred grade.

## Pathology<sup>3</sup>

### Academic Advisor

Professor Mark Braun, [braunm@indiana.edu](mailto:braunm@indiana.edu), (812) 855-3131

## Degrees Offered

Master of Science and Doctor of Philosophy

Courses are offered on the Bloomington campus as part of the combined degree program in medicine and on the Indianapolis campus as part of the medical graduate curriculum. A student admitted to one program is also eligible for instruction in the other.

## Special Program Requirements

(See also general University Graduate School requirements.)

### Admission Requirements

The degree Doctor of Medicine or good standing as a medical student. Nonmajors in pathology admitted by special arrangement with the faculty.

## Master of Science Degree

### Course Requirements

A total of 30 credit hours, including 20 credit hours in pathology.

### Thesis

Required.

### Foreign Language

Reading knowledge of one foreign language desirable.

## Doctor of Philosophy Degree

### Course Requirements

A total of 90 credit hours, including dissertation and 30 credit hours in pathology or research in pathology.

### Foreign Language/Research-Skill Requirement

One of three requirements: (1) reading proficiency in two languages, normally selected from French, German, and Russian; (2) proficiency in depth in one language, normally selected from the above languages; or (3) reading proficiency in one of the languages cited in (1), plus proficiency in biostatistics, biomedical instrumentation, or computer science.

### Qualifying Examination

Written and oral.

### Final Examination

Oral defense of dissertation.

## Courses

**C601 General Pathology (6 cr.)**<sup>5</sup> Principles of pathology, including a comprehensive introduction to mechanisms of reaction to injury and pathogenesis of disease processes.

**C602 Systemic Pathology (6 cr.)**<sup>5</sup> Principles of pathology, including a comprehensive introduction to mechanisms of reaction to injury and pathogenesis of disease processes.

**C800 Advanced Pathology (cr. arr.)** P: C603. Subject material and hours arranged to conform to needs of student.

**C858 Experimental Pathology (5 cr.)** Review and performance of selected experiments in pathology illustrating the types of pathologic processes.

**C859 Research in Pathology (cr. arr.)**\*\* Supervised initiation of a research project in pathology, and counseling in the completion of a thesis.

**C862 Basic Pathologic Techniques (5 cr.)** Methods of the histologic and chemical laboratories of pathology; principles of examination used in the usual procedures of surgical and autopsy pathology.

**C875 Biochemical Pathology (3 cr.)** P: C603 or B800. A survey of biochemical pathology as demonstrated by recent advances in research in pathology. Selected topics for lecture and discussion will include aspects of tissue, cellular, subcellular, and molecular pathology.

**M575 Human Diseases (3 cr.)** This course will explore and detail the basic elements of human disease. The fundamental pathology of all organ systems of the human body will be covered as will the basic elements of bodily response to a variety of forms of injury.

## Pharmacology<sup>4</sup>

## Degrees Offered

Master of Science and Doctor of Philosophy

## Special Program Requirements

(See also general University Graduate School requirements.)

### Admission Requirements

Applicants should have a bachelor's degree in the sciences or a substantial knowledge base in these disciplines. The Graduate Record Examination General Test is required. The Test of English as a Foreign Language (TOEFL) is required of international applicants.

## Master of Science Degree

### Course Requirements

A total of 30 credit hours, all of which must be taken in the program.

### Thesis

Required.

### Other Provision

One year of supervised teaching experience is encouraged.

## Doctor of Philosophy Degree

### Course Requirements

A total of 90 credit hours, including 40 credit hours in the program and dissertation.

### Minor

Required.

### Advisory Committee

To be composed of research advisor, the pharmacology faculty, and an individual from the minor discipline.

### Grades

B (3.0) average required.

### Qualifying Examination

Consists of two parts: (1) comprehensive written examination, and (2) written research proposal with oral presentation to the advisory committee.

### Final Examination

Oral defense of dissertation, followed by seminar.

### Other Provision

One year of supervised teaching experience is encouraged.

## Courses

**C580 Medical Biochemistry (3 cr.)** Biochemistry for medical students, emphasizing structure-function relationships of cellular components and biosynthesis and degradation of simple and complex cell constituents as well as regulation of metabolic pathways. Includes biochemical basis for genetic continuity and expression of hereditary characteristics.

**C583 Physiological Biochemistry (3 cr.)** P: C483. To develop a sound and rigorous biochemical background for students in medicine and allied health sciences. Biochemistry of physiological and pathological processes; role of heredity and environmental factors; effect on macromolecules, macromolecular aggregates, and cells.

**F605 Principles of Pharmacology I (4 cr.)** P: Chemistry C483, Medical Sciences P531-P532, or consent of instructor.<sup>5</sup> Basic principles and clinical aspects of modern pharmacology presented in lectures. Physicochemical properties of drugs. Drugs that affect the autonomic nervous system. Drugs that act on cardiovascular and renal systems. Chemotherapy of cancer, infections, and parasites.

**F606 Principles of Pharmacology II (4 cr.)** P: F605. Drugs that influence the central nervous system. Drugs that influence gastrointestinal and endocrine systems. Immunopharmacology and the pharmacology of allergy and inflammation. Toxicology.

**F611 Methods of Pharmacology I (3 cr.)** P: Consent of instructor. Chemical and biological procedures used in pharmacological research. Lectures and demonstrations of techniques

used for the determination of specific substances in biological material.

**F612 Methods of Pharmacology II (3 cr.)** P: F611. Laboratory application of principles and techniques presented in F611 to practical problems in pharmacological research. Introduction to data handling.

**F613 Graduate Pharmacology I (3 cr.)** P: F605-F606 or consent of instructor. Molecular mechanisms of drug action, drug-receptor interactions, drug metabolism, and pharmacokinetics.

**F614 Graduate Pharmacology II (3 cr.)** P: F613 or consent of instructor. Continuation of F613. Molecular mechanisms of drug action, drug-receptor interactions, drug metabolism and pharmacokinetics.

**F615 Chemotherapeutic Pharmacology (3 cr.)** P: F605-F606 or consent of instructor. Basic principles of use of drugs as selectively toxic agents and of chemotherapy of bacterial, parasitic, or viral diseases and malignancies.

**F616 Molecular Pharmacology (3 cr.)** P: F605-F606 or consent of instructor. Molecular mechanisms as they relate to drug action. Biological transducers, receptor mechanisms, subcellular phenomena in the actions of drugs on mammalian systems.

**F617 Pharmacology of Drug Metabolism (3 cr.)** P: F605-F606 or consent of instructor. Physicochemical principles involved in the absorption, distribution, metabolism, and excretion of drugs and other foreign compounds in the mammalian organism.

**F618 Pharmacokinetics (3 cr.)** P: F617. Kinetic aspects of the absorption, distribution, and excretion of drugs in the mammalian organism. Compartmentalization, multiphasic decay curves, and computerized treatments.

**F619 Endocrine Pharmacology (3 cr.)** P: F605-F606 or consent of instructor. The pharmacology of hormones. Biosyntheses, structures, actions, and degradations of hormones endogenous to mammalian species. Structure and pharmacological activity of synthetic analogs and antagonists of naturally occurring hormones.

**F620 Special Topics in Pharmacology (3 cr.)** P: F605-F606 or consent of instructor. Special topics of current interest in pharmacology. May be repeated.

**F621 Readings in Pharmacology (1-3 cr.)** Supplementary readings and tutorial discussions in aspects of pharmacology to fit the needs of individual students or for specialized areas.

**F625 Research in Pharmacology (cr. arr.)** Original research as approved.

**F630 Seminar in Pharmacology (1 cr.)** Research reports by students, faculty, and invited guests.

## Physiology<sup>6</sup>

### Degrees Offered

Master of Science and Doctor of Philosophy

#### Special Program Requirements

(See also general University Graduate School requirements.)

#### Admission Requirements

Applicants should have a bachelor's degree in the sciences or a substantial knowledge base in these disciplines. The Graduate Record Examination General Test is required. The Test of English as a Foreign Language (TOEFL) is required of international applicants.

### Master of Science Degree

#### Course Requirements

A total of 30 credit hours, including 12 credit hours in physiology. At least 20 credit hours must be in courses other than research.

#### Thesis

Required.

### Doctor of Philosophy Degree

#### Course Requirements

A total of 90 credit hours, including dissertation, and the following courses: P513, P531, P532, M555, C580, and C583. P550 is to be taken each semester prior to admission to candidacy. Other course requirements will be determined by the student's advisory or research committee.

#### Foreign Language/Research Skill Requirement

Students must demonstrate proficiency in one of the following areas, as determined by the student's advisory committee: a foreign language, statistics, or computer skills.

#### Qualifying Examination

Written and oral.

#### Final Examination

Oral defense of dissertation.

#### Other Provision

One year of supervised teaching required.

#### Ph.D. Minor in Physiology

Students outside the department desiring to obtain a minor in physiology are required to complete a minimum of 6 credit hours in physiology courses other than research.

### Courses

**P416 Comparative Animal Physiology (3 cr.)**

**P417 Neurobiology (3 cr.)**

**P418 Laboratory in Comparative Animal Physiology (2 cr.)**

**P421 Biophysical Principles in Physiology (3 or 5 cr.)**

**P431 Human Physiology (4 cr.)**

**P509 Physiological Adaptations (3 cr.)** Mechanisms of adaptation and acclimatization of invertebrate and vertebrate animals to environmental conditions. Seminar-type course.

**P510 Control Systems Theory in Biology (4 cr.)** P: Introduction to calculus; P531 or equivalent. Predicting the properties of physiological systems from the dynamic properties of their component parts. Laboratory emphasizes analog and digital simulation techniques.

**P512 Introduction to Research in Physiology (1 cr.)** Introduction to areas and methods of current faculty research. Required of all new graduate students.

**P513 Introduction to Research Techniques (1 cr.)** P: P512. Individual work on a research problem.

**P530 Special Topics (cr. arr.)** P: Consent of instructor. Work in advanced areas in physiology.

**P531 Human Physiology I (3 cr.)**<sup>5</sup> Basic principles of homeostasis; muscle, cardiovascular, and renal physiology and metabolism relevant to humans.

**P532 Human Physiology II (5 cr.)** Basic physiological principles of temperature regulation, respiration, digestion, and endocrinology relevant to humans.

**P541 Advanced Physiology I: Neurophysiology (3 cr.)** P: P531, P532 or P417, or consent of instructor. From molecular to behavioral level, with special emphasis on electrophysiology and reflexes.

**P543 Neurophysiology Seminar (2 cr.)** P: P541. May be taken more than once with consent of the department for a maximum of 6 credits.

**P547 Topical Seminar in Physiology (1-5 cr.)** P: Graduate standing and consent of instructor. Discussion and review of current research and literature in physiology.

**P548 Neuroethology (3 cr.)** P: Consent of instructor. The function of nerve cells in controlling the natural behavior of animals. Sensory, integrative, and motor processes underlying selected behavior patterns of invertebrate and vertebrate animals.

**P550 Seminar in Physiology (1 cr.)** P: Graduate standing in physiology. Biomedical colloquium/seminar series on current topics of interest in medical sciences.

**P551 Advanced Physiology II: Circulation (3 cr.)** P: P531, P532, or P416 or equivalent or consent of instructor. Lecture and seminar discussions of current literature, with emphasis on physical models.

**P561 Advanced Comparative Animal Physiology (3 cr.)**

P: P531, P416 or equivalent, or consent of instructor. Lectures and discussions of current literature on mechanisms and adaptations of respiration, temperature regulation, locomotion, and osmoregulation from a comparative approach. Topics will be covered in succeeding years on a rotating basis. May be taken more than once for different topics.

**P575 Advanced Physiology: Exercise (3 cr.)** Study of the regulation and integration of metabolic, cardiovascular, respiratory, endocrinological, and biochemical functions of the human body in response to exercise of all types and durations.

**P576 Advanced Physiology: Work and Environmental (3 cr.)** Mechanisms of contraction and neuromuscular control. Metabolic energy cost, efficiency and the fuels of work. Circulatory and respiratory adjustments and their regulation in exercise. The adjustments and regulation of chemical and thermal homeostasis. Effects of environmental factors, training, age, health, and disease on metabolic, cardiovascular, and respiratory adjustment to exercise. (Offered in School of Health, Physical Education, and Recreation.)

**P620 Renal Physiology (3 cr.)** P: P531, A464, P551, C483. Designed for graduate students in physiology. Covers recent advances in acid-base balance, blood pressure regulation, and salt balance in relation to endocrinology. Offered alternate years in second semester.

**P800 Research in Physiology (cr. arr.)\*\***

**BIOL L500 Independent Study (cr. arr.)** P: Must have written consent of faculty member supervising research.

**M555 Medical Neuroscience (5 cr.)** An interdisciplinary study of the morphological, functional, and clinical aspects of the human nervous system.

**GRAD G800 Biophysics Seminar (1 cr.)** Topics of current interest in biophysics.

\*\*These courses are eligible for a deferred grade.

<sup>1</sup> See also the Department of Anatomy, Indianapolis.

<sup>2</sup> Consent of the director of the Medical Sciences Program also required.

<sup>3</sup> See also the Department of Pathology, Indianapolis.

<sup>4</sup> See also the Department of Pharmacology and Toxicology, Indianapolis.

<sup>5</sup> Consent of the director of the Medical Sciences Program required in order to enroll.

<sup>6</sup> See also the Department of Physiology and Biophysics, Indianapolis.