

## Medical Neuroscience

### School of Medicine Indianapolis

**Program Director**  
Professor Grant Nicol\*

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**Departmental URL**  
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### Graduate Faculty

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

**Distinguished Professor**  
Bernardino Ghetti\* (Medical and Molecular Genetics, Neurobiology, Pathology, Psychiatry)

**Chancellor's Professors**  
Tatiana Foroud\* (Medical and Molecular Genetics), Janice C. Froehlich\* (Medicine, Cellular and Integrative Physiology), Joseph DiMicco\* (Pharmacology and Toxicology)

**Albert Eugene Sterne Professor**  
Christopher McDougle\* (Psychiatry)

**Raymond E. Houk Professor of Psychiatry**  
Anantha Shekhar\* (Neurobiology, Pharmacology and Toxicology)

**Joyce and Iver Small Professor of Psychiatry, Neurobiology, and Medical Genetics**  
John Nurnberger Jr.\* (Neurobiology, Psychiatry)

**Paul Stark Professor of Pharmacology**  
Michael Vasko\* (Pharmacology and Toxicology)

**Showalter Professor**  
Grant Nicol\* (Pharmacology and Toxicology)

**Mari Hulman George Professor**  
Xiao Ming Xu (Neurological Surgery)

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**Raymond C. Beeler Professor of Radiology**  
Andrew Saykin (Radiology)

**Professors**  
Charles Goodlett\* (Psychology), Joseph Hingtgen\* (Emeritus, Clinical Psychology, Neurobiology in Psychiatry), Debomoy Lahiri\* (Psychiatry, Medical and Molecular Genetics), William McBride\* (Biochemistry and Molecular Biology, Neurobiology in Psychiatry), James Murphy\* (Neurobiology, Psychology), Sean O'Connor\* (Psychiatry), Gerry Oxford\* (Stark Neuroscience Research Institute, Pharmacology and Toxicology), Simon Rhodes\* (Cellular and Integrative Physiology, Pharmacology and Toxicology), Jay Simon\* (Psychiatry, Biochemistry and Molecular Biology), David Suzuki\* (Ophthalmology, Anatomy and Cell Biology), Zao C. Xu\* (Anatomy and Cell Biology), Feng Zhou\* (Anatomy and Cell Biology)

**Associate Professors**  
Ellen A.G. Chernoff\* (Biology), Theodore Cummins\* (Pharmacology and Toxicology), Dena Davidson\* (Psychiatry), Nicholas J. Grahame\* (Psychology), Eri Hashino\* (Otolaryngology, Anatomy and Cell Biology), Cynthia Hingtgen\* (Neurology, Pharmacology and Toxicology), David Kareken\* (Neurology, Neuropsychology), Michael Kubek\* (Anatomy and Cell Biology), Wei-Hua Lee\* (Pediatrics, Anatomy and Cell Biology), Aimee Mayeda\* (Psychiatry), John H. Schild (Biomedical Engineering), Debbie Thurmond\* (Biochemistry and Molecular Biology), Frederick Unverzagt (Psychology), Ruben Vidal\* (Pathology and Laboratory Medicine), Donald Wong\* (Anatomy and Cell Biology)

**Assistant Professors**  
Nikolai Broustovetski\* (Pharmacology and Toxicology), R. Andrew Chambers (Psychiatry), Yansheng Du\* (Neurology), Andrew Hudmon\* (Biochemistry and Molecular Biology), Rajesh Khanna\* (Pharmacology and Toxicology), Samy Meroueh\* (Biochemistry and Molecular Biology), Evan Morris (Biomedical Engineering), Alexander B. Niculescu III (Psychiatry), Alexander Obukhov (Cellular and Integrative Physiology), Xiaoxi Qiao (Ophthalmology), Leonid Rubchinsky (Mathematical Sciences), Xin Zhang (Medical and Molecular Genetics)

**Associate Research Professor**  
Sandra Morzorati\* (Neurobiology)

**Assistant Research Professor**  
Richard J. Thielen (Neurobiology, Biochemistry and Molecular Biology)

**Graduate Advisor**  
Professor Grant Nicol\*, MS A402, (317) 274-1570

## Degrees Offered

Master of Science and Doctor of Philosophy

## Special Program Requirements

(See also general University Graduate School requirements.)

Bachelor's degree in chemistry, biological sciences, physics, mathematics, engineering, or psychology, which includes courses in general chemistry (8 credit hours), organic chemistry (8 credit hours), physics (4 credit hours), biological sciences (8 credit hours), and mathematics through calculus. Promising students may be accepted even though certain undergraduate prerequisites may be lacking, but they must remove deficiencies during the first year of graduate study. The Graduate Record Examination General Test results must be available before applicants will be considered for admission.

## Master of Science Degree

### Course Requirements

A total of 30 credit hours, including at least 17 credit hours of approved courses and 3 credit hours of research.

### Thesis

Required.

### Final Examination

Comprehensive oral examination.

## Doctor of Philosophy Degree

### Course Requirements

A total of 90 credit hours, including dissertation. A minimum of 36 credit hours must be in course work, the remainder in research.

### Minor

Twelve (12) credit hours must be taken in one of the basic sciences associated with the Medical Neurobiology Program: anatomy, biochemistry, biology, medical genetics, microbiology and immunology, pathology, pharmacology, physiology and biophysics, and psychology. The minor can also be fulfilled by taking G715, G716, and G717.

### Qualifying Examination

Written and oral.

### Final Examination

Oral defense of dissertation.

Core courses include N800, N801, N802, N612, G743, N614, G744, N616, G745, P615, D527. Additional appropriate courses in the Departments of Anatomy, Biochemistry, Biology, Medical Genetics, Microbiology and Immunology, Pathology, Pharmacology and Toxicology, Physiology and Biophysics, and Psychology will be accepted for credit toward the major with prior approval of the student's advisor.

## Courses

**N612 Fundamental Neuroscience—Neurotransmitter Dynamics and Synaptic Plasticity (2 cr.)** P: Consent of Instructor. A lecture/discussion course to explore the fundamental mechanisms involved in transmitter synthesis, release, storage, reuptake and general metabolism. Molecular mechanisms of synaptic plasticity as well as facilitation and depression of synaptic strength will also be explored.

**N614 Fundamental Neuroscience—Special Senses and Integrative Neurophysiology (2 cr.)** P: Consent of Instructor. A lecture/discussion course to explore fundamental concepts and mechanisms related to various sensory receptors (photo receptors, hair cells), spinal reflex circuits, central pattern generators, and the visual system as a complex integrative model.

**N616 Fundamental Neuroscience—Developmental Biology of Neuroscience (2 cr.)** P: Consent of Instructor. A lecture/discussion course to explore concepts in basic neuroembryology including examination of molecular cues for axial patterning, axonal pathfinding and growth, developmental regulation of gene transcription, neural stem cells and glia; cell precursors, and regionalization of nervous system function.

**N800 Research in Medical Neurobiology (cr. arr.)** P: Consent of instructor with whom research is being done. Supervised literature and laboratory research in selected area(s) of medical neurobiology.

**N801 Seminar: Topics in Medical Neurobiology (1 cr.)** Required of all graduate students in program. Recent topics in medical neurobiology covered by literature and research reports and discussions by faculty, graduate students, and invited guest lecturers.

**N802 Techniques of Effective Grant Writing (3 cr.)** The grantsmanship course is designed to teach graduate students how to write an NIH application and to provide information on the review process. Students will complete an NIH R03 application by the end of the semester. All students will participate in a mock IRG-style review of each application at the end of the course.

### Anatomy

**D527 Neuroanatomy (3 cr.)**

**D863 Peripheral Nervous System (2-3 cr.)**

**D875 Topics in Advanced Neuroanatomy (2-5 cr.)**

**D876 Neurotransmitter and Neuroendocrine Cytology and Anatomy (3 cr.)**

### Biochemistry

**B500 Introductory Biochemistry (3 cr.)**

**B835 Neurochemistry (3 cr.)**

**B836 Advanced Topics in Neurochemistry (2 cr.)**

## **Graduate**

**G743 Fundamentals of Electrical Signaling and Ion Channel Biology (1 cr.)** Experimental basis for cellular and molecular concepts of electrical excitability and membrane transport through ion channels. The goals are to foster an understanding of how we accumulate information and to provide students with tools to evaluate hypotheses and to define unanswered questions, rather than provide current “facts” to memorize.

**G744 Neuropharmacology of Synaptic Transmission: Receptors and Ligands (1 cr.)** Experimental basis for current cellular and molecular concepts of postsynaptic receptors and signals involved in chemical synaptic transmission in the nervous system. The goals are to foster an understanding of how we accumulate information and to provide students with tools to evaluate hypotheses and to define unanswered questions, rather than provide current “facts” to memorize.

**G745 Fundamentals of Intracellular Signal Transduction in Neurons (1 cr.)** Experimental basis for cellular and molecular concepts of intracellular signaling cascades attending neurotransmitter, growth factor, and cytokine receptor activation in neurons. The goals are to foster an understanding of how we accumulate information and to provide students with tools to evaluate hypotheses and to define unanswered questions, rather than provide current “facts” to memorize.

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

## **Pharmacology and Toxicology**

**F602 Pharmacology: Lecture (5 cr.)**

## **Physiology and Biophysics**

**F613 Mammalian Physiology Lecture (5 cr.)**