

## Neuroscience

### College of Arts and Sciences Bloomington

**Director**

Professor George V. Rebec\*

**Departmental E-mail**[iuneuron@indiana.edu](mailto:iuneuron@indiana.edu)**Departmental URL**[www.indiana.edu/~neurosci](http://www.indiana.edu/~neurosci)

### Graduate Faculty

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

**Chancellor's Professor of Psychology**

George V. Rebec\* (Psychological and Brain Sciences)

**Linda and Jack Gill Chair of Neuroscience**

Kenneth Mackie\* (Psychological and Brain Sciences)

**Rudy Professor**

Bennett I. Bertenthal\*

**Professors**

Joseph Farley\* (Psychological and Brain Sciences), Preston E. Garraghty\* (Psychological and Brain Sciences), William P. Hetrick\* (Psychological and Brain Sciences), David M. Koceja\* (Kinesiology), Laura L. Murray\* (Speech and Hearing Sciences), Brian F. O'Donnell\* (Psychological and Brain Sciences), Dale R. Sengelaub\* (Psychological and Brain Sciences), Olaf Sporns\* (Psychological and Brain Sciences), Roderick A. Suthers\* (Physiology), William D. Timberlake\* (Psychological and Brain Sciences)

**Associate Professors**

T. Rowan Candy\* (Optometry), Gregory E. Demas\* (Biology), James L. Goodson\* (Biology), Jonathan W. Mills\* (Informatics), Kyung-Tai Min\* (Biology), Luiz Pessoa\* (Psychological and Brain Sciences), William P. Shofner\* (Speech and Hearing Sciences), G. Troy Smith\* (Biology), Cara L. Wellman\* (Psychological and

University Graduate School  
Kirkwood Hall 111  
Indiana University  
Bloomington, IN 47405  
(812) 855-8853  
Contact: [grdschl@indiana.edu](mailto:grdschl@indiana.edu)

Brain Sciences), Robert H. Withnell\* (Speech and Hearing Sciences)

**Assistant Professors**

Heather B. Bradshaw\* (Psychological and Brain Sciences), Joshua W. Brown\* (Psychological and Brain Sciences), Theresa A. Burnett (Speech and Hearing Sciences), Laura Hurley\* (Biology), Karin Harman James\* (Psychological and Brain Sciences), Thomas W. James\* (Psychological and Brain Sciences), Sharlene D. Newman\* (Psychological and Brain Sciences), Nicholas Port\* (Optometry), Anne L. Prieto\* (Psychological and Brain Sciences)

**Emeriti**

Gabriel P. Frommer\* (Psychological and Brain Sciences), Dolores Schroeder\* (Anatomy), Alfred Strickholm\* (Physiology)

**Director of Graduate Studies and Academic Advisor**

Professor George V. Rebec\*, Psychology Building 361,  
(812) 855-4832

### Degree Offered

Doctor of Philosophy

### Special Program Requirements

(See also general University Graduate School requirements.)

### Doctor of Philosophy Degree

The program leading to the Ph.D. degree is designed to give students the opportunity to develop the technical skills and conceptual framework necessary for a successful research career in neuroscience. Research should be viewed as the student's greatest challenge and the major focus of the student's energy. Training in behavioral or systems neuroscience is emphasized through research participation with core faculty in the Departments of Biology, Computer Science, Kinesiology, Medical Sciences, Physics, Psychological and Brain Sciences, Speech and Hearing Sciences, and Visual Sciences. Students can also draw upon course offerings through the Center for the Integrative Study of Animal Behavior, the Cognitive Science Program, as well as the Department of Chemistry.

**Admission Requirements**

Undergraduate education that includes an adequate background in chemistry, mathematics, and the biological and behavioral sciences are urged to apply. Students with undergraduate concentrations in other areas of the natural sciences, computer science, or engineering also are encouraged to apply. Preference will be given to applicants with a background in laboratory research and with strong letters of recommenda-

tion. Applications must include a complete entrance form, three letters of recommendation, scores on the Graduate Record Examination (GRE), and the undergraduate transcript. At least one score on the GRE must be 600 or above. Students are admitted to the program only with the approval of the program graduate admissions committee.

### Course Requirements

A total of 90 credit hours, including dissertation, is required for the Ph.D. An individual program of study is planned for each student in consultation with the student's advisory committee. The aim is to provide each student with a solid background in neuroscience as well as the training necessary to supplement the student's particular research area. Course work consists of N500 (or M555) and N501 (a one-year core sequence in neuroscience), which must be completed by the fifth semester of residence, and selections totaling at least 14 credit hours from offerings listed by the Program in Neuroscience or cross-listed with other departments, divisions, or special programs. In addition, all doctoral students are required to complete six semesters of N650, a research seminar. Course work must be completed with an average of B+ (3.3) or above. No grades below B- (2.7) may be counted toward degree requirements.

### Advisory Committee

Chosen in consultation with the student, the student's research advisor, and the program director. The committee consists of at least three members of the Graduate Faculty who review the student's performance on a regular basis and provide feedback and guidance.

### Qualifying Examination

To remain in good standing and be admitted to doctoral candidacy, students must pass a written and oral examination before the end of their fifth semester in residence. Students with a double major may request one additional year before they take the qualifying examination. Students failing the qualifying examination twice will be dismissed from the program.

### Final Examination

In addition to the oral defense of the dissertation before the research committee, a public research seminar is required.

### Ph.D. Minor in Neuroscience

Students in other departments and programs who elect to minor in Neuroscience must complete the N500-N501 core sequence and at least 6 credit hours of graduate course work selected from the offerings listed by the Program in Neuroscience or cross-listed with other departments. A grade of B (3.0) or higher in each course is required.

## Courses

**N500 Neural Science I (4 cr.)** Basic introduction and current trends in cellular neurophysiology, neurocytology, synaptic processes, and neuroanatomy.

**N501 Neural Science II (4 cr.)** P: N500. Continuation of Neural Science I emphasizing higher integrative processes such as perception, cognition, and memory. Special emphasis will be

placed on timely topics and topics of particular relevance to members of the class.

**N510 Cellular and Molecular Neuroscience (3 cr.)** Examines the properties and behavior of neurons and glia, the principal cells of the nervous system. The function of neural cells, the molecules involved in these functions, and the organization of molecular components required to generate cellular activity will be considered.

### N550 Seminar on Sensorimotor Neuroplasticity (2-3 cr.)

P: Graduate status and consent of instructor. This course is intended to introduce students to the research methodologies and experimental findings of studies addressing sensorimotor brain plasticity. While the specific content of the course may vary across semesters, the overarching goal is to provide students with a firm grounding in the primary literature representing this area of research so that they become familiar with the mechanisms of neural plasticity from systemwide to molecular levels.

### N611 Neural Bases of Visual Sensation, Perception, and Cognition (3 cr.)

Basic neuroanatomy and neurophysiology of the visual system. Correlations will be made with current, biologically-based cognitive models of vision. The goal of this course is to integrate neural and cognitive approaches to the problems of vision.

### N612 Ion Channels and Receptors (3 cr.)

P: Graduate status and consent of instructor. Molecular, biophysical, and biochemical analysis of the major molecules responsible for neural excitability and synaptic transmission: receptor-coupled ion channels, voltage-dependent ion channels, G-protein coupled receptors, transporters, signal transduction pathways, synaptic vesicle-associated proteins, cytoskeletal proteins, classical and novel neurotransmitters and modulators.

### N613 Neural Mechanisms of Hearing (3 cr.)

P: Graduate status and consent of instructor. Review of anatomy and physiology of inner ear and central auditory pathways. Special attention to current research on the neural basis of auditory discrimination.

### N650 Neuroscience Colloquium Series (1 cr.)

P: Graduate status and consent of instructor. Colloquia in this series cover a broad range of topics in neuroscience research.

**N700 Readings-Nervous System (cr. arr.)** Reading in special topics with guidance from a member of the faculty.

**N800 Research (cr. arr.)**

## Cross-Listed Courses

### Animal Behavior

**A501 Seminar in the Integrative Study of Animal Behavior (3 cr.)**

**A502 Research and Professional Ethics in Bio-Behavioral Sciences (1 cr.)**

**Cognitive Science**  
Q551 Brain and Cognition (3 cr.)

V648 Neurophysiology of Vision (1 cr.)  
V767 Electrophysiology of Vision (3 cr.)  
V785 The Vertebrate Eye (3 cr.)

**Computer Science**  
B644 Very Large Scale Integration (3 cr.)

**School of Health, Physical Education, and Recreation**  
K542 Neuromuscular Control of Movement (3 cr.)  
K641 Topics in Motor Integration (3 cr.)  
K690 Seminar in Human Performance (1 cr.) (Topic: Motor Control)

**Medical Sciences**  
A464 Human Tissue Biology (4 cr.)  
A530 Special Topics (depending on topic)  
A610 Comparative Neuroanatomy (2 cr.)  
F605 Principles of Pharmacology I (4 cr.)  
F606 Principles of Pharmacology II (4 cr.)  
M555 Medical Neuroscience (5 cr.)  
P417 Neurobiology (3 cr.)  
P418 Laboratory in Comparative Animal Physiology (2 cr.)  
P421 Biophysical Principles in Physiology (3 or 5 cr.)  
P510 Control Systems Theory in Biology (4 cr.)  
P531 Human Physiology I (3 cr.)  
P532 Human Physiology II (5 cr.)  
P541 Advanced Physiology I: Neurophysiology (3 cr.)  
P543 Neurophysiology Seminar (2 cr.)  
P547 Topical Seminar in Physiology (1-5 cr.) (Biophysics of Membrane Transport)  
P548 Neuroethology (2 cr.)

**Psychological and Brain Sciences**  
P417 Animal Behavior (3 cr.)  
P423 Human Neuropsychology (3 cr.)  
P428 Laboratory in Comparative Psychology (3 cr.)  
P436 Laboratory in Animal Learning and Motivation (3 cr.)  
P504 Learning and Motivation (3 cr.)  
P514 Methods in Biopsychology (2 cr.)  
P526 Neurobiology of Learning and Memory (3 cr.)  
P527 Developmental Psychobiology (3 cr.)  
P566 Psychophysiology of Vision (3 cr.)  
P628 Psychophysiology of Somatic Functions (3 cr.)  
P657 Topical Seminar (1-4 cr.) (Check program brochure.)  
P667 Neuropsychopharmacology (3 cr.)  
P669 Neurobiology of Behavioral Disorders (3 cr.)  
P717 Evolutionary Bases of Learning (3 cr.)

**Speech and Hearing Sciences**  
S501 Neural Bases of Speech and Language (3 cr.)  
S515 Topical Seminar (2 cr.) (Conditional)  
S531 Traumatic Brain Injury (2 cr.)  
S537 Diagnosis and Management of Adult Aphasia (3 cr.)  
S540 Voice Disorders (3 cr.)  
S545 Adult Cognitive-Communication Disorders (2 cr.)  
S571 Auditory Anatomy & Physiology (3 cr.)  
S686 Physiological Research in Speech, Language and Hearing Sciences (3 cr.)

**Visual Sciences**  
V514 Neuroanatomy (1.5 cr.)