NEUROSCIENCE PROGRAM

Dr. Andrew J. Velkey, Director
Forbes Hall 1053
(757) 594-7927
avelkey@cnu.edu

Faculty

Professor: Cartwright
Associate Professor: Grau, Meighan, Velkey, Webb
Assistant Professor: Campolattaro, Lipatova, Mitrano, Rollins, Wiens

Mission Statement

The Neuroscience Program is an interdisciplinary degree program housed within the College of Natural and Behavioral Sciences. Upon successful completion of the curriculum, students are awarded a B.S. in Interdisciplinary Studies with a Major in Neuroscience. The mission of the Neuroscience Program is to offer students a comprehensive, rigorous, interdisciplinary curriculum in neuroscience and its many ancillary professional applications. Excellence in didactic and laboratory investigation is the objective of this program. Students will gain a systematic introduction to the scientific methodologies, theories, and literature focused on the anatomy, physiology, and biochemistry of the nervous system. In addition, students will develop skills in conducting independent research on aspects of neural functioning reflecting both molar and molecular levels of analysis.

The members of the Neuroscience Program faculty are dedicated to presenting their students with engaging and challenging courses in the current, basic and applied discipline of neuroscience and presenting them the opportunity to engage in a diversity of undergraduate research projects in basic and applied neuroscience.

Curricular Relevance to Graduate Education

The neuroscience curriculum prepares our undergraduates for highly selective and competitive graduate programs. We aim to produce graduates prepared for and qualified to pursue postgraduate study in neuroscience, psychology, biology, pharmaceutical and medical chemistry, and medicine. As well, the interdisciplinary major in neuroscience is integral to a broad liberal arts and science undergraduate education. Our key and central objective lies in training scholars, teachers, and practitioners who will exercise their intelligence, industriousness, and integrity in the pursuit of productive personal and professional lives.

Neuroscience and Pre-Medical Education

The 2009 report of the Association of American Medical Colleges - Howard Hughes Medical Institute on *Scientific Foundations for Future Physicians* describes eight general competencies that should be explicit in each applicant at the time of medical school matriculation. The neuroscience curriculum is designed to produce graduates who meet all eight competencies and who will compete successfully for admission to elite medical schools (generally meaning those with an explicit research orientation as opposed to those who specialize only in practitioner preparation).

The eight competencies from the AAMC-HHMI report are:

1. Apply quantitative reasoning and appropriate mathematics to describe or explain phenomena of the natural world.
2. Demonstrate understanding of the process of scientific inquiry, and explain how scientific knowledge is discovered and validated.
3. Demonstrate knowledge of basic physical principles and their applications to the understanding of living systems.
4. Demonstrate knowledge of basic principles of chemistry and some of their applications to the understanding of living systems.
5. Demonstrate knowledge of how biomolecules contribute to the structure and function of cells.
6. Apply understanding of principles of how molecular and cell assemblies, organs, and organisms develop structure and carry out function.
7. Explain how organisms sense and control their internal environment and how they respond to external change.
8. Demonstrate and understanding of how the organizing principle of evolution by natural selection explains the diversity of life on earth.

The Bachelor of Science in Interdisciplinary Studies Neuroscience Major

The neuroscience curriculum includes the neuroscience core and electives as well as additional required coursework in biology, chemistry, mathematics, physics, and psychology and optional coursework in computer science.

The Bachelor of Science degree in interdisciplinary studies with a major in neuroscience requires the successful completion of a minimum of 55 credits in the major. In addition to the successful completion of the liberal learning curriculum, the degree requires successful completion of the following courses:

1. Core: NEUR 201, 301W/301L, 305;
2. BIOL 211/211L;

3. CHEM 121/121L-122/122L, and 321/321L;
4. PHYS 151/151L-152/152L;
5. MATH 125 and 130 or higher (MATH 140 or 148 is strongly recommended);
6. Select at least 6 credits of additional NEUR courses at the 300- or 400-level, with at least 3 credits at the 400-level;
7. Select one (minimum of 3 credits): BIOL 307/307L, 313, 314/314L, 411, BCHM 414/414L, CHEM 322/322L, CPSC 471;
8. Select one (minimum of 3 credits): PSYC 305, 406/406L, 408/408L, 415/415L, or 428/428L;
9. IDST 490.

The Curriculum in Neuroscience

NEUR 201. Introduction to Neuroscience (3-3-0)
Prerequisites: PSYC 201 or BIOL 211/211L.
Spring.
This course is designed to provide a comprehensive introduction to the field of neuroscience and the basic principles of organization and function of the nervous system. An exploration of the neural basis of behavior at the cellular and systems levels will span the following topics: anatomy and development of the brain, cell biology, membrane potential, synaptic transmission, sensory and motor systems, and higher brain function (memory, language, etc.).

NEUR 301. WI: Research Methods in Neuroscience (4-3-0)
Prerequisites: MATH 125, NEUR 201, BIOL 211/211L and ENGL 223 with a C- or higher.
Corequisite: NEUR 301L.
Spring.
This course will provide an introduction to research design in empirical neuroscience research. General topics will include the scientific method, research ethics and research design. Students will also learn about methods such as EEG/ERP, structural and functional MRI, single- and multi-unit recording, transgenic and knockout methods with associated histological techniques, as well as lesion-based behavioral approaches. Students will write literature reviews and empirical research reports. Partially satisfies the writing intensive requirement.

NEUR 301L. Research Methods in Neuroscience Laboratory (0-0-4)
Corequisite: NEUR 301W.
Spring.
This laboratory course will provide students with an experiential introduction to research design in empirical neuroscience research. General topics will include the scientific method, research ethics and research design. Students will gain experience writing empirical research reports. Lab fees apply each term.

NEUR 305. Neurobiology (3-3-0)
Prerequisites: NEUR 201 and (BIOL 201/201L or BIOL 211/211L), each completed with a C- or higher.
Fall.
This course will cover the basic biological principles and processes involved in neural function, including the common architectural elements and functional processes of neurological systems, from the cellular/molecular to the organ system level. Integrative functions and behavior will be explored as well as developmental facets of neural function, neural plasticity and neuroendocrine functions.

NEUR 316. Brain and Cognition (3-3-0)
[Same as PSYC 316]
Prerequisites: NEUR 201 or PSYC 201 and 202, each completed with a C- or higher.
Fall and Spring.
This course examines behavioral and neuroscience research on human cognitive processes including perception, attention, memory, language, emotion, decision making, and executive functioning. In this course, the students will learn about the empirical methods, theoretical models, as well as classic and current research that cognitive neuroscientists use to study various topics within the broader field. In addition, it is expected that students will be able to identify how these cognitive processes are applicable to the situations we encounter in our everyday lives.

NEUR 360. Neuroendocrinology (3-3-0)
Prerequisites: NEUR 201, 305, each completed with a C- or higher.
Spring.
This course focuses on the neuroendocrine system and the regulation of behavior in humans and animals. Special consideration will be given to the interaction between brain structures and the endocrine system as related to reproduction and parenting behavior, stress responding, foraging and feeding behavior, and circadian rhythms. Example topics include neuroendocrine signaling pathways such as the hypothalamic-pituitary-adrenal axis, circadian regulation of gene expression as it related to brain function and behavior, and the role of neurotransmitter expression in attachment behaviors.

NEUR 395. Special Topics in Neuroscience (3-3-0)
Prerequisite: as announced.
Topics vary, determined by the special interests and needs of students and the expertise of the faculty. Students who are interested in having a topics course in a certain area should make their suggestion to the program director. Students may earn up to 9 credits in topics courses, but may not earn more that 3 credits for any single topic, should that topic be repeated.

NEUR 410. Neurobiology of Memory (3-3-0)
Prerequisites: NEUR 301W/301L and NEUR 305, each completed with a C- or higher.
Fall.
The focus of this course is on the neurobiological basis of memory as viewed from an integrative framework. Coursework will explore mechanisms of memory at cellular and molecular levels, through behavioral and physiological experimental studies, and in neuropsychological case studies. The goal of the course is to understand how the brain can support proper encoding, storage, and retrieval of various types of memories.

NEUR 420. Neuroanatomy (3-3-0)
Prerequisites: NEUR 201, NEUR 301W/301L, and NEUR 305, each completed with a C- or higher.
Spring.
This course provides an introduction to the anatomy and function of the human nervous system. Emphasis will be on cellular structure and function, neural development, and gross anatomy and function of the cerebrum, brainstem, cranial nerves, and spinal cord.

NEUR 430. Neurobiology of Addiction (3-3-0)
Prerequisites: NEUR 201, 301W/301L and NEUR 305, each completed with a C- or higher.
Fall.
This course will focus on the neurobiological processes that underlie drug effects, addiction, treatment and relapse. Students will learn the neural and physiological effects of the most commonly abused drugs at the cellular level. The course will include an introduction to basic pharmacology, including the pharmacodynamics and pharmacokinetics of the most highly abused drugs. The course readings will focus on the most current research that is being performed in the neuroscientific community in the area of addiction, as our understanding of the brain and causes of addiction are continually changing as the technology used to examine neurobiology continually evolves.

NEUR 495. Advanced Topics in Neuroscience (3-3-0)
Prerequisite: as announced.
Topics vary, determined by the special interests and needs of students and the expertise of the faculty. Students who are interested in having a topics course in a certain area should make their suggestion to the program director. Students may earn up to 9 credits in topics courses, but may not earn more that 3 credits for any single topic, should that topic be repeated.

NEUR 499. Independent Study in Neuroscience (Credits vary 1-3)
Prerequisite: as determined by and with the consent of the instructor.
Topics vary, determined by the special interests and needs of students and the expertise of the faculty.