# NEUROSCIENCE (NEURODPT)

**NEURODPT/NTP 610 – CELLULAR AND MOLECULAR NEUROSCIENCE**
4 credits.

Study of original papers leading to an understanding of the molecular basis of electrical activity in neurons. Topics include voltage-sensitive currents, molecular biology of neuronal receptorrs, synaptic transmission and sensory transduction.
**Requisites:** ZOOLOGY/PSYCH 523 and (PHYSICS 202, 208, or 248), or graduate/professional standing
**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2023
**Learning Outcomes:** 1. Identify the major anatomical parts of a neuron and summarize their functions Audience: Both Grad Undergrad

10. Synthesize concepts from different parts of the course into a cohesive integration of cellular and molecular neural function and communication. One example would be being able to list numerous points of failure in DNA, transcription, translation or postranslational modification of several different proteins that would all converge to produce similar or identical disease phenotypes Audience: Graduate

2. Name the major classes of voltage-gated ion channels responsible for the resting potential and action potential. Describe their functional roles in generating those potentials, with respect to concepts such as voltage-dependence, activation, inactivation and propagation. Identify the structural motifs in these proteins that permit their function Audience: Both Grad Undergrad

3. Summarize the sequence of events in the presynaptic terminal that lead from depolarization to neurotransmitter release, including the role of calcium. Explain the quantal hypothesis of neurotransmitter release and the experimental evidence that supports it. Describe the exocytosis/endocytosis cycle Audience: Both Grad Undergrad

4. Summarize basic principles of ligand/receptor interactions. Interpret the meaning of quantities such as the dissociation constant (Kd) and the maximum response (Vmax). Explain the experimental evidence that led to the equations (e.g., Hill Equation) that describe these principles Audience: Both Grad Undergrad

5. Name the major classes of ligand-gated ion channels that support fast synaptic transmission and differentiate their functions with respect to excitation versus inhibition. Identify the structural motifs in these proteins that permit their specific functions. Solve equations that describe the behavior of simple chemical and electrical systems as a function of time Audience: Both Grad Undergrad

6. Explain what second messengers and signaling cascades are and how they participate in regulating neuronal function. Describe the major processes leading from DNA to RNA to the production of proteins and explain how these processes are regulated with respect to the structure of chromatin and the action of transcriptional activators and repressors Audience: Both Grad Undergrad

**NEURODPT/NTP/PSYCH 611 – SYSTEMS NEUROSCIENCE**
4 credits.

Introduction to the anatomy and physiology of the mammalian nervous system. Lectures will cover the neuroanatomy of the major subdivisions of the human brain, the major sensory and motor systems, and higher order functions. Lab/discussion sections will emphasize readings from the primary literature and hands-on dissections.
**Requisites:** NEURODPT/NTP 610 or graduate/professional standing
**Course Designation:** Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2024
**Learning Outcomes:** 1. Describe the organization and structure of mammalian nervous system, including the spinal cord, brainstem, thalamus, cerebral cortex, cerebellum, basal ganglia, limbic system, and their interconnections on a systems leve Audience: Both Grad Undergrad

2. Demonstrate a solid understanding of the functions of the sensory and motor systems that underlie perception and action Audience: Both Grad Undergrad

3. Demonstrate a solid understanding of higher brain functions and behavior, including learning and memory and executive function\\n Audience: Both Grad Undergrad

4. Demonstrate knowledge about approaches of modern neuroscience research including neuroanatomy, neurophysiology, functional brain imaging, behavioral assays, and quantitative data analysis methods Audience: Both Grad Undergrad

5. Develop and apply critical thinking to evaluate original neuroscience research Audience: Graduate

6. Develop ability to formulate hypotheses and to apply knowledge learned from the course to design experiments for hypothesis testing Audience: Graduate

**NEURODPT/ZOOLOGY 616 – LAB COURSE IN NEUROBIOLOGY AND BEHAVIOR**
4 credits.

Independent experimental modules exploring neurophysiology and behavior will be completed in groups. Learn techniques and develop investigations into three separate areas of neurobiology.
**Requisites:** ZOOLOGY/PSYCH 523 and PSYCH 454
**Course Designation:** Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2017

**NEURODPT/NTP 629 – MOLECULAR AND CELLULAR MECHANISMS OF MEMORY**
3 credits.

Focuses on the cell signaling and the resulting structural changes that occur at neuronal synapses during memory formation. The aim is to understand how the synaptic changes underlying memory occur.
**Requisites:** Graduate/professional standing or ANAT&PHY 335, 435, PHYSIOL 335, 435 or ZOOLOGY/PSYCH 523
**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2023

**NEURODPT/NTP 640 – COMPUTATIONAL NEUROSCIENCE: FROM SINGLE CELLS TO WHOLE BRAIN MODELS**
3 credits.

Theory and application of methods in computational neuroscience across various levels of organization from single cells to global brain dynamics and cognition. Computational neuroscience is an approach to understanding the development and function of nervous systems in mechanistic terms at many different structural scales. Topics include biophysical properties of neurons and synapses, neural plasticity, sensory systems, neural circuits, whole brain analysis and modeling, and different views on brain function. Includes primers on relevant computational techniques (ICA, information theoretical approaches, dynamical systems) and a computational problem set. Starts with an introduction to MATLAB (used for problem sets).
**Requisites:** PSYCH/ZOOLOGY 523, PSYCH 454, MATH 221, and (PHYSICS 104, 202, 208, or 248); or graduate/professional standing and NEURODPT/NTP 610 and PSYCH/NEURODPT/NTP 611
**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2024

**NEURODPT/PSYCH/ZOOLOGY 674 – BEHAVIORAL NEUROENDOCRINOLOGY SEMINAR**
2 credits.

Behavior results from a complex interplay among hormones, the brain, and environmental factors. Behaviors and their underlying neural substrates have evolved in response to specific environmental conditions, resulting in vast species diversity in behavioral and neuroendocrine solutions to environmental problems. Designed to explore the primary literature on the neuroendocrine underpinnings of behavior spanning from feeding to sex differences in complex social behaviors. A range of taxonomic groups will be discussed, including (but not limited to) mammals, birds, and fish.
**Requisites:** ZOOLOGY/BIOLOGY 101, ZOOLOGY/BIOLOGY/BOTANY 151, BIOCORE 383 or graduate/professional standing
**Course Designation:** Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2021

**NEURODPT 675 – SELECTED TOPICS IN PHYSIOLOGY**
1-3 credits.

Topics include: advanced cardiovascular physiology, advanced respiratory physiology, advanced endocrinology, membrane transport physiology and neurobiology.
**Requisites:** None
**Course Designation:** Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** Yes, unlimited number of completions
**Last Taught:** Fall 2019
**Learning Outcomes:** 1. Apply, analyze, or evaluate advanced theories, concepts, or methods in Neuroscience and Physiology, including but not limited to: ion channels, advanced cardiovascular physiology, advanced respiratory physiology, advanced endocrinology, membrane transport physiology and neurobiology Audience: Both Grad Undergrad

2. Identify and describe key theories, concepts, and methods in Physiology and Neuroscience, including but not limited to: ion channels, advanced cardiovascular physiology, advanced respiratory physiology, advanced endocrinology, membrane transport physiology and neurobiology and apply the knowledge gained to research in the field Audience: Graduate

**NEURODPT 699 – DIRECTED STUDY**
1-4 credits.

Independent work.
**Requisites:** Consent of instructor
**Repeatable for Credit:** Yes, unlimited number of completions
**Last Taught:** Spring 2024
**Learning Outcomes:** 1. Apply concepts learned in coursework to real life situations Audience: Undergraduate

2. Read and effectively search scientific literature Audience: Undergraduate

3. Develop critical, analytical, and independent thinking skills Audience: Undergraduate

**NEURODPT 747 – SENSORY AND MOTOR SYSTEMS**
2 credits.

Overview of the basic science principles of sensory and motor systems in the central and peripheral nervous system, with clinicians providing complementary presentations on their relevant experiences in the clinic. Topics include Somatosensory pathways in spinal cord, brainstem and cerebrum, Motor neurons in spinal cord and brainstem and the descending systems that control them, Blood Supply of the CNS and affiliated vascular syndromes, Cerebellum, Basal Ganglia and associated pathways, Eye Movement control, Vestibular, Auditory, and Visual systems and organization of Cerebral Cortex.
**Requisites:** MED SC-M 810, 811, 812, and 813
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2024
**Learning Outcomes:** 1. Identify and summarize the main sensory and motor structures within the nervous system. Audience: Graduate

2. Explain how elements in the nervous system interact to enable specific sensory and motor functions. Audience: Graduate

3. Describe how pathology in specific neural pathways leads to particular clinical neurological signs and symptoms (e.g., ischemic stroke syndromes). Audience: Graduate

4. Predict the location of damage in the nervous system based on symptoms and signs. Audience: Graduate

**NEURODPT/NTP/ZOOLOGY 765 – DEVELOPMENTAL NEUROSCIENCE**
3 credits.

Analysis of neural development with emphasis on experimental approaches. Combination of lectures and discussions of primary literature. Topics include neural induction, patterning, mechanisms of axon guidance, neural crest cell migration and differentiation, cortical development, and synapse formation and elimination.
**Requisites:** Graduate/professional standing
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2023

**NEURODPT 990 – RESEARCH AND THESIS**
1-9 credits.

Research supervised by individual faculty members.
**Requisites:** Consent of instructor
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** Yes, unlimited number of completions
**Last Taught:** Spring 2024
**Learning Outcomes:** 1. Exhibit a broad understanding of general Neuroscience principles Audience: Graduate

2. Conduct independent research using a variety of approaches Audience: Graduate

3. Think critically to address research challenges Audience: Graduate

4. Exhibit and foster professional and ethical conduct in their research Audience: Graduate

5. Collaborate with other investigators within or outside the thesis lab Audience: Graduate