Neuroscience

http://krieger.jhu.edu/neuroscience

Neuroscience is the study of the nervous system and how it functions. Neuroscientists study the nervous system from all levels, ranging from molecules interacting with cell membranes to brain systems subserving cognitive functions such as language. Dramatic progress has been made at all levels, and the field continues to grow. On the Homewood campus, researchers studying the nervous system are in the departments of Biology, Biomedical Engineering, Biophysics, Cognitive Science, and Psychological and Brain Sciences and in the Krieger Mind/Brain Institute. Their presence provides the opportunity for an innovative, interdepartmental program which offers a broad overview of the neuroscience field, as well as more advanced training in one of four focus areas.

Cellular and Molecular Neuroscience (CM) focuses on the mechanisms by which information flows within and between cells in the nervous system, and the mechanisms through which the cellular structure of the nervous system develops and is maintained. Topics include the molecular basis of membrane permeability, action potentials, sensory transduction, synaptic transmission, neuronal modulation, mechanisms of drug action, and the molecular basis of genetic disorders of the nervous system.

Cognitive Neuroscience (CG) focuses on how cognitive functions, such as vision or language, are implemented by the brain. Drawing upon a variety of techniques for probing the working brain at cognitive and neural levels, including functional neuroimaging, analysis of cognitive impairments in brain-damaged patients, and electrophysiological techniques, research in cognitive neuroscience seeks to relate mental representations and computations to brain mechanisms and processes.

Computational Neuroscience (CP) focuses on applying mathematical tools and theories to investigate brain function. This discipline incorporates a diverse set of approaches from mathematics, physics, engineering, and computer science, to understand how the nervous system processes information. Such principles are used to answer questions across a variety of domains of neuroscience: cellular/molecular, systems and circuits, behavioral and cognitive.

Systems Neuroscience (ST) seeks to relate brain structure and functioning to behaviors and related physiological processes. Research in this area explores the description and analysis of neural circuits. This includes identifying the brain nuclei and interconnections making up a circuit, identifying and investigating the implicated neurotransmitters, and characterizing the intrinsic and extrinsic factors that modulate the development and adult functioning of the circuit. Topics as diverse as learning and memory, communication, sensory systems, and motivated behaviors (e.g., reproduction, feeding, and aggression) are explored from this perspective.

Neuroscience Program Committee

The Neuroscience Program Committee coordinates course offerings, oversees the program’s interdepartmental courses, reviews and updates the administration of the program, makes decisions about admission to the B.S./M.S. program, approves proposed research programs and mentors for students in the B.S./M.S. mentored research program, and evaluates the final reports and presentations from the research year.

Undergraduate Programs

The neuroscience major consists of two degree programs: a four-year B.S. based primarily on course work and 6 credits of research; and a five-year concurrent B.S./M.S. involving additional course work and a yearlong intensive laboratory experience. (Under special circumstances, a student may be able to complete the B.S./M.S. program in less than five years.) Both programs are designed to provide rigorous preparation for advanced study in either a Ph.D., M.D. or Ph.D./M.D. programs. The concurrent B.S./M.S. program accepts students every spring semester.

Additional information regarding the undergraduate degree and the B.S./M.S. programs is available through our website at http://krieger.jhu.edu/neuroscience. You may also contact our Academic Program Administrator, Linda White, mailto:linda.m.white@jhu.edu (linda.m.white@jhu.edu) or 410-516-6196.

Requirements for the B.S. Degree

Also see Requirements for a Bachelor’s Degree (http://e-catalog.jhu.edu/undergrad-students/academic-policies/requirements-for-a-bachelors-degree).

General Information

- Students are encouraged to complete an optional introductory course in their freshman year, such as AS.200.141 Foundations of Brain, Behavior and Cognition or AS.050.105 Introduction to Cognitive Neuropsychology.
- Students interested in attending medical school will need to take a second semester of organic chemistry and its corresponding laboratory to meet medical school admission requirements; however, these courses are not major requirements.
- Students are required to select their advanced neuroscience elective courses from one of four approved focus areas: cellular and molecular neuroscience, cognitive neuroscience, computational neuroscience, or systems neuroscience. Approved courses fulfilling this requirement are found on the neuroscience website (http://krieger.jhu.edu/neuroscience/bs-program/courses) or in the schedule of classes.
- To apply towards the major, all courses must be taken for a letter grade and a grade of C- or better is required.

Neuroscience Sequence

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.050.203</td>
<td>Neuroscience: Cognitive (spring)</td>
<td>3</td>
</tr>
<tr>
<td>AS.080.250</td>
<td>Neuroscience Laboratory (fall/spring)</td>
<td>3</td>
</tr>
<tr>
<td>AS.080.305</td>
<td>Neuroscience: Cellular and Systems I (fall)</td>
<td>3</td>
</tr>
<tr>
<td>AS.080.306</td>
<td>Neuroscience: Cellular and Systems II (spring)</td>
<td>3</td>
</tr>
</tbody>
</table>

Mathematics, Statistics, and Science Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN.553.211</td>
<td>Probability and Statistics for the Life Sciences</td>
<td>4</td>
</tr>
<tr>
<td>or EN.553.310</td>
<td>Probability &amp; Statistics</td>
<td></td>
</tr>
<tr>
<td>or EN.553.311</td>
<td>Probability and Statistics for the Biological Sciences and Engineering</td>
<td></td>
</tr>
<tr>
<td>or EN.553.111</td>
<td>Statistical Analysis I</td>
<td></td>
</tr>
<tr>
<td>&amp; EN.553.112</td>
<td>and Statistical Analysis II</td>
<td></td>
</tr>
<tr>
<td>AS.110.106</td>
<td>Calculus I (Biologoy and Social Sciences)</td>
<td>4</td>
</tr>
<tr>
<td>or AS.110.108</td>
<td>Calculus I</td>
<td></td>
</tr>
<tr>
<td>AS.110.107</td>
<td>Calculus II (For Biological and Social Science)</td>
<td>4</td>
</tr>
<tr>
<td>or AS.110.109</td>
<td>Calculus II (For Physical Sciences and Engineering)</td>
<td></td>
</tr>
<tr>
<td>or AS.110.113</td>
<td>Honors Single Variable Calculus</td>
<td></td>
</tr>
</tbody>
</table>
Biology Sequence

Two biology courses with lab selected from the following:

- AS.020.151 & AS.020.153
  General Biology I and General Biology Laboratory I (see footnote about AP Biology credits)
- AS.020.152 & AS.020.154
  General Biology II and General Biology Lab II (see footnote about AP Biology credits)
- AS.020.303 & AS.020.340
  Genetics and Developmental Genetics Lab
- AS.020.305 & AS.020.315
  Biochemistry and Biochemistry Project lab
  or AS.250.254 Protein Engineering and Biochemistry Lab
  or AS.250.253 Protein Biochemistry and Engineering Laboratory
- AS.020.306 & AS.020.316
  Cell Biology and Cell Biology Lab
- AS.020.374 & AS.020.377
  Comparative Animal Physiology and Comparative Physiology Lab

Advanced Neuroscience Elective Courses and Focus Area

Nine credits of 300-level or higher approved courses from one of four focus areas: systems neuroscience, cognitive neuroscience, computational neuroscience, or molecular neuroscience.

Three credits of 300-level or higher approved course outside of focus area selected above.

If pursuing the Computational Neuroscience focus area, EN.553.291 is required in addition to the other 12 credits required of the focus area (or the combo of AS.110.201/212 and AS.110.302 may be used).

If pursuing the Cellular and Molecular Neuroscience focus area, AS.020.306 and AS.020.316 must be selected as one of the two required biology courses with lab.

Research **

Six credits of neuroscience research

For students with AP Biology credit, they may use only one course and its lab from those credits towards this requirement. Therefore, these students must take at least one biology course and its lab at JHU. Students who elect to take General Biology I or II with its lab will lose the corresponding AP credits. Students should also refer to AP credit policies for additional details around the use of AP Biology credits.

Sample Program

The following course sequence is only a suggestion and is based on the assumption that there are no AP/IB/TR credits applied. Please consult with your faculty advisor when selecting and registering for classes, as there are multiple ways to complete the major.

Freshman

<table>
<thead>
<tr>
<th>Course #1</th>
<th>Credits Spring</th>
<th>Credits</th>
<th>Course #2</th>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.030.101</td>
<td>Introductory Chemistry I</td>
<td>3 AS.030.102</td>
<td>Introductory Chemistry II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>AS.030.105</td>
<td>Introductory Chemistry Laboratory I</td>
<td>1 AS.030.106</td>
<td>Introductory Chemistry Laboratory II</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AS.110.106</td>
<td>Calculus I (Biology and Social Sciences)</td>
<td>4 AS.110.107</td>
<td>Calculus II (For Biological and Social Science)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Biology Option 1</td>
<td>3 Biology Option 2</td>
<td>3</td>
<td>Biology Lab Option 1</td>
<td>1 Biology Lab Option 2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

Sophomore

<table>
<thead>
<tr>
<th>Course #1</th>
<th>Credits Spring</th>
<th>Credits</th>
<th>Course #2</th>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.080.305</td>
<td>Neuroscience: Cellular and Systems I</td>
<td>3 AS.080.306</td>
<td>Neuroscience: Cellular and Systems II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>AS.030.205</td>
<td>Introductory Organic Chemistry I</td>
<td>4 EN.553.211</td>
<td>Probability and Statistics for the Life Sciences</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Junior

<table>
<thead>
<tr>
<th>Course #1</th>
<th>Credits Spring</th>
<th>Credits</th>
<th>Course #2</th>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.171.103</td>
<td>General Physics I for Biological Science Majors</td>
<td>4 AS.171.104</td>
<td>General Physics/Biology Majors II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>AS.173.111</td>
<td>General Physics Laboratory I</td>
<td>1 AS.173.112</td>
<td>General Physics Laboratory II</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AS.080.500</td>
<td>Scientific Communication: Neuroscience</td>
<td>NA AS.080.501</td>
<td>Scientific Communication: Neuroscience</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9-11</td>
<td></td>
</tr>
</tbody>
</table>

Upper Level Neuroscience Course #1

<table>
<thead>
<tr>
<th>Course #2</th>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.080.551</td>
<td>Neuroscience Research for Juniors</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Upper Level Neuroscience Course #2

<table>
<thead>
<tr>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.080.554</td>
<td>Neuroscience Research - Juniors</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Honors in the Major
To receive honors in Neuroscience, students must meet the following criteria:

• Earn a GPA of 3.5 or better in major requirements
• Conduct research and give a research presentation
• Receive a recommendation from research mentor
• Three (3) additional Neuroscience Research credit(s) beyond the required 6 credits for the major (Effective for students entering Fall 2016)

Graduate Program
Requirements for the B.S./M.S. Degree
Current JHU undergraduate Neuroscience majors who wish to apply for the B.S./M.S. Program in their junior or senior year must meet the following minimum requirements (prior to applying):

• A minimum 3.5 GPA in all required courses for the undergraduate major and cumulative GPA of 3.5.
• Completion of all courses required 6 credits of research for the JHU B.S. degree in Neuroscience.

Advanced Seminars in Neuroscience (6 credits)
The Advanced Seminar in Neuroscience is offered in the fall and spring terms.

Final Spring Courses (12 credits)
Degree requirements include 12 credits of additional advanced course work (300-level or above). At least three credits must be at 400-level or above. Courses must be related to the study of neuroscience and ideally focused on the student's concentration of study and area of research. Students may choose courses from the approved list of undergraduate advanced courses. (In addition, up to six additional credits of the Advanced Seminar in Neuroscience, and/or statistics courses, graduate courses and seminars may be taken with the approval of the program director.)

Mentored Research (24 credits)
During the research year, students will complete a total of 24 credits of mentored research. Students must complete nine credits of research in a spring academic term, six in the summer and an additional nine in the fall.

B.S./M.S. Commencement Project (1 credit)
After completing the research year, students must register for a one-credit independent study course intended to track the progress and defense of the student's final research project.

Note: This masters degree is only open to current Johns Hopkins University undergraduate students pursuing a major in neuroscience.

For current faculty and contact information go to https://krieger.jhu.edu/neuroscience/people/

Faculty
Chair
Hey-Kyoung Lee, Ph.D.
Professor, Mind/Brain Institute

Director of Undergraduate Studies
Jason Trageser, Ph.D.
Senior Lecturer, Psychological and Brain Sciences

Director of BS/MS Program
Jay Baraban, MD., Ph.D.
Psychological and Brain Sciences

Professors
Patricia Janak, Ph.D.
Psychological and Brain Sciences

Michael McCloskey, Ph.D.
Cognitive Science

Brenda Rapp, Ph.D.
Cognitive Science

Haiqing Zhao, Ph.D.
Biology

John Desmond, M.S., Ph.D.
Neurology-Cognitive Neurology, School of Medicine

Charles Connor, Ph.D.
Mind/Brain Institute

Assistant Professors
Robert Johnston, Ph.D.
Biology

Shreesh Mysore, Ph.D.
Psychological and Brain Sciences

Vikram Chib, Ph.D.
Biomedical Engineering

Mohamed Farah, Ph.D.
Neurology-Neuromuscular Medicine, School of Medicine

Arnold Bakker, Ph.D.
Psychiatry and Behavioral Sciences, School of Medicine

Kristina Nielsen, Ph.D.
Mind/Brain Institute
Lecturers
Hita Adwanikar, Ph.D
Psychological and Brain Sciences

Dani Smith, Ph.D.
Psychological and Brain Sciences

Susanne Sterbing-D'Angelo, Ph.D.
Psychological and Brain Sciences

For current course information and registration go to https://sis.jhu.edu/classes/

Courses

AS.080.250. Neuroscience Laboratory. 3.0 Credits.
This course will give students the "hands-on" experience of the interdisciplinary nature of neuroscience. Students will use anatomical and neuro-physiological techniques to understand the basic underlying principles of neuroscience. There will be a total of 13 class meetings during the summer session. Course open to JHU undergraduates only.
Prerequisites: (AS.080.305 AND AS.080.306) OR AS.200.141
Corequisites: NA
Instructor(s): J. Trageser; S. Sterbing-d’angelo
Area: Natural Sciences

AS.080.260. Bridging the gap between Biology and Statistics. 1.0 Credit.
This course is designed to support the lectures and assignments in Probability and Statistics in Life Sciences, EN.553.211. This one-hour a week course is led by a behavioral biology professor with extensive expertise in statistics and mathematics. The primary goal of this course is to increase success and understanding of EN.553.211 by bridging the gap between theoretical statistics and biological thinking. In addition, when possible, examples and direct applications in neuroscience and behavioral biology will be presented to provide a context for EN.553.211 materials.
Prerequisites: NA
Corequisites: Students must also enroll in EN.553.211.
Instructor(s): K. Porth-Bohn
Area: NA

AS.080.301. Behavioral Assessment of Animal Models of Cognition and Neuropsychiatric Disorders. 3.0 Credits.
What does a rat exploring its environment tell us about memory? How can a mouse help us better understand schizophrenia? This course will focus on procedures that are routinely used to study behavior in animal models of cognition and neuropsychiatric disorders. Topics will include motor function, emotional and motivational states, disorders such as dementia and schizophrenia, among others. Throughout the course, we will read and discuss original research articles to illustrate and compare the various mechanisms and results from the various procedures.
Prerequisites: Students may not have taken AS.200.302; AS.200.141 OR (AS.080.305 and AS.080.306), OR by instructor permission.
Corequisites: NA
Instructor(s): D. Smith
Area: Social and Behavioral Sciences

AS.080.303. Structure of the Nervous System. 3.0 Credits.
This course takes a structural biological approach to studying the nervous system. In using a systems approach it provides students of cellular-molecular and computational neuroscience with a thorough introduction to functional, microscopic and submicroscopic organization of the brain, spinal cord and peripheral nervous system.
Prerequisites: AS.080.305 AND AS.080.306
Corequisites: NA
Instructor(s): S. Hendry; S. Sterbing-d’angelo
Area: Natural Sciences

AS.080.304. Neuroscience Learning and Memory. 3.0 Credits.
This course is an advanced survey of the scientific study of learning and memory. Different perspectives will be used to review the science of learning and memory including the cellular-molecular basis of synaptic plasticity, the functional circuitry involved in learning and memory and memory systems in the brain. The course is designed to provide a deep understanding of the issues and current debates in learning and memory research and focuses specifically on animal models of memory and memory impairment. This is an interactive lecture course with a strong emphasis on student participation.
Prerequisites: AS.200.141[C] OR (AS.080.305[C] AND AS.080.306[C]) OR (AS.020.312[C] AND AS.020.306[C]) or instructor permission.
Corequisites: NA
Instructor(s): A. Bakker
Area: Natural Sciences

AS.080.305. Neuroscience: Cellular and Systems I. 3.0 Credits.
(Formerly Nervous Systems I) Neuroscience: Cellular and Systems I is a fully integrated, two-semester course that surveys the cellular and molecular biology of neurons as well as the structure and function of the nervous system. Students must register for Neuroscience: Cellular and Systems II offered in the second term. Course open to JHU undergraduates only.
Prerequisites: AS.080.203 OR AS.050.203 OR AS.200.141 or 080.105 or Permission
Corequisites: NA
Instructor(s): C. Fetsch; H. Zhao; K. Kuchibhotla
Area: Natural Sciences

AS.080.306. Neuroscience: Cellular and Systems II. 3.0 Credits.
(Formerly Nervous Systems II) Neuroscience: Cellular and Systems II uses the functional organization of the somatosensory system as a means to examine mechanisms of neural development. Generation and maturation of neurons, guidance of axons, formation of synapses and the regressive events that shape the adult nervous system will be examined. At the same time we will explore the structure and function of brain regions that allow us to feel pain and temperature, detect vibration, recognize shape and perceive where we are in space. Finally, the single-neuron events that lead to adaptive changes in function will be explored in the context of central nervous system control of movement and of higher order functions of speech and memory. Students who do not register for Neuroscience: Cellular and Systems I offered during the first term should not register for this class.
Prerequisites: AS.080.305
Corequisites: NA
Instructor(s): H. Zhao; S. Hendry
Area: Natural Sciences

NA.
AS.080.308. **Neuroeconomics. 3.0 Credits.**

Every day decisions often require us to weigh the costs and benefits of engaging in a particular course of action in order to obtain some expected outcome. Unfortunately, we often lack the information necessary to obtain our desired goal with complete certainty. Economists have long been interested in understanding human decision-making under these circumstances. In parallel, neuroscientists have made great strides at describing the underlying neural basis of simple decision-making. However, despite much progress in both fields, our understanding of how the brain makes decisions is incomplete. In order to strengthen and further research in both fields, the interdisciplinary field of Neuroeconomics arose. This course will survey the field of Neuroeconomics focusing on theoretical concepts developed by economists and the role these theories are playing in guiding current experimental neuroscience. Recommended Course Background: AS.080.305 and AS.080.306 or AS.200.141 and AS.020.306 or permission.

**Prerequisites:** Pre-reqs: AS.080.306 OR AS.200.141 OR AS.020.312

**Corequisites:** NA

Instructor(s): J. Trageser
Area: Natural Sciences

NA.

AS.080.310. **Synaptic Function and Plasticity. 3.0 Credits.**

The function of the nervous system is based on synaptic transmission between neurons. Synapses are not static structures, but dynamically change with experience. Experience-dependent synaptic plasticity not only allows proper development of the nervous system in tune with the environment, but also is the basis for learning and memory. This course will cover the structure and function of synapses, and how they are altered by experience to encode information.

**Prerequisites:** (AS.020.305 AND AS.020.306) OR (AS.080.305 AND AS.080.306)

**Corequisites:** NA

Instructor(s): A. Kirkwood; H. Lee
Area: Natural Sciences

NA.

AS.080.320. **The Auditory System. 3.0 Credits.**

This course will cover the neuroanatomy and neurophysiology of the human auditory system from the ear to the brain. Behavioral, electrophysiological, and neuroimaging methods for assessing peripheral and central auditory function will be discussed. Acquired and developmental disorders of auditory function will be reviewed using clinical case studies.

**Prerequisites:** AS.080.305 OR AS.080.203 OR AS.050.203 OR AS.200.141 OR AS.020.312 or permission of the instructor.

**Corequisites:** NA

Instructor(s): D. Boatman
Area: Natural Sciences

NA.

AS.080.321. **Computational Neuroscience. 3.0 Credits.**

This course is designed to give students an overview of computational neuroscience. The topics discussed will cover many exciting domains of the field including neural coding, decision-making, learning, attention and connectomics. Lectures will be complemented with hands on experience working with computational models using Matlab and/or other programming language. The overarching goal of the course is to increase overall literacy in the field of computational neuroscience and to gain an appreciation of the interplay between experimental and theoretical neuroscience.

**Prerequisites:** AS.080.306 OR AS.200.141. Familiarity with programing in Matlab will be helpful but not necessary.

**Corequisites:** NA

Instructor(s): J. Trageser
Area: Natural Sciences

NA.

AS.080.322. **Cellular and Molecular Biology of Sensation. 3.0 Credits.**

Leading scientists in sensory biology from the Johns Hopkins community will present the most current knowledge in the cellular and molecular biology of sensation. A lecture and a student presentation of an exemplar manuscript will be presented each week on a different topic of sensory systems.

**Prerequisites:** NA

**Corequisites:** NA

Instructor(s): P. Fuchs
Area: Natural Sciences

NA.

AS.080.325. **Neurobiology and Diseases of the Peripheral Nervous System. 3.0 Credits.**

This course will cover neurobiology and disorders of the peripheral nervous system (PNS). A particular emphasis will be on cellular interactions within the PNS and with target tissues. For example, the two principal components of the peripheral nerves- axons and Schwann cells- have intimate and continuous cellular communications that are critical for physiological function of the PNS. The course will teach how these cellular interactions are developed, maintained throughout life, and are impacted by injury and diseases.

**Prerequisites:** AS.080.305 AND AS.080.306

**Corequisites:** NA

Instructor(s): M. Farah
Area: Natural Sciences

Writing Intensive.

AS.080.328. **Behavioral Neuroscience Lab. 3.0 Credits.**

This class is designed to give students first-hand knowledge of the behavioral procedures and techniques used to study behavior in the field of neuroscience. Students will gain hands-on experience by carrying out some of the behavioral tasks used to assess animals under specific behavioral domains, discuss why certain aspects (i.e. genotype, environment conditions, group size, etc.) are important factors to consider when designing, planning, and carrying out such experiments, and learn the relevance of behavioral research in translational medicine.

**Prerequisites:** AS.200.141 OR AS.200.302 OR AS.080.301 OR (AS.080.305 AND AS.080.306) or permission by instructor.

**Corequisites:** NA

Instructor(s): D. Smith
Area: Natural Sciences

NA.
AS.080.336. Brain-Body Interactions in Health and Disease. 3.0 Credits.
Both classical and recent primary research papers that deal with cross
signaling of other major organs with the nervous system, particularly the
central nervous system, will be discussed. Students will be exposed to
emerging literature on how peptides, signaling molecules, and hormones
effect the nervous system function both in health and in diseases.
Prerequisites: AS.080.305 AND AS.080.306
Corequisites: NA
Instructor(s): M. Farah
Area: Natural Sciences
Writing Intensive.

AS.080.345. Great Discoveries in Neuroscience. 3.0 Credits.
This course examines the historical and intellectual context of selected,
key advances in neuroscience, how they were made and the impact they
had on an understanding of the nervous system. Particular attention will
be paid to advances in cellular and molecular neuroscience. Among the
topics covered will be the discovery of monoamine neurotransmitters and
of endocannabinoids, the role of neurotrophins in neural development,
and prion-based diseases of the brain.
Prerequisites: Pre-reqs: AS.080.306
Corequisites: NA
Instructor(s): J. Baraban
Area: Natural Sciences

AS.080.355. Fundamental Principles of Vision. 3.0 Credits.
Even though we rarely acknowledge it as such, vision is our superpower.
It is so central to how most of us interact with the world, and it comes to
us with such ease, that we underappreciate its complexity. To this date,
there are no computer vision programs that can parallel the performance
of the human visual system. Vision is also the topic that both of us
actively research, and are passionately interested in. Lastly, the neural
underpinnings of vision are amongst the most thoroughly studied,
providing a very useful framework for learning about general principles of
Neuroscience. The goal of this class is to teach you the Neuroscience of
vision, with topics ranging from a general overview of the visual system
to highlighting ongoing research studies. We will also talk about state-of-
the art computer vision efforts. The class is designed to provide you with
the relevant background knowledge, and to teach you how to critically
evaluate current research papers. The class will be split into ‘classical’
lectures, in which we provide an overview over a particular topic, and
discussion classes. Discussion classes will serve to discuss one or two
original papers in depth. Our intention is for these classes to feel like a
real journal club or lab meeting, with a very active discussion amongst
all of the participants. To achieve the latter will require rigorous work by
everybody. All of the reading for the discussion classes will be primary
material, which might (at least initially) be challenging. However, if we
all do our job right, you should be well able to read the primary literature
by the end of the class. Nonetheless, be prepared to work hard, and set
aside time for the reading. This is a small and very advanced seminar,
and participation in the discussions will be a central part of it (including
your grade). Talking (or not talking) about things you haven’t read will
not go unnoticed, and will be reflected in your grade. Attendance at every
session is required.
Prerequisites: AS.080.306
Corequisites: NA
Instructor(s): C. Connor; K. Nielsen
Area: Natural Sciences

AS.080.360. Diseases & Disorders of the Nervous System. 3.0 Credits.
Prerequisites: Pre-reqs: ( EN.580.421 AND EN.580.422) OR ( AS.020.305
AND AS.020.306 ) OR AS.080.306 OR By Permission.
Corequisites: NA
Instructor(s): D. Smith; J. Baraban
Area: Natural Sciences

AS.080.362. Neurobiology of Hearing. 3.0 Credits.
The course focuses on sound processing, including current research
topics in Auditory Neuroscience, including synaptic physiology,
neural circuitry, acoustics, physiology, and behavior. Course taught in
Salamanca. This course fulfills upper-level Neuroscience electives.
Course must be taken for a grade.
Prerequisites: NA
Corequisites: NA
Instructor(s): Staff
Area: Natural Sciences
Writing Intensive.

AS.080.366. Neuroscience of Pain. 3.0 Credits.
This course is a systems-oriented course focusing on the basic neural
processing of pain signals in both the spinal cord and the brain.
Class lectures will cover the anatomical and molecular basis for the
transmission and perception of pain signals, basic concepts such as
allodynia, hyperalgesia, peripheral and central sensitization, remodeling,
the pathophysiology of chronic pain disorders and the cognitive and
emotional aspects of pain. We will also discuss the regulation of pain
signals by descending systems, and current practices and new advances
in the treatment of pain.
Prerequisites: AS.080.305 OR AS.080.306 OR AS.020.312 or permission
of instructor.
Corequisites: NA
Instructor(s): H. Adwanikar
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

AS.080.360. Diseases & Disorders of the Nervous System. 3.0 Credits.
NA

AS.080.362. Neurobiology of Hearing. 3.0 Credits.
NA

AS.080.366. Neuroscience of Pain. 3.0 Credits.
NA

AS.080.370. The Cerebellum: Is it just for motor control?. 3.0 Credits.
The cerebellum is traditionally thought to be involved in movement and
motor control, and observations of patients with cerebellar damage
do in fact show motor deficits. However, since the proliferation of
functional MRI, cerebellar activations have been observed in a surprising
number of brain activation studies that were designed to investigate
the neural correlates of cognitive function. Over the past 2 decades, an
increasing number of investigators have tried to characterize the role
of the cerebellum in cognitive function. Through lectures and reading
discussions this course will survey cerebellar circuitry, neuroimaging
and neuromodulatory methods for investigating the cerebellum, and
traditional and non-traditional functions of the cerebellum, including
cerebellar involvement in cognitive functions such as language, working
memory, and executive control.
Prerequisites: Pre-reqs: ( AS.080.306 AND AS.080.203 ) OR AS.050.203
Corequisites: NA
Instructor(s): J. Desmond
Area: Natural Sciences, Social and Behavioral Sciences
NA.
AS.080.400. Research Practicum: Language Disorders-Community Based Learning. 2.0 Credits.
This course provides the opportunity to learn about adult aphasias; language disorders which are one of the most common consequence of stroke. You will receive training in Supportive Communication Techniques and work as a communication partner with an individual with aphasia for two hours per week. Three class meetings for orientation and reading assignments will be held on campus; training and practicum will be conducted at a local aphasia support center. Transportation required. A valid driver’s license for zip car use. This is a two (2) credit practicum.
Prerequisites: NA
Corequisites: NA
Instructor(s): B. Rapp
Area: Natural Sciences, Social and Behavioral Sciences NA.

AS.080.411. Advanced Seminar: Neuroscience I. 3.0 Credits.
For students in the first semester of the BS/MS Program. Instructor permission required.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Baraban
Area: Natural Sciences NA.

AS.080.412. Advanced Seminar: Neuroscience II. 3.0 Credits.
For students in the 2nd semester of the BS/MS Program.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Baraban
Area: Natural Sciences NA.

AS.080.413. Advanced Seminar: Neuroscience III. 3.0 Credits.
For students in the 3rd semester of the BS/MS Program.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Baraban
Area: Natural Sciences NA.

AS.080.500. Scientific Communication: Neuroscience. NA Credit.
Scientific communication is crucial to advancing science. The Scientific Communication section is taken concurrently with Neuroscience Research and consists of a two hour research orientation session held at the beginning of the semester and a two hour exit session held at the end of the semester. The student is also expected to meet with their lab supervisor or attend a lab meeting once a week to understand the research the lab is currently working on and receive feedback on the work they are doing. See special notes section for specific meeting day/time. Students must sign up for Scientific Communication prior to signing up for NS Research until they complete their 6 credits of research. See Neuroscience Research website for more details.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.531 OR AS.080.541 OR AS.080.551 OR AS.080.561
Instructor(s): D. Smith; H. Adwanikar; J. Trageser; S. Sterbing-d’angelo
Area: NA

AS.080.511. Independent Study. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): J. Trageser
Area: NA

AS.080.512. Independent Study. 0.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): L. Gorman
Area: NA

AS.080.531. Research Neuroscience-Freshmen. 1.0 - 3.0 Credits.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500 (Scientific Communication)
Instructor(s): Staff
Area: NA

AS.080.534. Neuroscience Research- Freshmen. 0.0 - 3.0 Credits.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): Staff
Area: NA

AS.080.541. Research Neuroscience - Sophomores. 1.0 - 3.0 Credits.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500 (Scientific Communication)
Instructor(s): Staff
Area: NA

AS.080.544. Neuroscience Research-Sophomores. 0.0 - 3.0 Credits.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): Staff
Area: NA
AS.080.550. Neuroscience BS/MS Summer Research - Seniors. NA
Credit.
This summer research course is only for Neuroscience BS/MS students that are seniors in the program over the summer.
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): J. Baraban
Area: NA
NA.

AS.080.551. Research Neuroscience for Juniors. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500 (Scientific Communication)
Instructor(s): Staff
Area: NA
NA.

AS.080.554. Neuroscience Research - Juniors. 0.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): Staff
Area: NA
NA.

AS.080.561. Research Neuroscience for Seniors. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500 (Scientific Communication)
Instructor(s): Staff
Area: NA
NA.

AS.080.564. Neuroscience Research - Seniors. 0.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): Staff
Area: NA
NA.

AS.080.572. Direct Readings/Independent Study. 0.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): J. Baraban; L. Gorman
Area: NA
NA.

AS.080.582. Neuroscience: Internship. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): J. Trageser
Area: NA
NA.

AS.080.590. Independent Study. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): J. Baraban; J. Trageser
Area: NA
NA.

AS.080.592. Research-Freshmen. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): Staff
Area: NA
NA.

AS.080.594. Research-Sophomores. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): Staff
Area: NA
NA.

AS.080.595. Neuroscience: Internship. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): J. Trageser
Area: NA
NA.

AS.080.596. Research-Juniors-Summer. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): J. Baraban; L. Gorman
Area: NA
NA.
AS.080.597. Internship: Neuroscience. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: NA
Instructor(s): L. Gorman
Area: NA
NA.

AS.080.598. Research-Seniors-Summer. 1.0 - 3.0 Credits.
NA
Prerequisites: You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.
Corequisites: AS.080.500
Instructor(s): Staff
Area: NA
NA.

AS.080.601. Neuroeconomics -Graduate Level. NA Credit.
Every day decisions often require us to weigh the costs and benefits of engaging in a particular course of action in order to obtain some expected outcome. Unfortunately, we often lack the information necessary to obtain our desired goal with complete certainty. Economists have long been interested in understanding human decision-making under these circumstances. In parallel, neuroscientists have made great strides at describing the underlying neural basis of simple decision-making. However, despite much progress in both fields, our understanding of how the brain makes decisions is incomplete. In order to strengthen and further research in both fields, the interdisciplinary field of Neuroeconomics arose. This course will survey the field of Neuroeconomics focusing on theoretical concepts developed by economists and the role these theories are playing in guiding current experimental neuroscience. Only graduate students can register for this course. Instructor signature is required.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Trageser
Area: NA
NA.

This experiential learning experience provides the opportunity to learn and interact with children recovering from brain, spinal, and musculoskeletal injuries. Students will travel to the Kennedy Krieger Institute to volunteer in the Child Life Department where they will participate in a variety of therapeutic activities including playing with the children and helping them achieve goals on Saturdays (days/times TBA). Students will gain valuable clinical experience while learning patient empathy. Students MUST attend a mandatory orientation and a mandatory exit session held on the Homewood campus (see section web notes for days/times). Students are required to present a written description of their experiences and to discuss their experiences at the exit session. Transportation will be provided by the JHMI shuttle. No credit - S/U Grading Only
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Trageser
Area: NA
NA.

AS.080.612. Experiential Learning: Autism and other Neurological Disorders. NA Credit.
In this experiential learning experience, students will work with children who have a variety of neurological disabilities, including autism, cerebral palsy and Down syndrome through exercise and recreational activities. We partner with the KEEN (Kids Enjoy Exercise Now), a nonprofit organization. Student “coaches” will receive a profile for the KEEN athlete that they will pair up with during a session. Students will receive initial training and then select 4 sessions to attend. Sessions are held on the first and third Sunday of each month during the semester at KEEN centers in Maryland. Students MUST attend a mandatory orientation and a mandatory exit session held on the Homewood campus (see section web notes for days/times). Students are required to present a written description of their experiences and to discuss their experiences at the exit session. Transportation will be via student carpools using Zipcars, personal vehicles or Hop Vans. No credit - S/U Grading Only
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Trageser
Area: NA
NA.

AS.080.614. Experiential Learning: STEM in the Classroom. NA Credit.
STEM subjects are particularly important in today's society and getting students interested in these areas early is crucial. Working with Making Neuroscience Fun (MNF), a community outreach program, which brings age-appropriate interactive presentations about the brain and nervous system to Baltimore city and county elementary school students, our students share their love of the sciences with young children. The elementary school students learn about the nervous system and our students learn valuable communication skills. Hopkins students will receive initial training prior to participating and will select and present 6, 45-minute presentations. In order to participate, students must be available either 7am-11am or 11am-3pm at least one day per week, Monday-Friday. Students MUST attend a mandatory orientation, a mandatory training and a mandatory exit session held on the Homewood campus (see section web notes for days/times). Students are required to present a written description of their experiences and to discuss their experiences at the exit session. Students will also be given the opportunity to work with the faculty to develop new materials for the program. Presentations will take place at Baltimore city and county elementary schools. Transportation to the schools will be via student carpools using Zipcars or personal vehicles. No credit - S/U Grading Only
Prerequisites: NA
Corequisites: NA
Instructor(s): L. Gorman
Area: NA
NA.
AS.080.616. Experiential Learning: Working with Children in the Clinic. NA Credit.
This experiential learning experience provides students the opportunity to learn, play and interact with children receiving treatment in over 20 different specialties including dermatology, endocrine, GI, immunology, urology, plastics and hematology. Students will volunteer in outpatient clinics at the Johns Hopkins Children’s Center where they will encourage, provide developmentally supportive play for children and participate in a variety of activities including art projects, coloring, board games, and reading. Students will gain valuable clinical experience and be exposed to a wide range of children with a variety of diseases/illnesses. Students MUST attend a mandatory orientation and a mandatory exit session held on the Homewood campus (see section web notes for days/times. Students will sign up for 5 shifts on a first-come, first-serve basis after the mandatory orientation. Shifts are Mondays 1pm-3pm, Tuesdays 10am-12pm, Wednesdays 1pm-3pm, Thursdays 10am-12pm and Fridays 10am-12pm throughout the semester. Students are required to present a written description of their experiences and to discuss their experiences at the exit session. Volunteer shifts will take place at outpatient clinics in the Rubenstein Child Health Building. Transportation will be provided by the JHMI shuttle. No credit - S/U Grading Only
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Trageser
Area: NA
NA.

AS.080.620. Theoretical Neuroscience. NA Credit.
Topics of theoretical neuroscience and computational neuroscience will be discussed based on the original literature. Students are expected to actively participate in the discussion and also to present selected material to the class.
Prerequisites: NA
Corequisites: NA
Instructor(s): E. Niebur
Area: NA
NA.

AS.080.630. Bodian Seminar Series. NA Credit.
The Bodian Seminar is an interdisciplinary colloquium for discussion of current research into the neural basis of mental processes. Leading researchers, generally from outside the University, are invited to give lectures. About 12 lectures are scheduled per semester (see http://www.mb.jhu.edu/seminars.asp). Speakers, titles of lectures, and dates are announced to participants per e-mail (contact Debby Kelly, 410 516-8640). The announcements also include links to one or two recent publications of the speaker. Undergraduate students who register for this course are asked to study these papers and to prepare a question for each speaker together with a brief discussion of the possible answers. Question and discussion have to be in writing and turned in the day before the lecture. Undergraduates must e-mail the instructor for permission (von.der.heydt@jhu.edu) prior to registering for the course.
Prerequisites: NA
Corequisites: NA
Instructor(s): V. Stuphorn
Area: NA
NA.

AS.080.631. Bodian Seminar Series. NA Credit.
Graduate students and Seniors with instructor permission. The Bodian Seminar is an interdisciplinary colloquium for discussion of current research into the neural basis of mental processes. Leading researchers, generally from outside the University, are invited to give lectures. About 12 lectures are scheduled per semester (see http://www.mb.jhu.edu/seminars.asp). Speakers, titles of lectures, and dates are announced to participants per e-mail (contact Debby Kelly, 410 516-8640). The announcements also include links to one or two recent publications of the speaker. Undergraduate students who register for this course are asked to study these papers and to prepare a question for each speaker together with a brief discussion of the possible answers. Question and discussion have to be in writing and turned in the day before the lecture. Undergraduates must e-mail the instructor for permission (von.der.heydt@jhu.edu) prior to registering for the course.
Prerequisites: NA
Corequisites: NA
Instructor(s): V. Stuphorn
Area: NA
NA.

AS.080.660. Commencement Project. NA Credit.
This course is for BA/MS students that have completed their year of research and are now working on their final thesis. In this course, students devote their semester to preparing their final thesis documentation and move forward with their Master’s Thesis Defense which is the last piece to the program. This course is for BA/MS student only and students should only register for this course in their last semester in the program.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Baraban
Area: NA
NA.

AS.080.849. Teaching Practicum. NA Credit.
Permission required. Graduate students only.
Prerequisites: NA
Corequisites: NA
Instructor(s): L. Gorman
Area: NA
NA.

AS.080.850. Mentored Research: Neuroscience I. NA Credit.
For students in the BA/MS Program first semester. Permission required.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Baraban
Area: NA
NA.

AS.080.851. Mentored Research: Neuroscience. NA Credit.
NA
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Baraban
Area: NA
Writing Intensive.
AS.080.852. Mentored Research: Neuroscience II. NA Credit.
Permission Required. For students in the BA/MS Program.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Baraban
Area: NA
NA.

AS.080.854. Mentored Research: Neuroscience III. NA Credit.
For students in the BA/MS Program Permission required.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Baraban
Area: NA
NA.

Cross Listed Courses

Biology
AS.020.317. Signaling in Development and Disease. 3.0 Credits.
An advanced undergraduate level seminar on current topics on signal transduction mechanisms underlying neuronal morphology, development and function. The proper functioning of the nervous system relies on the establishment of precise neuronal circuits through a developmental program including proliferation, neuronal migration, axonal growth, and neuronal survival. This course pertains to the extracellular cues and downstream neuronal signaling pathways that coordinate these key events during neuronal development. The course will also cover the role of aberrant signaling mechanisms in neuronal degeneration and disease. Recommended Course Background: AS.020.305, AS.020.306, and AS.080.306
Prerequisites: NA
Corequisites: NA
Instructor(s): R. Kuruvilla
Area: Natural Sciences
NA.

Cognitive Science
AS.050.105. Introduction to Cognitive Neuropsychology. 3.0 Credits.
When the brain is damaged or fails to develop normally, even the most basic cognitive abilities (such as the ability to understand words, or perceive objects) may be disrupted, often in remarkable ways. This course explores a wide range of cognitive deficits, focusing on what these deficits can tell us about how the normal brain works. Topics include brain anatomy and causes of brain damage, reading and spelling deficits, unilateral spatial neglect, hemispheric disconnection, cortical plasticity, and visual perception of location and orientation. Students read primary sources: journal articles that report deficits and discuss their implications.
Prerequisites: NA
Corequisites: NA
Instructor(s): M. McCloskey
Area: Natural Sciences, Social and Behavioral Sciences
NA.

When we think about our ability to see, we tend to think about our eyes, but in fact vision happens mostly in the brain. This course explores the remarkable perceptual deficits that occur when the visual regions of the brain are damaged or fail to develop normally, focusing on what these perceptual malfunctions tell us about normal visual perception. Topics include visual system anatomy and physiology; functional specialization in the lower visual system as revealed by cerebral achromatopsia (color blindness resulting from brain damage) and akinetopsia (impaired motion perception); cortical plasticity in the visual system; spatial deficits in perception and action; and the implications of high-level visual deficits, including prosopagnosia (impaired face recognition), Charles Bonnet syndrome (complex visual hallucinations in blind areas of the visual field), blindsight (accurate responding to visual stimuli despite apparent inability to see them), and aphantasia (lack of visual imagery).
Prerequisites: AS.050.105 OR AS.050.203 OR AS.080.203 OR AS.050.101 OR AS.200.110 OR AS.200.211 or instructor's permission.
Corequisites: NA
Instructor(s): M. McCloskey
Area: Natural Sciences, Social and Behavioral Sciences
NA.

AS.050.326. Foundations of Cognitive Science. 3.0 Credits.
This course explores general issues and methodologies in cognitive science through the reading of classic works (from Plato and Kant through Skinner and Turing) and recent research articles to begin construction of a coherent picture of many seemingly divergent perspectives on the mind/brain. Recent brain-based computational models serve to focus discussion. Also offered as AS.050.626.
Prerequisites: NA
Corequisites: NA
Instructor(s): P. Smolensky
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

AS.050.332. Developmental Cognitive Neuroscience. 3.0 Credits.
In-depth examination of the current literature on cognitive development in the context of developmental cognitive neuroscience. Please see course prerequisites. Meets with AS.050.632.
Prerequisites: AS.050.101 OR AS.050.339 OR AS.200.132 OR AS.050.105 OR Instructor’s Permission.
Corequisites: NA
Instructor(s): B. Landau
Area: Natural Sciences, Social and Behavioral Sciences
NA.

AS.050.339. Cognitive Development. 3.0 Credits.
This is a survey course in developmental psychology designed for individuals with some basic background in psychology or cognitive science, but little or none in development. The course is strongly theoretically oriented, with emphasis on issues of nature, and development psychology as well as relevant empirical evidence. The principle focus will be early development, i.e., from conception through middle childhood. The course is organized topically, covering biological and prenatal development, perceptual and cognitive development, the nature and development of intelligence, and language learning.
Prerequisites: NA
Corequisites: NA
Instructor(s): J. Yarmolinskaya
Area: Natural Sciences, Social and Behavioral Sciences
NA.
**AS.050.626. Foundations of Cognitive Science. NA Credit.**

Also offered as AS.050.326. This course explores general issues and methodologies in cognitive science through the reading of classic works (from Plato and Kant through Skinner and Turing) and recent research articles to begin construction of a coherent picture of many seemingly divergent perspectives on the mind/brain. Recent brain-based computational models serve to focus discussion.

**Prerequisites:** NA
**Corequisites:** NA

Instructor(s): P. Smolensky
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

**AS.050.639. Cognitive Development. NA Credit.**

Also offered as AS.050.339. This is a survey course in developmental psychology designed for individuals with some basic background in psychology or cognitive science, but little or none in development. The course is strongly theoretically oriented, with emphasis on issues of nature, and development psychology as well as relevant empirical evidence. The principle focus will be early development, i.e., from conception through middle childhood. The course is organized topically, covering biological and prenatal development, perceptual and cognitive development, the nature and development of intelligence, and language learning.

**Prerequisites:** NA
**Corequisites:** NA

Instructor(s): J. Yarmolinskaya
Area: NA
NA.

**Psychological Brain Sciences**

**AS.200.141. Foundations of Brain, Behavior and Cognition. 3.0 Credits.**

A survey of neuropsychology relating the organization of behavior to the integrative action of the nervous system. Cross-listed with Behavioral Biology and Neuroscience.

**Prerequisites:** NA
**Corequisites:** NA

Instructor(s): D. Smith
Area: Natural Sciences, Social and Behavioral Sciences
NA.

**AS.200.302. Behavioral Assessment of Animal Models of Cognition and Neuropsychiatric Disorders. 3.0 Credits.**

What does a rat exploring its environment tell us about memory? How can a mouse help us better understand schizophrenia? This course will focus on procedures that are routinely used to study behavior in animal models of cognition and neuropsychiatric disorders. The procedures discussed will include assessments that fall into 3 broad functional domains: motor function, affective or emotional states, and cognition. Throughout the course, we will read and discuss original research articles to illustrate and compare some of the measures and results from the various procedures. Postdoc Teaching Fellowship. This is designed to be an upper level course.

**Prerequisites:** Pre-reqs: AS.200.141 OR (AS.080.305 AND AS.080.306) or permission of the instructor.
**Corequisites:** NA

Instructor(s): D. Smith
Area: Social and Behavioral Sciences
NA.

**AS.200.304. Neuroscience of Decision Making. 3.0 Credits.**

This course will survey the neural mechanisms of decision-making. Current experimental research and theory concerning selection, control, and evaluation of actions are examined in humans and animals. Topics will range from simple perceptual judgements to complex social behavior. The course involves a weekly lecture about a specific topic followed by a student presentation of a current research paper. Cross-listed with Neuroscience.

**Prerequisites:** AS.080.305 OR AS.200.141
**Corequisites:** NA

Instructor(s): V. Stuphorn
Area: Natural Sciences
NA.

**AS.200.329. Real World Human Data: Analysis & Visualization. 3.0 Credits.**

Experiments in human cognition typically involve careful manipulation and control of variables in order to answer specific questions about the mind or brain. However, digital devices now provide an ocean of incidental human data: information collected continuously about our behavior and physiological states as we go about our lives. These incidental datasets are often large and noisy, and pose different analysis and visualization challenges from more traditional manipulated experiments. In this course students will learn computational tools and qualitative approaches for exploring, visualizing and interpreting large human data. The course emphasizes computer-based analysis of open-source human behavioral and neuroimaging datasets. Analyses will be conducted in MATLAB. Instructor will grant approval as long as you have previous programming experience (roughly equivalent to material covered in an introductory-level programming course). Self-taught or real-world experience can be applicable in lieu of previous formal classroom instruction.

**Prerequisites:** NA
**Corequisites:** NA

Instructor(s): J. Chen
Area: Quantitative and Mathematical Sciences, Social and Behavioral Sciences
NA.

**AS.200.334. Human Memory Psychology. 3.0 Credits.**

This class will survey the behavioral and biological science of human memory. Historical perspectives as well as modern controversies will be discussed. Intersections with other fields such as law, education, medicine, and technology will be highlighted. The course will be a mixture of lectures and group discussions.

**Prerequisites:** NA
**Corequisites:** NA

Instructor(s): J. Chen
Area: Social and Behavioral Sciences
NA.

**AS.200.344. Behavioral Endocrinology. 3.0 Credits.**

An examination of the effects of hormones on behavior in non-human and human animals. Topics will include the effects of hormones on sexual differentiation, reproductive behavior, parental behavior, homeostasis and biological rhythms, regulation of body weight, learning and memory. Cross-listed with Behavioral Biology and Neuroscience.

**Prerequisites:** (AS.200.141 OR AS.080.306) OR (AS.020.151 AND AS.020.152) OR (AS.020.305 AND AS.020.306) or instructor’s permission
**Corequisites:** NA

Instructor(s): K. Porth-Bohn
Area: Natural Sciences, Social and Behavioral Sciences
NA.
AS.200.368. Sleep, Dreams, and Altered States of Consciousness. 3.0 Credits.
Sleep, dreaming, resting and arousal to waking represent very different states of consciousness which differ dramatically both psychologically and physiologically. This course focuses on cognitive, psychological, physiological, biological and genetic aspects characterizing each of these states with some reference to other altered states. The course includes a focus on the major pathologies affecting sleep-wake states. Clinical cases will be considered. These inform about both psychological and biological aspects of these states. The relative biological functions of each state will be evaluated with particular attention to the mystery of why we have and apparently need REM and NREM sleep. Actual physiological recordings of sleep states will be reviewed and the student will learn how these are obtained and how to evaluate these. The circadian rhythms, ontogeny and evolution of these sleep-wake states will also be covered. This will include a review of information learned from non-human animal sleep. The change from sleep to full awakening reflects change toward increasing brain organization supporting consciousness. Understanding of the neurobiology of these states will be used to explore some of the more modern and scientific concepts of human self-awareness or consciousness. Recommended Course Background: AS.200.101 OR AS.080.203 OR AS.050.203
Prerequisites: NA
Corequisites: NA
Instructor(s): R. Allen
Area: Natural Sciences, Social and Behavioral Sciences
NA.

AS.200.376. Neuropsychopharmacology. 3.0 Credits.
Designed to provide information about how drugs affect the brain and behavior. The course focuses on biological concepts underlying structures and functions of the brain that relate to mental disorders. An introduction to neurobiology and brain function is presented as it applies to the interaction of various classes of drugs with the individual neurotransmitter systems in the brain. A brief historic review is followed by a discussion of clinical relevance. Cross-listed with Behavioral Biology and Neuroscience. Enrollment limited to juniors and seniors. Prerequisites: (AS.080.305 AND AS.080.306) OR AS.020.306 AND AS.020.312) OR (AS.200.141 AND AS.020.306)
Corequisites: NA
Instructor(s): S. Sterbing-d’angelo
Area: Natural Sciences, Social and Behavioral Sciences
NA.