BEHAVIORAL BIOLOGY PROGRAM

http://krieger.jhu.edu/behavioralbiology

The David S. Olton Behavioral Biology Program seeks to establish a greater understanding of the relations of brain and behavior through an interdisciplinary program of study. Students in the Behavioral Biology Program examine the complex interplay between environment and behavior, and the processes and mechanisms that underlie behavior. One goal of the program is for students to learn how to integrate scientific discoveries from the wide array of scientific fields of inquiry that contribute to the study of behavioral biology, from molecular biology to sociology.

The interdisciplinary characteristics of the Behavioral Biology Program provide an excellent preparation for postgraduate work. For those interested in the health professions, behavioral biology can be integrated into a premedical curriculum that will provide a broad, humanistic perspective. For those who wish to pursue scientific careers in psychopharmacology, behavioral neuroscience, and physiological psychology, the program provides excellent preparation. Students interested in the fields of organismal or integrative biology should also consider this major.

Many students ask about the similarities and differences between the behavioral biology major and the neuroscience major. Both of these programs are interdepartmental, and a majority of professors teach courses that are listed for both majors. Behavioral Biology majors can explore many aspects of the biology of behavior, including the neural mechanisms of behavior (which obviously overlaps with the neuroscience major), but also biomechanical, evolutionary, ecological, and social aspects of behavior. The behavioral biology major also has fairly liberal course requirements which provide students with an opportunity to explore more choices in their liberal arts education. Students majoring in neuroscience focus directly on the brain and on neural function/mechanisms. Generally speaking, the systems Neuroscience focus area into a premedical curriculum that will provide a broad, humanistic perspective. For those who wish to pursue scientific careers in psychopharmacology, behavioral neuroscience, and physiological psychology, the program provides excellent preparation. Students interested in the fields of organismal or integrative biology should also consider this major.

The core program of the behavioral biology major provides background and breadth in

1. The life sciences (e.g., biology and neuroscience)
2. The natural sciences (e.g., chemistry and physics) and mathematics (e.g., calculus and statistics)
3. The social and behavioral sciences (e.g. psychology and anthropology)

The exact courses to be taken are determined by the student in conjunction with the faculty advisor. A grade of C- or better is required for courses fulfilling major requirements and courses may not be taken satisfactory/unsatisfactory. Hopkins undergraduates may enter the Behavioral Biology Program at any time, provided all requirements can be completed before graduation.

Additional information regarding the Behavioral Biology Program is available through our website at http://krieger.jhu.edu/behavioralbiology. You may also contact our Academic Program Administrator, Linda White, linda.m.white@jhu.edu or 410-516-6196.

Requirements for the B.A. Degree
Also see Requirements for a Bachelor's Degree. (http://e-catalog.jhu.edu/undergrad-students/academic-policies/requirements-for-a-bachelors-degree) Requirements for the behavioral biology major are as follows:

Math and Science Core Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.030.101 &amp; AS.030.105</td>
<td>Introductory Chemistry I and Introductory Chemistry Laboratory I</td>
<td>4</td>
</tr>
<tr>
<td>AS.030.102 &amp; AS.030.106</td>
<td>Introductory Chemistry II and Introductory Chemistry Laboratory II</td>
<td>4</td>
</tr>
<tr>
<td>AS.030.103</td>
<td>Applied Chemical Equilibrium and Reactivity w/lab</td>
<td>4</td>
</tr>
<tr>
<td>AS.171.101</td>
<td>General Physics: Physical Science Major I</td>
<td>4</td>
</tr>
<tr>
<td>AS.171.103 &amp; AS.171.107</td>
<td>General Physics for Biological Science Majors</td>
<td>4</td>
</tr>
<tr>
<td>AS.171.111</td>
<td>General Physics Laboratory I</td>
<td>1</td>
</tr>
<tr>
<td>AS.171.102</td>
<td>General Physics: Physical Science Major II</td>
<td>4</td>
</tr>
<tr>
<td>AS.171.104 &amp; AS.171.108</td>
<td>General Physics/Biology Majors II and Physical Science Majors (AL)</td>
<td>4</td>
</tr>
<tr>
<td>AS.173.112</td>
<td>General Physics Laboratory II</td>
<td>1</td>
</tr>
<tr>
<td>AS.110.106</td>
<td>Calculus I (Biology and Social Sciences)</td>
<td>4</td>
</tr>
<tr>
<td>AS.110.108</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>AS.110.109</td>
<td>Calculus II (For Biological and Social Science)</td>
<td>4</td>
</tr>
<tr>
<td>AS.110.110</td>
<td>Calculus II (For Physical Sciences and Engineering)</td>
<td>4</td>
</tr>
<tr>
<td>AS.110.113</td>
<td>Honors Single Variable Calculus</td>
<td>1</td>
</tr>
</tbody>
</table>

One Statistics Option. Students may select from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN.553.111 &amp; EN.553.112</td>
<td>Statistical Analysis I and Statistical Analysis II</td>
<td>8</td>
</tr>
<tr>
<td>EN.553.211</td>
<td>Probability and Statistics for the Life Sciences</td>
<td>4</td>
</tr>
<tr>
<td>EN.553.310</td>
<td>Probability &amp; Statistics</td>
<td>4</td>
</tr>
<tr>
<td>EN.553.311</td>
<td>Probability and Statistics for the Biological Sciences and Engineering</td>
<td>4</td>
</tr>
</tbody>
</table>

Biology Sequence

Students must have 2 of the following Biology Options. Students can use any combination of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.020.151 &amp; AS.020.153</td>
<td>General Biology I and General Biology Laboratory I (see footnote about AP Biology credits)</td>
<td>4</td>
</tr>
<tr>
<td>AS.020.152 &amp; AS.020.154</td>
<td>General Biology II and General Biology Lab II (see footnote about AP Biology credits)</td>
<td>4</td>
</tr>
<tr>
<td>AS.020.303 &amp; AS.020.340</td>
<td>Genetics and Developmental Genetics Lab (Lab)</td>
<td>5</td>
</tr>
<tr>
<td>AS.020.305 &amp; AS.020.315</td>
<td>Biochemistry and Biochemistry Project lab (AS.250.253/254 may substitute for AS.020.315)</td>
<td>5</td>
</tr>
<tr>
<td>AS.020.306 &amp; AS.020.316</td>
<td>Cell Biology and Cell Biology Lab</td>
<td>5</td>
</tr>
<tr>
<td>AS.020.374 &amp; AS.020.377</td>
<td>Comparative Animal Physiology and Comparative Physiology Lab</td>
<td>4</td>
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</table>

Behavioral Biology Core Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.290.101</td>
<td>Human Origins</td>
<td>3</td>
</tr>
<tr>
<td>AS.200.141</td>
<td>Foundations of Brain, Behavior and Cognition</td>
<td>3</td>
</tr>
<tr>
<td>AS.200.208</td>
<td>Animal Behavior</td>
<td>3</td>
</tr>
<tr>
<td>AS.080.250</td>
<td>Neuroscience Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>AS.290.490</td>
<td>Senior Seminar: Behavioral Biology</td>
<td>1</td>
</tr>
</tbody>
</table>
Behavioral Biology Program

Behavioral Biology Elective Courses **
Nine credits of advanced bio-behavioral science courses (BEHB-BIOBEH)
Six credits of intermediate/advanced social/developmental/cognitive sciences courses (BEHB-SOCSCI)

Research or Internship Requirement
AS.290.500 Connections in Behavioral Biology 0.5
Behavioral biology research or internship (one semester)

* For students with AP Biology credit, they may use only one course and its lab from those credits towards this requirement. Therefore, these student 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.

** Students should refer to the program website (http://krieger.jhu.edu/behavioralbiology/courses) or the schedule of classes to identify elective choices.

Sample Program
This is only one of many possible course sequences that students may elect to follow; it assumes that students do not have any AP/IB/TR courses to apply toward their degrees.

Freshman

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.110.106 Calculus I (Biology and Social Sciences)</td>
<td>4</td>
<td>AS.110.107 Calculus II (For Biological and Social Science)</td>
<td>4</td>
</tr>
<tr>
<td>AS.030.101 Introductory Chemistry I</td>
<td>3</td>
<td>AS.030.102 Introductory Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>AS.030.105 Introductory Chemistry Laboratory I</td>
<td>1</td>
<td>AS.030.106 Introductory Chemistry Laboratory II</td>
<td>1</td>
</tr>
<tr>
<td>AS.200.141 Foundations of Brain, Behavior and Cognition</td>
<td>3</td>
<td>AS.290.101 Human Origins</td>
<td>3</td>
</tr>
</tbody>
</table>

Sophomore

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology Option 1</td>
<td>3-4 Biology Option 2</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Biology Lab Option 1</td>
<td>1-3 Biology Lab Option 2</td>
<td>1-3</td>
<td></td>
</tr>
<tr>
<td>AS.200.208 Animal Behavior</td>
<td>3</td>
<td>EN.553.112 Statistical Analysis II</td>
<td>4</td>
</tr>
<tr>
<td>EN.553.111 Statistical Analysis I</td>
<td>4</td>
<td>Upper Level Elective (BEHB-BIOBEH)</td>
<td>3</td>
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</table>

Junior

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.171.103 General Physics I for Biological Science Majors</td>
<td>4</td>
<td>AS.171.104 General Physics/Biology Majors II</td>
<td>4</td>
</tr>
<tr>
<td>AS.173.111 General Physics Laboratory I</td>
<td>1</td>
<td>AS.173.112 General Physics Laboratory II</td>
<td>1</td>
</tr>
<tr>
<td>Upper Level Elective (BEHB-BIOBEH)</td>
<td>3</td>
<td>Upper Level Elective (BEHB-SOCSCI)</td>
<td>3</td>
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</tbody>
</table>

Research or Internship
AS.290.500 Connections in Behavioral Biology 0.5

Senior

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS.080.250 Neuroscience Laboratory*</td>
<td>3</td>
<td>Upper Level Elective (BEHB-BIOBEH)</td>
<td>3</td>
</tr>
<tr>
<td>Upper-Level Elective (BEHB-SOCSCI)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS.290.490 Senior Seminar: Behavioral Biology**</td>
<td>1</td>
<td></td>
<td></td>
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</tbody>
</table>

Senior Total Credits: 71.5-79.5

* AS.080.250 Neuroscience Laboratory can be taken anytime after AS.200.141
** AS.290.490 Senior Seminar: Behavioral Biology can be taken either Fall or Spring of senior year.

Honors in the Major
To receive honors in behavioral biology, students must have met the following criteria:

1. Earn a GPA of 3.5 or better in major requirements
2. Conduct research and give a research presentation
3. Receive a recommendation from research mentor

For current faculty and contact information go to http://krieger.jhu.edu/behavioralbiology/faculty_directory/

Faculty

Chair
Christopher Honey, Ph.D
Assistant Professor, Psychological and Brain Sciences
Director of Undergraduate Studies
Linda Gorman, Ph.D
Teaching Professor, Psychological and Brain Sciences

Professor
Peter Holland, Ph.D
Psychological and Brain Sciences

Lecturers
Kirsten Bohn, Ph.D
Psychological and Brain Sciences
Chris Kraft, Ph.D
Johns Hopkins Center for Marital and Sexual Health, Sexual Behaviors Consultation Unit, Johns Hopkins Medical Institutions
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.290.101. Human Origins. 3.0 Credits.**
This course examines the origins of human structure, function and behavior from an evolutionary perspective. It includes study of the evolution, behavior and behavioral ecology of nonhuman primates, hominid evolution (including the paleontological and archaeological records), and the origins of human cognition, social behavior and culture. Instructor(s): P. Holland
Area: Natural Sciences, Social and Behavioral Sciences.

**AS.290.303. Animal Communication. 3.0 Credits.**
This course examines animal communication in all modalities (especially sound, sight, and scent) across taxa. Production, perception and evolution of signals will be discussed. Students will learn how to conduct research and write scientific papers in publication form. Prerequisites: (AS.200.208 OR AS.200.141) AND ( AS.171.102 OR AS.171.104)
Instructor(s): K. Bohn
Area: Natural Sciences, Social and Behavioral Sciences.

**AS.290.304. Comparative Neuroanatomy. 3.0 Credits.**
This course examines the phylogenetic and developmental history of the central nervous system across the vertebrate tree of life, with emphasis on the deep history of those features that characterize the human brain. We will study how our understanding of non-human vertebrates (both model and non-model organisms) can provide important insights into the structure and function of the modern human brain. Prerequisites: (AS.080.305 AND AS.080.306) OR AS.200.141
Instructor(s): A. Balanoff
Area: Natural Sciences.

**AS.290.420. Human Sexual Orientation. 3.0 Credits.**
This course will examine the historical and current theories of sexual orientation and sexual variation development by examining the biological, psychological and social contributing factors that influence the development of sexual orientations and variations along with treatment and modification of problematic sexual behaviors. Please note that the use of electronic devices is not permitted during this class, in order to promote the full interactive potential of this engaging seminar-style offering. Students may enroll in both AS.200.204 and AS.290.420, but cannot do so in the same semester. Enrollment is limited to Senior Majors & Minors in Behavioral Biology, Biology; Cognitive Science; Medicine, Science & the Humanities; Molecular & Cellular Bio; Neuroscience; Psychology; Public Health; Sociology; Study of Women, Gender, & Sexuality.
Corequisites: Students may enroll in both AS.200.204 and AS.290.420, but cannot do so in the same semester.
Instructor(s): C. Kraft
Area: Social and Behavioral Sciences.

**AS.290.490. Senior Seminar: Behavioral Biology. 1.0 Credit.**
Great ideas in Behavioral Biology. Discussion of classic and cutting edge articles in the original literature. Student presentations and reaction papers. Capstone course for senior Behavioral Biology majors. Prerequisites: (AS.290.101 AND AS.200.208 AND AS.200.141) or Instructor permission.
Instructor(s): C. Moss; P. Holland
Area: Social and Behavioral Sciences.

**AS.290.500. Connections in Behavioral Biology. 0.5 Credit.**
A small group of students will meet two times in the semester to share experiences and information on research, internship and volunteer activities in Behavioral Biology. This course is designed to 1) help Behavioral Biology majors obtain real world experiences that can lead to opportunities after graduation, 2) provide an informal setting to develop oral and written communication skills, and 3) build community among students in the major. Students will make oral presentations to the group about activities they wish to pursue or have already completed. Students will also write a short paper/news piece or prepare a webpage on an internship, research or volunteer experience. Instructor(s): Staff.

**AS.290.501. Research-Freshmen. 3.0 Credits.**
Instructor(s): Staff.

**AS.290.502. Research-Freshmen. 1.0 - 3.0 Credits.**
Instructor(s): Staff.

**AS.290.503. Research-Sophomores. 3.0 Credits.**
Instructor(s): Staff.

**AS.290.504. Research-Sophomores. 1.0 - 3.0 Credits.**
Instructor(s): Staff.

**AS.290.505. Research-Juniors. 3.0 Credits.**
Instructor(s): Staff.

**AS.290.506. Research-Juniors. 1.0 - 3.0 Credits.**
Instructor(s): Staff.

**AS.290.507. Research-Seniors. 3.0 Credits.**
Instructor(s): Staff.

**AS.290.508. Research-Seniors. 1.0 - 3.0 Credits.**
Instructor(s): Staff.

**AS.290.519. Independent Study. 3.0 Credits.**
Instructor(s): L. Gorman.

**AS.290.520. Independent Study. 1.0 - 3.0 Credits.**
Instructor(s): C. Moss; K. Bohn; L. Gorman.

**AS.290.590. Behavioral Biology Internship. 1.0 - 3.0 Credits.**
Instructor(s): Staff.

**AS.290.594. Behavioral Biology Internship. 1.0 Credit.**
Instructor(s): C. Moss; L. Gorman.

**AS.290.596. Behavioral Biology Internship. 1.0 - 3.0 Credits.**
Instructor(s): L. Gorman.

**AS.290.597. Research - Summer. 3.0 Credits.**
Instructor(s): C. Moss; E. Fortune; F. Madison; K. Bohn; L. Gorman.

**Cross Listed Courses**

**Biology**

**AS.020.151. General Biology I. 3.0 Credits.**
This course is an introduction to biology from an evolutionary, molecular and cellular perspective. Specific topics and themes include evolutionary theory, the structure and function of biological molecules, mechanisms of harvesting energy, cell division, classical genetics and gene expression. This section will involve in-class problem solving and the use of assigned pre-class videos and questions. Instructor(s): C. Roberson; R. Pearlman; R. Shingles
Area: Natural Sciences.
AS.020.152. General Biology II. 3.0 Credits.
This course builds on the concepts presented and discussed in General Biology I. The primary foci of this course will be on the diversity of life and on the anatomy, physiology, and evolution of plants and animals. There will be a special emphasis on human biology.
Prerequisites: Prereg: AS.020.151
Instructor(s): C. Roberson; R. Pearlman; R. Shingles
Area: Natural Sciences.

AS.020.153. General Biology Laboratory I. 1.0 Credit.
This course reinforces the topics covered in AS.020.151. Students participate in a semester-long project, identifying bacteria from Homewood campus soils using molecular biology techniques. Other laboratory exercises cover aspects of evolution, genomics and biochemistry. Cross-listed with Behavioral Biology. Student must have enrolled in AS.020.151 either this term or in past terms. Students who have credit for AP Biology but take General Biology Lab I will lose four credits of AP Biology credit. Cross-listed with Behavioral Biology.
Prerequisites: Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module;AS.020.151
Instructor(s): R. Pearlman
Area: Natural Sciences.

Anthropology
AS.070.352. Evolution, Ecology, Becoming. 3.0 Credits.
The concept of evolution is central to social theory. Originating in the question of the species, it has moved into questions of human ecology, cultural forms and modes of thought. While it remains a deeply contested, often criticized concept, particularly in its neo-Darwinian manifestation, it orients anthropological thinking in ways that are as yet to be examined. Reaching into the archives of anthropology and other cognate disciplines, this course will examine the writings of Lyell, Darwin, Marx, Morgan, Boas, Steward, Bateson, Ingold among others. Co-listed with AS.070.610
Instructor(s): A. Goodfellow; N. Khan
Area: Humanities, Social and Behavioral Sciences.

Neuroscience
AS.080.330. Brain Injury & Recovery. 3.0 Credits.
This course investigates numerous types of brain injuries and explores the responses of the nervous system to these injuries. The course’s primary focus is the cellular and molecular mechanisms of brain injury and the recovery of function. Discussions of traumatic brain injury, stroke, spinal cord, and tumors, using historical and recent journal articles, will facilitate students’ understanding of the current state of the brain injury field. Cross-listed with Psychological and Brain Sciences and Behavioral Biology.
Prerequisites: (AS.080.305 AND AS.080.306) OR (AS.020.312 OR AS.020.306) OR (200.141 and 200.306) OR Permission of Instructor
Instructor(s): L. Gorman
Area: Natural Sciences
Writing Intensive.

AS.080.348. Science of Learning. 3.0 Credits.
Can what we know about the brain guide how we learn or teach in our schools? This seminar course is designed to address this question. In this course we will focus on the science of what we know about learning and teaching (and not the politics) to see if we can actually use the research to “optimize learning in society”. As we read the literature, we will look at some of the “neuromyths” that have been propagated thus far and discuss how to avoid creating new neuromyths by effectively communicating the research.
Prerequisites: Pre-reqs: AS.080.306 OR AS.200.141
Instructor(s): L. Gorman
Area: Natural Sciences, Social and Behavioral Sciences
Writing Intensive.

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.
Instructor(s): L. Gorman
Area: Natural Sciences, Social and Behavioral Sciences.

AS.200.208. Animal Behavior. 3.0 Credits.
Examines basic principles of animal behavior (orientation, migration, communication, reproduction, parent-offspring relations, ontogeny of behavior and social organization). Evolution and adaptive significance of behavior will be emphasized.
Prerequisites: AS.200.141 OR AS.200.152 OR Permission of Instructor.
Instructor(s): K. Bohn
Area: Natural Sciences, Social and Behavioral Sciences.

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: Prereqs: (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
Instructor(s): K. Bohn
Area: Natural Sciences, Social and Behavioral Sciences.

AS.200.376. Psychopharmacology. 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.200.141 OR AS.020.306 OR AS.080.305 or Instructor Permission
Instructor(s): H. Adwanikar; S. Sterbing-d’angelo
Area: Natural Sciences, Social and Behavioral Sciences.
AS.200.386. Animal Cognition. 3.0 Credits.
Examine relations between brain, mind, and behavior in nonhuman animals, focusing on topics such as learning, memory, attention, decision-making, navigation, communication, and awareness. We will take a variety of approaches, including behavioral, computational, evolutionary, neurobiological, and psychological perspectives.

Prerequisites: AS.200.141 OR AS.200.208 OR AS.290.101 or Instructor permission.
Instructor(s): P. Holland
Area: Social and Behavioral Sciences.