

Biology 11

The Science of Life: Animal Minds

Professors

Prof. Tom Jack LSC 331 Office Hours: Tues. 1:15-2:45 (except 4/9) or by appointment

Prof. Mark Laidre LSC 221 Office Hours: Mon. 11:15-12:45 or by appointment

Additional office hours will be added prior to quizzes.

Overview

Biology 11 is open to all students interested in biology. For many, it is the appropriate entry course for all other major courses in biology. There are several offerings of Bio 11 each year. Each is designed to provide a synthetic overview of the life sciences, and to introduce the fundamental ideas, processes and theories on which the modern life sciences are built. Different offerings of Biology 11 have different themes that the instructors have chosen to meet these goals. Different offerings may be organized somewhat differently, in the way the professors combine to organize the class sessions, the scheduling of discussions, and the role of quizzes, exams and papers in student assessment.

All Bio 11 offerings will cover the key principles and concepts in biology. However, the specifics of what you learn in “Animal Minds” will be different from other offerings of Biology 11. A useful analogy is to think about Biology 11 as a first-year seminar in biology. Dartmouth’s first-year writing seminars are focused on different topics, but all teach valuable writing skills. Similarly, Biology 11 offerings feature different specific information, but provide learning experiences to think critically and in a more sophisticated way about biology.

We have chosen “Animal Minds” as a theme, to highlight how a seemingly mysterious phenomena (what goes on in animals’ heads) can be subject to rigorous scientific discovery. Darwin claimed that other species share the same “mental powers” as humans, only to different degrees. This course will examine the evidence for Darwin’s claim, focusing on the evolutionary, neural, and molecular basis of animal cognition. We will ask how and why organisms behave as they do, exploring the ways in which evolution has adapted organisms’ information gathering, perception, learning ability, memory, and decision making to both their physical and social world. Key examples will be drawn from navigation, tool-use, communication, and cultural imitation. An overarching emphasis will be placed on the active process of scientific discovery, especially how strong inference and multiple competing hypotheses enable scientists to make discoveries.

An important component of each class session is small group activities in which students will be challenged to develop competing hypotheses, design critical experiments, and test their hypotheses in a field and a laboratory exercise, thus experiencing firsthand how scientific conclusions are drawn on the workings of animal minds.

Prerequisites

There are no prerequisites for Bio 11; it is open to all students.

Readings

Readings in the course will be posted on the course Canvas site. Some readings will be taken from journal articles and some from the following books:

Shettleworth, S.J. 2009. *Cognition, Evolution, and Behavior*. Oxford University Press.
Bekoff, M., C. Allen & G.M. Burghardt. 2002. *The Cognitive Animal*. MIT Press.
Griffin, D.R. 2001. *Animal Minds*. University of Chicago Press.
Gould, J.L. & C.G. Gould 1999. *The Animal Mind*. Scientific American Library.

Popular science book (required):

Heinrich, B. 1999. *Mind of the Raven*. New York: HarperCollins.

We will provide a schedule for you to read Bernd Heinrich's book during the course, since one question on each quiz and some questions on the final will test your knowledge of assigned pages from this book. Although this book is a popular science account, with an easy-to-read style, it exemplifies the type of rigorous approach that is essential to studying animal minds. This approach includes detailed natural history observations in the wild, followed by critical field and laboratory experiments. Heinrich's book elegantly unravels the types of ecological and social problems that raven brains have been shaped to solve by evolution, and it provides an excellent firsthand account of what it means to do science. It may also be inspiring to learn how a 'local biologist' (Heinrich is a Professor Emeritus at University of Vermont) undertook path-breaking scientific studies, literally, in the backyard.

Optional textbook:

Recommended: We will assign background readings from a general comprehensive biology text: *Biological Science* by Scott Freeman (Pearson/Prentice Hall). Only rarely will material presented in class match this text closely, but Freeman covers much of the basic science underlying the course, and would be a useful reference for further studies in biology. In previous offerings of Bio 11, some students found Freeman extremely useful, while others did not use it at all. This reflects different levels of interest and motivation, as well as different levels of high school biology preparation among the students taking Bio 11.

Learning Objectives

There are five learning objectives of this course. At the completion of the course, students will be able to 1) communicate key concepts in biology, 2) think critically and analytically about science, 3) understand how scientific hypotheses are designed and tested, 4) draw valid conclusions from visual display of data, 5) be conversant in the specific material (i.e. behavioral biology and cognition) that is the focus of "Animal Minds".

Office hours

There will be several hours of office hours per week. We have tried to schedule office hours at different times of day and different days of the week to accommodate varying student schedules. We are also available to meet with students by appointment (email to arrange).

Special appointments

If you have particular concerns, difficulties or interests that you would like to discuss individually, email to set up an appointment.

Canvas

We have set up a Canvas site for Bio 11. This syllabus, announcements, the reading assignments for each week, Powerpoint lecture presentations, screencasts, solutions to quizzes etc. will be posted on the course Canvas site.

Interactive Technology

We will use an interactive technology, called Echo360, that will allow you to respond to a variety of different types of questions that you will answer either prior to coming to class or in class. To take best advantage of Echo360, you should bring your computer to class. When the class responds to one of the interactive questions, we can immediately see the results for the entire class. **Note: at times when interactive questions are not being asked, we will ask students to place phones, iPads, and laptops beneath your desks (substantial evidence indicates that hand-written notes best maximize learning and memory retention).** Class participation using Echo360 will count for a small percentage of your overall grade. With the Echo360 questions, the key is to participate; we will not be keeping track students' answers to questions. What is important is that you participate and attempt to answer the interactive questions.

Assessment of your academic performance

We will have 3 quizzes throughout the term, and each will count for 16% of your final grade, for a total of 48% from quizzes. Quizzes will focus mainly on the topics covered since the last quiz. However, in keeping with the goals of the course, we will take opportunities to link each week's topics with earlier material, and those connections will be reflected in the quizzes. It is your responsibility to make sure you wake up and get to class in time for quizzes. If necessary, set two reliable, sufficiently loud alarms. In fairness to other students, we can arrange alternative quiz times only in cases of documented emergencies or illness. A documented illness requires that you notify us at least 18 hours prior to the quiz.

The two experiments, a laboratory and a field exercise, will count 15% total (5% for the first and 10% for the second) and grades will be based on short reports you will write, which must detail the competing hypotheses you came up with, how you tested those hypotheses, and what you were able to conclude from your experiments.

The presentation will count for 10% of your final grade.

The final exam will cover all topic areas (i.e. it is cumulative), and will count for 20% of your final grade. It will be less detailed than the quizzes, and will emphasize major concepts, integration and synthesis.

The remaining 7% will be based on class attendance and participation in pre-class questions in Canvas and in-class questions in Echo360. With the interactive questions, the key is to participate; your grade is not dependent on answering questions correctly. To get full credit for participation, you need to attend a minimum of 90% of the class periods, and complete a minimum of 90% of the pre-class exercises. In other words, if you forget your computer, or are sick and have to miss a class, or are too busy to complete one of the pre-class exercises, it will not affect your grade until you have missed more than 10% of classes (3 or more classes) or failed to complete more than 10% of the pre-class exercises (3 or more assignments).

Academic Honesty

Academic honesty is essential. The following is quoted directly from the Dartmouth College Student Handbook: "Students who submit work that is not their own or who commit other acts of academic dishonesty forfeit the opportunity to continue at Dartmouth." The complete text of the Academic Honor Principle is available at <http://www.dartmouth.edu/judicialaffairs/honor/index.html>. Please read it carefully; you are responsible for it. In Bio 11, where assessment is based primarily on in-class quizzes and a final exam, the application of the Honor Principle is quite simple; all your quiz and exam work must be 100% your own, and you may not use notes, text or other resources during the quizzes and exam. Any violations of the Honor Principle within the context of Biology 11 will be referred to the Judicial Affairs Office and can result in your suspension for multiple terms or, in the most extreme cases, separation from the College.

Student Accessibility

Students with disabilities who may need disability-related academic adjustments and services for this course are encouraged to see me privately as early in the term as possible. Students requiring disability-related academic adjustments and services must consult the Student Accessibility Services office (Carson Hall, Suite 125, 646-9900). Once SAS has authorized services, students must show the originally signed SAS Services and Consent Form and/or a letter on SAS letterhead to their professor. As a first step, if students have questions about whether they qualify to receive academic adjustments and services, they should contact the SAS office. All inquiries and discussions will remain confidential.

Religious observances

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please meet with one of the professors before the end of the second week of the term to discuss appropriate accommodations.

Mental Health

The academic environment at Dartmouth is challenging, our terms are intensive, and classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including your undergraduate dean (<http://www.dartmouth.edu/~upperde/>), Counseling and Human Development (<http://www.dartmouth.edu/~chd/>), and the Student Wellness Center (<http://www.dartmouth.edu/~healthed/>).

Sexual Misconduct and Title IX

At Dartmouth, we value integrity, responsibility, and respect for the rights and interests of others, all central to our Principles of Community. We are dedicated to establishing and maintaining a safe and inclusive campus where all have equal access to the educational and employment opportunities Dartmouth offers. We strive to promote an environment of sexual respect, safety, and well-being. In its policies and standards, Dartmouth demonstrates unequivocally that sexual assault, gender-based harassment, domestic violence, dating violence, and stalking are not tolerated in our community.

The Sexual Respect Website (<https://sexual-respect.dartmouth.edu>) at Dartmouth provides a wealth of information on your rights with regard to sexual respect and resources that are available to all in our community.

Please note that, as a faculty member, I am obligated to share disclosures regarding conduct under Title IX with Dartmouth's Title IX Coordinator. Confidential resources are also available, and include licensed medical or counseling professionals (e.g., a licensed psychologist), staff members of organizations recognized as rape crisis centers under state law (such as WISE), and ordained clergy (see <https://sexual-respect.dartmouth.edu/reporting-support/all-resources/confidential-resources>).

Should you have any questions, please feel free to contact Dartmouth's Title IX Coordinator (Kristi.Clemens@Dartmouth.edu) or Title IX Office (TitleIX@Dartmouth.edu).

Class Schedule

March 25	M	“Animal Minds” overview	ML/TJ
March 27	W	Studying animal minds: strong inference and scientific discovery	ML
March 28	Th (X)	Genes to brain I	TJ
March 29	F	Genes to brain II	TJ
April 1	M	Genes to brain III	TJ
April 3	W	Evolution I	TJ
April 4	Th (X)	Evolution II	TJ
April 5	F	Evolution III	TJ
April 8	M	Evolution IV – game theory	ML
April 10	W	QUIZ 1	
April 11	Th (X)	Levels of analysis	ML
April 12	F	Sensation – neurons and brains	TJ
April 15	M	Sensory world and perception	ML
April 17	W	Hermit crab olfaction - indoor laboratory exercise	ML/TJ
April 18	Th (X)	<i>Interactive discussion and interpretation of results</i>	ML
April 19	F	Memory, learning	TJ
April 22	M	Social dominance and fish brains	TJ
April 24	W	QUIZ 2	
April 25	Th (X)	Theory of mind and empathy	ML
April 26	F	Dog evolution and domestication	ML
April 29	M	Pilfering and cache protection	ML
May 1	W	Extended phenotypes- <i>Toxoplasma gondii</i>	TJ
May 2	Th (X)	Tool use as an extended phenotype	ML
May 3	F	Tool use (captivity vs. the wild)	ML
May 6	M	Conceptual prep and ‘how to’ on field experiments	ML
May 8	W	Squirrel foraging (outdoor field exercise)	ML/TJ
May 9	Th (X)	<i>Interactive discussion and interpretation of results</i>	ML
May 10	F	<i>FOXP2</i> and language	TJ
May 13	M	Evolution of cognition	ML
May 15	W	QUIZ 3	
May 16	Th (X)	Social learning I	ML
May 17	F	Social learning II	ML
May 20	M	Collective intelligence and ‘wisdom of the crowd’	ML
May 22	W	Student presentations I (each student presents on a topic and proposes new hypotheses and experiments explicitly on the raven system that builds on Heinrich's foundation)	
May 23	Th (X)	Student presentations II	
May 24	F	Student presentations III	
May 27	M	No Class – Memorial Day	
May 29	W	Discussion and review	ML/TJ
June 1	Sat	Final Exam (cumulative) – 8-11 AM	