

Biology 11

The Science of Life: Animal Minds

Professors

Prof. Tom Jack, office hours W 11:25-12:25 (104 LSC), Thurs 3-4 (331 LSC)

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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, problem sets 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.

For each class session, we will try to incorporate small group activities in which students will be challenged to develop competing hypotheses, design critical experiments, and test their hypotheses, 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.

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 displays of data, 5) be conversant in the specific material (i.e. behavioral biology and cognition) that is the focus of “Animal Minds”.

Popular science book (required):

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

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.

We will provide a schedule for you to read Bernd Heinrich's book during the course. We will ask questions about the book on the problem sets. The student presentations at the end of the course will also be based on Heinrich's book.

Other 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.

Office hours

There will be several hours of office hours per week. We have tried to schedule office hours 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 and we can arrange a meeting.

Canvas

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

Assessment of your academic performance

There are four components that we will be assessing this term:

- 1) Class participation
- 2) Problem sets
- 3) Lab exercise
- 4) Student presentation

Class participation – 10%

There are two components to class participation. First, prior to many classes, you need to watch one or more short videos and answer several short questions about the video in Canvas. The questions in the post-video quiz are very straightforward and are designed to make sure you have mastered the key aspects of each video. With the post video quizzes, the key is to participate; your grade is not dependent on answering questions correctly. To get full credit for pre-class participation, you must complete a minimum of 90% of the pre-class exercises (you can miss a maximum of three and it will not affect your grade). Second, you need to come to class and participate in class exercises and discussions. To get full credit for in-class participation, you need to attend a minimum of 90% of classes (you can miss a maximum of three classes and it will not affect your grade). If you miss

more than three classes or pre-class quizzes, your grade will be slowly reduced, but you would need to miss the majority of pre-class questions and/or the majority of classes for the participation grade to go to 0%.

Problem sets – 63% (9% each)

For weeks 2-9, you will have weekly problem sets that you will submit via Gradescope. These problem sets will be graded. Problem sets that are handed in late will be assessed a 10% late penalty per day. Problem sets that are more than seven days late will not be accepted.

Lab/field exercise – 10%

There will be a short lab write up for a lab exercise that we will do in week #7.

Student presentations – 17%

In the last week of the course, each student will give a short presentation on a topic related to *Mind of the Raven*.

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 problem sets, the application of the Honor Principle is as follows. The answers you submit on the problem sets must be entirely written individually. In doing the problem sets, you can talk with other students, but you the key is that you must write up answers to the problems independently. Sharing of computer files with problem set answers is not allowed. Any violations of the Honor Principle within the context of Biology 11 will be referred to the Community Standards and Accountability Office and can result in your suspension for multiple terms or, in the most extreme cases, separation from the College.

Student Accessibility

Students requesting disability-related accommodations and services for this course are required to register with Student Accessibility Services (SAS; [Apply for Services webpage](#); student.accessibility.services@dartmouth.edu; 1-603-646-9900) and to request that an accommodation email be sent to me in advance of the need for an accommodation. Then, students should schedule a follow-up meeting with me to determine relevant details such as what role SAS or its [Testing Center](#) may play in accommodation implementation. This process works best for everyone when completed as early in the quarter as possible. If students have questions about whether they are eligible for accommodations or have concerns about the implementation of their accommodations, 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 me as soon as possible, or before the end of the second week of the term—at the latest, to discuss appropriate adjustments. Dartmouth has a deep commitment to support students' religious observances and diverse faith practices.

To assist with calendar planning and awareness of our diverse religious and spiritual community, the list of holy days can be found at <https://students.dartmouth.edu/tucker/spiritual-life/about-spiritual-life/holy-day-calendar>. The list represents major holy days which may impact campus events in general, as well as student course attendance, exams, Commencement and participation in activities in the coming year. Thank you for your consideration. If you have any questions about these dates or other concerns, please contact Rev. [Nancy Vogele](#), Chaplain and Director of the Tucker Center for Spiritual and Ethical Life.

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 28	M	“Animal Minds” overview	ML/TJ
March 30	W	Studying animal minds: strong inference and scientific discovery	ML
March 31	Th (X)	Genes to brain I	TJ
April 4	M	Genes to brain II	TJ
April 6	W	Genes to brain III	TJ
April 7	Th (X)	Evolution I	TJ
April 11	M	Evolution II	TJ
April 13	W	Evolution III – game theory	ML
April 14	Th (X)	Levels of analysis PS #1 due	ML
April 18	M	Sensation – neurons and brains	TJ
April 20	W	Sensory world and perception	ML
April 21	Th (X)	Memory, learning PS #2 due	TJ
April 25	M	Tool use as an extended phenotype	ML
April 27	W	Social dominance in fish	TJ
April 28	Th (X)	Extended phenotypes - <i>Toxoplasma gondii</i> PS #3 due	TJ
May 2	M	Theory of mind and empathy	ML
May 4	W	Pilfering and cache protection	ML
May 5	Th (X)	Dog evolution and domestication PS #4 due	ML
May 9	M	‘How’ to for field experiments	ML
May 11	W	Squirrel lab	ML
May 12	Th (X)	<i>FOXP2</i> and language PS #5 due	TJ
May 16	M	Evolution of cognition	ML
May 18	W	Social learning I	ML
May 19	Th (X)	Social learning, culture, and collective intelligence PS #6 due	ML
May 23	M	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 25	W	Student presentations II	
May 26	Th (X)	Student presentations III	
May 31	M	No Class – Memorial Day	
June 1	W	Discussion and review PS #7 due	ML/TJ