

# Biology 11

## The Science of Life: Animal Minds

### Professors

Prof. Tom Jack Office Hours: TBD or by appointment

Prof. Mark Laidre Office Hours: TBD or by appointment

### 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.

### 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.

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.

### **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".

### **Office hours**

There will be several hours of office hours per week via Zoom. 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 Zoom meeting or phone call.

### **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**

As you know, Dartmouth has adopted a CREDIT/NO CREDIT grading system for this term. To receive CREDIT in the course, you need to complete ALL elements of the course including:

- 1) Videos and post-video quizzes
- 2) Problem sets
- 3) Lab exercise
- 4) Student presentation

Videos and post-video quizzes – 10%

Each week, there will be one or more videos to watch. After watching each, you need to complete the post-video quiz. 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. To receive credit, you have to submit answers to the post-video quiz question (i.e. not graded as to whether you answered them correctly)

Problem sets – 63% (9% each)

For weeks 2-8, you will have weekly problem sets that you will submit answers for in Canvas. These problem sets will be graded and returned to students.

Lab/field exercise – 10%

There will be a short lab write up for a lab exercise that you will carry out wherever you are living!

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*.

To get a CREDIT, students need to complete all of the work, i.e all of the problem sets, video quizzes, the lab/field exercise and the presentation. On the problem sets, the lab/field exercise and the presentation, you need to achieve a reasonable level of mastery (i.e. greater than 50%) to receive CREDIT. We plan to give out citations to those of you who perform outstandingly well.

### **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 Judicial Affairs Office and can result in your suspension for multiple terms or, in the most extreme cases, separation from the College.

### **Consent to Record**

#### **(1) Consent to recording of course and group office hours**

a) I affirm my understanding that this course and any associated **group** meetings involving students and the instructor, including but not limited to scheduled and ad hoc office hours and other consultations, may be recorded within any digital platform used to offer remote instruction for this course;

b) I further affirm that the instructor owns the copyright to their instructional materials, of which these recordings constitute a part, and distribution of any of these recordings in whole or in part without prior written consent of the instructor may be subject to discipline by Dartmouth up to and including expulsion;

b) I authorize Dartmouth and anyone acting on behalf of Dartmouth to record my participation and appearance in any medium, and to use my name, likeness, and voice in connection with such recording; and

c) I authorize Dartmouth and anyone acting on behalf of Dartmouth to use, reproduce, or distribute such recording without restrictions or limitation for any educational purpose deemed appropriate by Dartmouth and anyone acting on behalf of Dartmouth.

#### **(2) Requirement of consent to one-on-one recordings**

By enrolling in this course, I hereby affirm that I will not under any circumstance make a recording in any medium of any one-on-one meeting with the instructor without obtaining the prior written consent of all those participating, and I understand that if I violate this prohibition, I will be subject to discipline by Dartmouth up to and including expulsion, as well as any other civil or criminal penalties under applicable law.

Proposed notification to faculty [from Dean's Office and/or Department Chair]

Please be aware that any recording you make within any digital platform used to offer remote course instruction may be regarded as an education record within the meaning of the Family Educational Rights and Privacy Act, which prohibits the disclosure to a third party of any student's personally identifiable information from such records, in the absence of that student's prior written consent, unless a specified exception to prior written consent applies.

Please also be aware that you are prohibited from making a recording in any medium of any one-on-one meeting with a student without obtaining that student's prior written consent. If you violate that prohibition, please understand that you will be subject to discipline by Dartmouth up to and including dismissal, as well as any other civil or criminal penalties under applicable law. **This prohibition does not apply to recordings of the course and any associated group meetings, to which students are being asked to consent via their enrollment in this course.**

Finally, please be reminded that the instructor owns the copyright to their instructional materials, of which these recordings constitute a part. Distribution of another instructor's recordings in whole or in part without prior written consent of that instructor may be subject to discipline by Dartmouth up to and including dismissal.

## **Student Accessibility**

Students requesting disability-related accommodations and services for this course are encouraged to schedule a phone/video meeting with me as early in the term as possible. This conversation will help to establish what supports are built into my online course. In order for accommodations to be authorized, students are required to consult with Student Accessibility Services (SAS; [student.accessibility.services@dartmouth.edu](mailto:student.accessibility.services@dartmouth.edu); SAS website; 603-646-9900) and to email me their SAS accommodation form. We will then work together with SAS if accommodations need to be modified based on the online learning environment. If students have questions about whether they are eligible for 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 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](mailto:Kristi.Clemens@Dartmouth.edu)) or Title IX Office ([TitleIX@Dartmouth.edu](mailto:TitleIX@Dartmouth.edu)).

**Weekly Schedule**

**Week 1**

Introduction/Course Overview  
Strong inference  
Genes to Brain  
Heinrich Chapters 1-3

**Week 2**

Evolution  
Heinrich Chapters 4-7

**Week 3**

Evolutionary Game Theory  
Levels of analysis  
Heinrich Chapters 8-11

**Week 4**

Sensory world and perception  
Sensation – neurons and brains  
Learning and Memory  
Heinrich Chapters 12-14

**Week 5**

Social dominance in fish  
Theory of mind  
Dog evolution and domestication  
Heinrich Chapters 15-18

**Week 6**

Pilfering and cache protection  
Extended phenotypes – *Toxoplasma gondii*  
Tool use  
Heinrich Chapters 19-22

**Week 7**

*FOXP2* and language  
'How' to for field experiments  
Heinrich Chapters 23-26

**Week 8**

Evolution of Cognition  
Social Learning  
Heinrich Chapters 27-29 (finish book)

**Week 9**

Collective Intelligence  
Student Presentations

**Week 10 (half week)**

Student Presentations  
Wrap up