

Bio 0410: Invertebrate Zoology (2015)

Lectures:

Martinos Auditorium (Room 110)
Granoff Center
Monday, Wednesday 11:00 – 11:50

TBD
Friday 11:00 – 11:50



Laboratory: Wednesday 1:00-3:50
BioMed Center 112C

Instructor: Prof. Casey Dunn
<http://dunnlab.org>
Office: 301 Walter Hall
Email: To expedite replies, please begin the subject of each course related e-mail with “inverts:” – casey_dunn@brown.edu
Office hours: Monday 12:30-2:30 pm

Teaching assistants: Alex Damian (alejandro_damianserrano@brown.edu)
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Online resources: Canvas - <https://canvas.brown.edu/courses/1018259>
Course Wiki - <http://goo.gl/HqMLh>
CreatureCast - creaturecast.org

Readings:

Lecture text: Biology of the Invertebrates, Jan Pechenik (7th edition)

Lab manual: Instructions for each lab are posted on Canvas by the Monday before the lab

Optional text: Field Guide to the Atlantic Seashore, K.L. Gosner (copies available in lab)

Papers: Several papers will be assigned for class discussion. Links for these papers will be provided one week in advance of discussion.

Course Description

This course focuses on the awesome diversity of animals (all animals are invertebrates, vertebrates are just invertebrates that happen to have a spine). Much of the focus will be on general themes and concepts that are applicable to the study of any group of organisms, such as phylogenetics (the analysis of relationships between organisms), the study of evolutionary patterns in a comparative context, and the interaction of organisms with their environments. It is, however, an –ology course, these themes will be explored

in the context of the actual diversity of animal life on Earth. This course is about both marine and terrestrial animals, though most animal groups live predominantly or exclusively in the ocean.

Animal diversity will be systematically surveyed from a phylogenetic perspective. The animal tree of life provides a biologically relevant organizational framework for what could otherwise seem a laundry-list of facts about worms you never heard of before. Rather than independently consider the attributes of each species, a tree-thinking approach will allow you to organize your knowledge of diversity through a birds-eye view of animal relationships in combination with the examination of where particular changes have occurred on this tree. Throughout this survey, and in dedicated classes that follow it, we will explore a variety of themes that cut across this tree. These include the evolution of lifecycles (including the extremely complex life cycles of many parasites), organ systems (such as the nervous system), and ecological interactions.

The course wiki includes notes from lectures, study guides that TA's and students have contributed to, information about the organisms and sites that we will see on the fieldtrip, and much more. You are encouraged to use it to take notes and organize information while you study. Since it is a derivative resource (based on the lectures and other sources) it is important to evaluate the information in the wiki critically. If there is a mistake in the wiki and you propagate this mistake on an exam, points will be taken off.

Requirements and Evaluation

Class attendance and participation: You are expected to attend all classes, labs, and fieldtrips, and to complete the reading assigned for each day. You are expected to be engaged in the lectures, and be ready to both ask and answer questions on the readings and lecture material.

Book reading assignments: Readings from the textbook will supplement and reinforce the material covered in the lecture. There is a massive body of knowledge regarding animal diversity, and you are not expected to have an encyclopedic knowledge of every bristle on each arthropod limb or tentacle count on jellyfish. But you are expected to use the reading to steep yourself in general broad-scale patterns, and to familiarize yourself with the fundamental attributes of the various groups of organisms we address.

Paper reading assignments: Several papers from the primary literature will be assigned for reading during the course. These will then be discussed in class. You will get a link to the paper one week before we discuss it. These papers will serve to highlight the unique biologies of particular groups of animals, explore their form and function in greater detail, and to introduce you to the structure of a peer-reviewed scientific study and paper.

Exams: There will be three exams, all scheduled during lectures. You will be held responsible for lecture material, reading assignments, and subjects addressed during lab exercises. The subject of the exams will be drawn mostly from the material since the previous exam (or the start of the course, in the case of the first exam), though earlier material may be covered when essential to evaluating newer material. Be sure to have your Banner ID handy to write on your exam.

Quizzes: Three 15 minute quiz will be provided. It will have the same scope as the exams in terms of subject material, and will be announced two classes in advance. Be sure to have your Banner ID handy to write on your exam.

Labs: Labs are held weekly, and are a critical component of the class. It is essential that you thoroughly read the exercises that will be performed in the lab, which are outlined in the course reader, before coming to lab. We will be working with live and preserved animals in the lab. It is required that you treat the animals respectfully; no gratuitous harm to the animals will be tolerated.

The Invertebrates by Sherman and Sherman (S&S) will be used as a reference and source of anatomical diagrams. Some copies are available for sharing in the lab. Field Guide to the Atlantic Seashore by K. Gosner, and Marine Animals of Southern New England and New York by H. Weiss will be used to identify organisms observed on the field trips and in the lab. Invertebrate Zoology Online (<http://lanwebs.lander.edu/faculty/rsfox/invertebrates/>) will be a source for some lab activities.

You will keep a lab notebook that is distinct from your lecture notes. The content, organization, and presentation of this notebooks will be part of your grade. We will discuss what is expected of a lab notebook during the first lab period. Laboratory notebooks will be collected for grading at the last exam. I suggest using an artist sketchbook as a lab notebook.

Field trips: There will be two field trips. Your participation in these trips will be evaluated in the same way as for labs. The bus for each trip will depart from the corner of Brown St. and Olive St.

Final project: There are two options:

Research paper- A fully cited research paper 6-8 pages in length (do not exceed 8 pages), double spaced in 12-point font. The lists of references do not count towards the page limit (*ie* a 7 page paper could have 3 additional pages of references). For a paper of this length, you should have at least 20 citations. Formatting guidelines, including citation and reference format, should follow those of *American Naturalist*, as described at <http://goo.gl/T3fPa>. You can browse published articles at <http://goo.gl/ixDus> to better understand the reference formatting and get a sense of the tone and organization of scientific papers.

Animation- A video episode (1-3 minutes in length) explaining some aspect of invertebrate biology to a general audience. Some videos may be selected for public distribution via creaturecast.org. Visit the site to familiarize yourself with the format. Information on producing a video is available at <http://creaturecast.org/making-a-creaturecast-episode>. Be sure to take a look at previous episodes (you can browse them at <http://vimeo.com/user1747626> as well as <http://creaturecast.org>) to see what topics

have been done before (there is much room for exploring different aspects of stories that have already been covered, but we want to avoid telling the same story in the same way twice). Production quality, as well as content and effectiveness at communicating with the target audience, will be evaluated. Along with the episode, you submit a brief caption that includes links to music and other resources (see <http://creaturecast.org> for example captions), a list of citations to the scientific literature that back up each factual assertion in your story, and a 600 word essay for a general audience that puts the animations in a broader context .

You must submit a plan for your final project for preliminary evaluation. This is due at the beginning of class on the date indicated on the schedule below. For the paper, the project plan consists of the abstract (250-400 words), with citations for 5 sources from the primary literature that will be used in support of the paper. For an animation, the project plan will consist of a script, the caption, and your citations.

Any content that is included in any final project (be it music in an animation or a figure in a paper) must be original, or available under a license that allows its reuse, such as a <http://creativecommons.org> license that allows derivative works. You must also attribute the work, ie by providing a link for music or specifying the source of a figure. It is fine to cite references, such as copyrighted journal articles, that are available under stricter licenses. The license covers the media itself (i.e., the text, sound, or images), not the ideas in the media.

Students are encouraged to discuss their proposed topics with the professor and the TA's in advance of submitting their plan. The topic can be the functional biology or natural history of an organism, the evolution of a particular character or suite of characters, a review of the state of phylogenetic knowledge of a group, or an ecological examination of a clade or other grouping of animals. Other topics may also be considered if they are discussed well in advance of submitting the project plan. The final projects are due at the beginning of class on the date indicated on the schedule.

Evaluation:

Lecture:	3 hour-long exams	20% each
	3 quizzes	3% total
	Final project	20%
	Class participation	2%
Laboratory:	Lab participation	5%
	Lab notebook	10%

Lecture Schedule

Reading is from Pechenik unless otherwise noted. Additional papers from the primary will be assigned throughout the semester.

Date	Class	Reading
9-Sep	Introduction- what are animals?	
11-Sep	Animals in their environments	Ch 1
14-Sep	Tree thinking- phylogeny and classification	Ch 2, http://www.sciencemag.org/content/http://link.springer.com/article/10.1007%
16-Sep	The context: Eukaryotes	Ch 3
18-Sep	A bird's eye view of animal phylogeny and anatomy	
21-Sep	Ctenophores	Ch 7
23-Sep	Sponges	Ch 4
25-Sep	Placozoa, Cnidaria	p. 89-90, Ch 5,6
28-Sep	Cnidaria	Ch. 6
30-Sep	Bilateria Introduction, Acoelomorpha	
2-Oct	Deuterostome Introduction, Hemichordates	Ch 21
5-Oct	Echinoderms	Ch 20
7-Oct	Echinoderms	Ch 20
9-Oct	Exam One (Through Cnidaria)	
12-Oct	No Class (Fall Weekend)	
14-Oct	Chordates	Ch 23
16-Oct	Chordates; FINAL PROJECT PLAN DUE	Ch 23
19-Oct	Biomechanics	Ch 5
21-Oct	Protostome Introduction, Chaetognaths	p. 461-467
23-Oct	Ecdysozoa Introduction, Scalidpohora	Ch 17
26-Oct	Nematoida	Ch 16
28-Oct	Tardigrades and Onychophorans	Ch 15
30-Oct	Arthropods	Ch 14
2-Nov	Arthropods	Ch 14
4-Nov	Predators and Prey	
6-Nov	Exam Two (through arthropods)	
9-Nov	Comparative embryology	Ch 24
11-Nov	Spiralia Introduction, Platyhelminthes	Ch 8
13-Nov	Platyhelminthes, Gnathifera, and friends	Ch 10, p. 459-460
16-Nov	Nemerteans, Lophophorates	Ch 11, 19
18-Nov	Annelids	Ch 13

20-Nov	Annelids	Ch 13
23-Nov	Life Cycle Evolution	Ch 24
25-Nov	No Class (Thanksgiving)	
27-Nov	No Class (Thanksgiving)	
30-Nov	Molluscs	Ch 12
2-Dec	Molluscs; FINAL PROJECT DUE	Ch 12
4-Dec	Animals in Earth History	
7-Dec	Evolution of organ systems	
9-Dec	CreatureCast showing	
11-Dec	Exam Three	

Lab and Field Trip Schedule

Date	Lab	Notes
16-Sep	FIELD TRIP TO NARRAGANSETT (low tide 4:07 PM)	Depart from corner of Brown and Olive Street at 12:15 PM, arrive Haffenreffer ~12:45PM, depart 5:00, arrive Brown ~5:30
20-Sep (Sunday)	FIELD TRIP TO NAHANT (low tide 10:35 AM)	Depart from corner of Brown and Olive Street at 9:00AM, arrive at Nahant ~10:30AM, Depart 3:00PM, arrive Brown 4:30PM
23-Sep	Eukaryotes	
30-Sep	Porifera (Sponges)	
7-Oct	Cnidaria and Ctenophora	
14-Oct	Deuterostomia	
21-Oct	Environmental samples	
28-Oct	Nematodes, Tardigrades, and Onychophora	
4-Nov	Arthropods	
11-Nov	Flatworms	
18-Nov	Annelids	
25-Nov	No lab - Thanksgiving	
2-Dec	Molluscs	
9-Dec	No lab	

The Animal Tree

A phylogeny depicting animal relationships that are broadly supported across studies.
Higher resolution image available at <http://goo.gl/yNFDTG> . From:

Dunn, CW, G Giribet, GD Edgecombe, A Hejnol (2014) Animal Phylogeny and its Evolutionary Implications. Annual Review of Ecology, Evolution, and Systematics 45:371–395.[doi:10.1146/annurev-ecolsys-120213-091627](https://doi.org/10.1146/annurev-ecolsys-120213-091627).

