

Biology 337
Biology of Invertebrates

Lecture/reading syllabus
Spring 2020

No one with an unbiased mind can study any living creature, however humble, without being struck with enthusiasm at its marvelous structure and properties. – Charles Darwin

CONTACT

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Lecture times: 10:50-12:05 T & Th, in RITA 102

Laboratory times: 9:30-12:30 or 12:30-3:30 F in GML 101

Office hours: before/after lecture T/Th or by appt (in all cases email in advance to arrange)

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EDUCATIONAL GOALS and LEARNING OUTCOMES

How many different ways could you build an animal? Although animals all face the same basic challenges—how to consume, digest, move (or stay put), sense, defend themselves, exchange gases, eliminate wastes, reproduce, and so on—evolution produced more than 30 distinct body designs that represent different solutions to these challenges. The so-called “invertebrates” (distributed among *all* animal phyla) include a far greater range of diversity in design than the “vertebrates” (just *part of one* phylum). **My goal** is to develop your ability to use the major phyla (and some lower taxa) as examples to illustrate these diverse solutions. Our comparison of body designs will reveal the radically different ways that animals have evolved over the last 600 million years to solve the same problems using different structures and processes.

As a hard-working and engaged participant in this course, you will come to be able to:

- explain how different body designs solve (or create!) biological problems related to physiological and environmental challenges
- contrast major animal groups with regard to how the body works in movement, growth, nutrition, respiration, water balance, excretion, defense, & reproduction
- demonstrate how and why “shared, derived traits” are used to deduce evolutionary relationships
- identify the major characters that are used to deduce relationships among the major animal taxa
- describe large-scale patterns in the history of animal diversity and identify general mechanisms that have led to variation in animal body design
- explain why most animals should be thought of as a series of radically different life cycle stages that experience different environments and selection pressures during their ontogeny
- describe animals in the context of communities, ecological interactions, and conservation problems
- explain and use terms and taxonomic names that reflect your understanding of major concepts in animal form, function, and phylogeny

Along with introducing you to the diversity and evolution of animal body plans, **my goal** is also to develop your critical thinking skills through interactive lectures, readings from textbooks and articles, short writing assignments, laboratory exercises, and concept-centered exams. **Your goal** should be to look for patterns, figure out processes, pose questions, seek evidence, and organize information into a framework for talking about animal structure and function—that is, to **practice thinking like a biologist**. I also hope you will teach and learn from one another, especially when studying course material and completing laboratory exercises.

** Carefully read and consult the course syllabi and website throughout the course. They offer information that is key to your performance in this course, about which I expect you to take full responsibility.*

COURSE WEBSITE and OAKS NOTIFICATIONS

I will use OAKS for making all course announcements, posting course content, and receiving completed assignments. Please subscribe to the course site so that you will receive announcements promptly by email.

Printing your own materials: You must print the lecture guides/illustrations and bring them to each lecture. Having the illustrations to scribble on will help you to understand and learn the class material. **You must also print the lab handouts *before the start time of lab* and arrive to lab on time. If you are still printing at the start of lab you will be counted as late.** I have provided the full lab manual as well as individual laboratory worksheets for you to print.

POLICIES

Lecture attendance. You are *expected* to attend each lecture. If you miss class your absence will be apparent when you do poorly on exams. You will not understand the emphasis I put on lecture material only by reading the book, looking over illustrations, or reading someone else's notes. I provide a guide for each lecture but not detailed lecture notes. If you must miss a lecture, be sure to get notes and go through them with a classmate and ask me questions during office hours. I am always willing to take the time to help you to better understand material.

Laboratory: You are *required* to attend each 3-hour lab for its duration. Arriving late or leaving early (without an excuse approved before class) will result in loss of 1/3 of attendance/participation points for any fraction of each hour missed. You should work together to **examine material** and **discuss questions**, but drawings and written answers **must be your own**. Given their nature, labs cannot be "made up," and access to material cannot be provided outside of the lab period. You may hand in lab worksheets at the end of lab or start of the following lecture.

Exam prep. Exam days will involve both a lab practical exam and a lecture/reading exam, **all in one 3-h lab period**. Use the study guide I provide for each lecture and the worksheet for each lab. **For lecture, you must know taxonomy to the level listed at the top of each guide, and for laboratory, to the level listed in the taxonomy section of the lab handout.** See the **EXAMS** link at the website for more information. Group study is recommended as follows: only after first studying thoroughly on your own, quiz each other about terms and concepts. Nothing tests understanding better than being forced to verbalize answers out loud.

Disabilities. I will do my best to accommodate any student with a documented disability who has been approved through SNAP. The lab exam setup can complicate the accommodation, but I have worked this out with students before. Talk with me during office hours.

Missing an exam. Because there is no way to "make up" a laboratory exam, you may be excused from taking an exam at the scheduled time **only** for *an officially documented medical emergency suffered on the day of the exam*. Other unavoidable professional conflicts (which includes med school interviews, but not family gatherings) should be discussed with me well in advance.

Late assignments. Assignments are due at the date and time indicated. Assignments handed in past the deadline without prior approval will have approximately 5% per day deducted.

Academic misconduct. Lying, cheating, attempted cheating, unauthorized collaboration, plagiarism, and re-use of work done by you previously are all violations of the honor code. Be sure that you understand the definition and consequences of all potential violations, including

intentional and unintentional plagiarism, as described in the student handbook at <http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.php>. **It is far better to turn in poor work for a poor grade than to receive an XF (failure for cheating) and a suspension**, which are automatic sanctions for intentional plagiarism. Members of the honor board, mostly students, take these issues seriously.

Electronics. Cell phones and other communication devices must be turned off at the start of class (check with me before class if you have a special need). My phone will stay on in case of a CougarAlert. After one warning, your phone may be held at the front of the room and returned at the end of class. Please show respect to me and your peers by giving your full attention and effort during the class period. Please talk with me if you plan to use a laptop or tablet for taking notes.

How to succeed, in education & life. Work hard and show determination (grit). Studies show these are greater predictors of success than innate intelligence. See the “Success” link at the course website and take my advice to heart! Also, keep in mind Socrates’ view of what we are here for: “*Education is the kindling of a flame, not the filling of a vessel.*”

LECTURE and LAB TOPICS

Taxonomic lectures at the start of the course will each develop one or more themes to develop general principles of body form and function. The final lectures (after the second midterm exam) will use earlier information to make bigger-picture comparisons among the major taxa.

Lectures are listed on the days they are *likely to start*. You should therefore be prepared for each unit on the day it is first listed. I will keep you up to date with OAKS notifications about what is planned each week.

Laboratory topics are listed for reference. A separate laboratory syllabus will be provided.

Important: (1) **Dates are tentative! Check OAKS notifications for updates.* (2) *You are responsible for printing lecture illustrations for lecture and lab worksheets for lab.*

Wk	Date*	Unit/Topic	Friday lab unit/topic
1	Jan 9 R	1. Classification & phylogeny: thinking in hierarchies and trees	A. Boltozoa
2	14 T 16 R	2. Protozoa (animal relatives), Porifera (sponges), Placozoa 3. Cnidaria and Ctenophora	B. Porifera, Cnidaria I
3	21 T 23 R	Cnidaria and Ctenophora (cont.) 4. Platyhelminthes (flatworms) and Nemertea (ribbon worms)	C. Cnidaria II, Worms I, Ctenophora
4	28 T 30 R	5. Nematoda and other former “pseudocoelomates” 6. Annelida (Cl. Polychaeta)	D. Worms II
5	Feb 4 T 6 R	Various worms recently reclassified as annelids 7. Special topic: Invertebrate parasites	Midterm Exam I
6	11 T 13 R	8. Mollusca: Polyplacophora and Gastropoda 9. Mollusca: Bivalvia and Cephalopoda	E. Mollusca I

7	18 T Mollusca (cont.) 20 R 10. Arthropoda: general characteristics and Crustacea	F. Mollusca II
8	25 T Crustacea (cont.) 27 R 11. Special topic: barnacles!	G. Arthropoda I
9	Mar 3 T 12. Echinodermata 5 R Echinodermata (cont.)	H. Echinodermata
10	10 T 13. Hemichordata and Urochordata 12 R 14. Phoronida, Brachiopoda, Bryozoa, & Kamptozoa	I. Urochordata, “Lophophorate” phyla
11	17 T ---spring break--- 19 R ---spring break---	---spring break---
12	24 T 15. Arthropoda (cont.): Tracheata and Chelicerata 26 R Taxonomic lectures wrap-up (cont.)	Midterm exam II
13	31 T 16. Phylogenetic review/revision and history of diversity Apr 2 R 17. Mechanisms that generate diversity: HOX and allometry	J. Arthropoda II
14	7 T 18. Asexual reproduction and modular growth 9 R 19. Sexual reproduction and larval biology	K. Benthic sampling
15	14 T 20. Physical biology: challenges at small and large scales 16 R 21. Invertebrate communities: plankton and meiofauna	L. Planktonic sampling
16	21 T 22. Issues in invertebrate conservation	

READING ASSIGNMENTS

The following table summarizes **all readings** you are responsible for completing before each unit is covered in lecture. Three types of required readings are involved:

- (1) [**page numbers**] in bold from Biology of the Invertebrates, 7th ed. (black cover), by Jan A. Pechenik. For each set of page numbers, the text at the start and end of the reading is shown (*in italics*) in cases where the start and end of the sections to be read might be ambiguous.
- (2) Research Focus **Box #s** in Pechenik text--included in the assignment only when specified.
- (3) supplemental readings [**SR**], which are available as .pdf files at the **SR** link at the website.

Important: *All readings are subject to change. Check OAKS notifications for updates.*

Unit Reading assignment

- 1 Classification [**2-6** (*Environmental...*), **7-19** (*...named.*) , **19-27** (*How...text.*), **29-30** (*Classification...exception.*)]
- 2 Protozoa [**35-36** (*...Chapter 2*), **37-41** (*Contractile...slowly.*)], Porifera/Placozoa [**77-88** (*...spicules*), **89**], [**SR**]
- 3 Hydrostats [**95-97**], Cnidaria [**99-126**], Research [**1-2** (*...zoology.*)], **Box 6.1**
Ctenophora [**135-144**], **Box 7.1**
- 4 Platyhelminthes [**147-155**], Nemertea [**205-211** (*...predators.*)]

- 5 Cavities [9-10 (*Developmental... Chapter 5.*)], Nematoda [431-35, 444]
- 6 Annelida [295-304 (...*groups?*) , 328 (*Circulatory...annelid.*)], Box 13.1
Siboglinidae [305-11 (...*bones.*)], Echiura & Sipuncula [312-18] (...*distances.*)]
- 7 Parasites [156-68, 196-8 (...*issue.*)], 452-4 (...*startling.*)], Box 8.1 [SR]
- 8 Mollusca [215-37 (...*pneumostome.*)], Box 12.1
- 9 Mollusca [237-71], Box 12.3
- 10 Arthropoda [341-5 (...*groups.*)], 349-350 (*Classification...limb*), [SR]
Crustacea [373-82]
- 11 Barnacles! [389-92 (...*habitats.*)]
- 12 Echinodermata [497-520] & [SR]
- 13 Hemichordata [529-34] & Urochordata [539-48]
- 14 “Lophophorate” phyla and Kamptozoa [473-92]
- 15 Chelicerata/Tracheata [345-349 (...*body*)], 350-67 (...*systems.*)], lobopods [421-8]
- 16 History and phylogeny [19-22 (...*other.*)], 27-29 (*Cladistic...phyla.*)], Box 11.1 & [SR]
- 17 Mechanisms [SR]
- 18 Modular growth: Box 19.1 & [SR]
- 19 Sex and larval biology [555-80]
- 20 Physical biology [2-6, review] & [SR]
- 21 Meiofauna [454-7, 198-9, 459-60], Chaetognatha [461-7, Box 18.1] & [SR]
- 22 Conservation issues [SR], Box 6.2, Box 24.1

WRITING ASSIGNMENTS

You will complete two short writing assignments this semester. Information will be available at the **Writing assignments** link on OAKS closer to the time of the assignments. Be sure to **carefully review guidelines to avoid problems with plagiarism** (also see Academic Misconduct under Policies). Note that each assignment has a topic and reference due the week before each midterm exam, and the actual assignment is due one week after each midterm exam.

INVERTEBRATE CONCEPT MAP (ICM)

As an *optional* assignment and study guide, I offer substantial extra credit for putting together, over the course of the semester, one or more concept maps of the information you learn about invertebrates. You may work alone or in pairs. See the website for many details and suggestions about how to complete your concept map.

MFT FOR GRADUATING SENIORS

Graduating seniors will be required to sign up to take the Biology Major Field Test (MFT), a standardized test that the Biology Department administers to graduating seniors and uses for program assessment. (You will likely hear about this requirement in other classes, but you have to take the test only once!) Your score on the exam will not be figured into your grade in this class, but doing your best will help us to assess our curriculum relative to other schools in the country. More details will follow.

GRADING and SUMMARY OF ASSIGNMENTS

Your grade is based on a preliminary exam, 3 lecture/reading exams, 2 lab practical exams, a lab notebook composed of worksheets and drawings, and 2 writing assignments. **Your final grade is based on a curve done on overall grades compiled at the end, with the mean in the B-/C+ range.** (The curve can only move your grade up, not down.) Exceptional improvement and active participation in office hours, lecture and lab can be positive factors in cases where your final course grade is near a boundary.

Exercise	Due date and place	Coverage	% grade	Notes
“Preliminary” Exam	take home, end of week 3	Lecture Units 1-5 Labs A-C	1	a
Midterm Exam I Lab Practical Exam I	F Feb 7, in lab (GML 101)	Lecture units 1-7 Labs A-D	10 6	b
Midterm EXAM II Lab Practical Exam II	F Mar 27, in lab (GML 101)	Units 8-15 Labs E-I	12 8	b
Final Exam	T Apr 28, 8 AM (RITA 102)	“cumulative”	20	c
Lab attendance and worksheets	by Tuesday lecture after lab	week’s lab material	20	d
Writing asgmt. #1 topic	F Jan 31 by Dropbox, lab start		0.5	e
Writing asgmt. #1	F Feb 14 by Dropbox, lab start	see Writing webpage	11	f
Writing asgmt. #2 topic	“M Mar 23” by Dropbox		0.5	e
Writing asgmt. #2	F Apr 3 by Dropbox, lab start	see Writing webpage	11	f
Invertebrate concept map	before each exam	see ICM webpage	x-credit	g
Questionnaire	T Apr 28, at final exam	course evaluation	x-credit	
Active participation	lecture and lab	all course material	bump	h

- a.** PRELIMINARY EXAM will give you experience with the format of questions used in lecture and lab exams. It will be a take-home exam that must be completed in one sitting.
- b.** MIDTERM EXAMS will include a lab practical exam and a separate lecture/reading exam, given in succession during a single lab period. (Note that 1st Midterm EXAM covers some of the same material as the Preliminary EXAM.)
- c.** FINAL EXAM does not involve a lab practical. This “cumulative” exam will cover lecture/reading material and written information from laboratory covered in the last few weeks of course, but will also assume knowledge of general information from earlier lectures.
- d.** Laboratory exercise sheets are due by the start of Tuesday lecture following the lab.
- e.** Topic and reference must be submitted for review in appropriate OAKS Dropbox. **Include all of the information listed on the assignment web page.**
- f.** Assignment must be submitted as an MSWord document in the appropriate OAKS Dropbox. **Follow format described on the assignment web page.**
- g.** See website for details and suggestions about how to complete an Invertebrate Concept Map.
- h.** Exceptional participation in lecture and lab could bump your grade up if it is near a boundary.