

Biology 337
Biology of Invertebrates

Lecture/reading syllabus
Spring 2018

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

Dr. Bob Podolsky, 214 Grice Marine Lab, podolskyr@cofc.edu (contact by email preferred)

Lecture times: 10:50-12:05 T & Th, in SSMB 138

Laboratory times: 10:10-1:10 or 1:10-4:10 F in GML 101

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

Graduate teaching assistant: Amanda Bayless, Marine Biology <slonea@g.cofc.edu>

EDUCATIONAL GOALS and LEARNING OUTCOMES

How many different ways can you build an animal? Although all animals 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 has 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.

** Please carefully read this syllabus, the lab syllabus and the related course website. Use them for reference throughout the course. They contain information that is important to your academic health.*

COURSE WEBSITE and OAKS NOTIFICATIONS

I will use OAKS **only** for (1) making all course announcements and (2) receiving completed assignments. Please subscribe so that you will receive announcements by email.

All other course information—details of assignments, articles, and lecture guides and illustrations—will be posted at my own course website <<http://podolskyr.people.cofc.edu/biol337>>. Use the password "invertzoo" for any protected material.

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. If you are still printing at the start of lab you will be counted as late.**

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 a *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. Also, keep in mind Socrates' view of what we are doing:

“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*	Lecture unit/topic	Friday lab unit/topic
1	Jan 9 T 11 R	1. Classification & phylogeny: thinking in hierarchies and trees 2. Protozoa (animal relatives), Porifera (sponges), Placozoa	A. Boltozoa
2	16 T 18 R	3. Cnidaria and Ctenophora Cnidaria and Ctenophora (cont.)	B. Porifera, Cnidaria I
3	23 T 25 R	4. Platyhelminthes (flatworms) and Nemertea (ribbon worms) 5. Nematoda and other former “pseudocoelomates”	C. Cnidaria II, Worms I, Ctenophora
4	30 T Feb 1 R	6. Annelida (Cl. Polychaeta) Various worms recently reclassified as annelids	D. Worms II

5	6 T 7. Special topic: Invertebrate parasites 8 R 8. Mollusca: Polyplacophora and Gastropoda	Midterm Exam I
6	13 T 9. Mollusca: Bivalvia and Cephalopoda 15 R Mollusca (cont.)	E. Mollusca I
7	20 T 10. Arthropoda: general characteristics and Crustacea 22 R Crustacea (cont.)	F. Mollusca II
8	27 T 11. Special topic: barnacles! Mar 1 R 12. Echinodermata	G. Arthropoda I
9	6 T Echinodermata (cont.) 8 R 13. Hemichordata and Urochordata	H. Echinodermata
10	13 T 14. Phoronida, Brachiopoda, Bryozoa, & Kamptozoa 15 R 15. Arthropoda (cont.): Tracheata and Chelicerata	I. Urochordata, “Lophophorate” phyla
11	20 T ---spring break--- 22 R ---spring break---	---spring break---
12	27 T Taxonomic lectures (cont.) 29 R 16. Phylogenetic challenges and history of diversity	Midterm exam II
13	Apr 3 T 17. Mechanisms that generate diversity: HOX and allometry 5 R 18. Asexual reproduction and modular growth	J. Arthropoda II
14	10 T 19. Sexual reproduction and larval biology 12 R 20. Physical biology: challenges at small and large scales	K. Benthic sampling
15	17 T 21. Invertebrate communities: plankton and meiofauna 19 R 22. Issues in invertebrate conservation	L. Planktonic sampling

READING ASSIGNMENTS

The following table summarizes **all readings** you are responsible for completing before each lecture on the date listed. 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: *Dates are tentative! Check OAKS notifications for updates.

Wk	Date*	Unit and Reading assignment
1	Jan 9 T	1. Classification [2-6 (<i>Environmental...</i>), 7-19 (<i>...named.</i>), 19-27 (<i>How...text.</i>)]
	11 R	2. Protozoa [35-36 (<i>...Chapter 2</i>), 37-41 (<i>Contractile...slowly.</i>), Porifera/Placozoa [77-88 (<i>...spicules</i>), 89], [SR]
2	16 T	3. Hydrostats [95-97], Cnidaria [99-126], Research [1-2 (<i>...zoology.</i>)], Box 6.1
	18 R	Ctenophora [135-144], Box 7.1
3	23 T	4. Platyhelminthes [147-155], Nemertea [205-211 (<i>...predators.</i>)]
	25 R	5. Cavities [9-10 (<i>Developmental...Chapter 5.</i>)], Nematoda [431-35, 444]
4	30 T	6. Annelida [295-304 (<i>...groups?</i>), 328 (<i>Circulatory...annelid.</i>)], Box 13.1
	Feb 1 R	Siboglinidae [305-11 (<i>...bones.</i>)], Echiura & Sipuncula [312-18] (<i>...distances.</i>)]
5	6 T	7. Parasites [156-68, 196-8 (<i>...issue.</i>), 452-4 (<i>...startling.</i>)], Box 8.1 [SR]
	8 R	8. Mollusca [215-37 (<i>...pneumostome.</i>)], Box 12.1
6	13 T	9. Mollusca [237-71], Box 12.3
	15 R	Mollusca (cont.)
7	20 T	10. Arthropoda [341-5 (<i>...groups.</i>), 349-350 (<i>Classification...limb</i>)], [SR]
	22 R	Crustacea [373-82]
8	27 T	11. Barnacles! [389-92 (<i>...habitats.</i>)]
	Mar 1 R	12. Echinodermata [497-520] & [SR]
9	6 T	Echinodermata (cont.)
	8 R	13. Hemichordata [529-34] & Urochordata [539-48]
10	13 T	14. "Lophophorate" phyla and Kamptozoa [473-92]
	15 R	15. Chelicerata/Tracheata [345-349 (<i>...body</i>), 350-67 (<i>...systems.</i>)], lobopods [421-8]
11	20 T	---spring break---
	22 R	---spring break---
12	27 T	Taxonomic lectures (cont.)
	29 R	16. History and phylogeny [19-22 (<i>...other.</i>), 27-29 (<i>Cladistic...phyla.</i>)], Box 11.1 & [SR]
13	Apr 3 T	17. Mechanisms [SR]
	5 R	18. Modular growth: Box 19.1 & [SR]
14	10 T	19. Sex and larval biology [555-80]
	12 R	20. Physical biology [2-6, review] & [SR]
15	17 T	21. Meiofauna [454-7, 198-9, 459-60], Chaetognatha [461-7, Box 18.1] & [SR]
	19 R	22. Conservation issues [SR], Box 6.2, Box 24.1

WRITING ASSIGNMENTS

You will complete two short writing assignments this semester, as described briefly below. For a great deal more information about how to complete them, see the **Writing assignments** link at the website. Be sure to **carefully review suggestions that will help you to avoid problems with plagiarism** (also see Academic Misconduct under Policies).

1) Research Focus Box (RFB). Imagine that you are a freelance science writer. You decide to submit to the author of our textbook, Jan Pechenik, a Research Focus Box (RFB) in the style of his textbook. From reading his RFBs, you understand that your job is to write an engaging summary and critical commentary of a research article about any organism covered in the course. Pechenik requires that you focus on the **process** of science: what gap in understanding led to the research question, why the experimental design and methods were useful for addressing the question, how the results were used to draw conclusions, and what new questions were uncovered. The competition for publication is strong! (In fact, Pechenik and I started a website for this purpose and I will select one or two RFBs each semester to be published). *Due: 1 week after the 1st exams.*

2) Invertebyte. Imagine you are a science blogger hoping to contribute to a popular new biology blog called “Invertebytes”. The goal of each blog entry is to highlight an interesting and unique feature/behavior/activity/lifestyle/interaction of an invertebrate, living or extinct, that will teach about invertebrate biology, captivate your public audience, and generate web traffic. Your goal in part is to contrast what the animal does with how other animals meet the same biological challenge in a different way. Your *Invertebyte* perspective should be based on scientific evidence and must therefore reference the primary literature. *Due: 1 week after the 2nd exams.*

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.

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 the grades compiled at the end, with the mean in the B-/C+ range.** (The curve can only benefit students.) Exceptional improvement will be rewarded. Active participation in office hours, lecture and lab can be a positive factor 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 9, in lab (GML 101)	Lecture units 1-7 Labs A-D	10 6	b
Midterm EXAM II Lab Practical Exam II	F Mar 30, in lab (GML 101)	Units 8-15 Labs E-I	12 8	b
Final Exam	T May 1, 8 AM (SSMB 138)	“cumulative”	20	c
Lab attendance and worksheets	by Tuesday’s lecture after lab	week’s lab material	20	d
RFB reference/topic	F Feb 2 by email, start of lab		0.5	e
RFB report	F Feb 16 by email, start of lab	see Writing webpage	11	f
Invertebyte ref/topic	“M Mar 26” by email		0.5	e
Invertebyte blog post	F Apr 6 by email, start of lab	see Writing webpage	11	f
Invertebrate concept map	at each exam	see ICM webpage	x-credit	g
Questionnaire	T May 1, 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 RFB assignment web page.**
- f.** Assignment must be submitted as an MSWord document in the appropriate OAKS Dropbox (RFB) or as a blog entry (Invertebyte). **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.