

# BIO 2241: Invertebrate Biology

## Spring 2019

**Lecture:** Monday, Wednesday, and Friday, 9:00-9:50am, SERC 116  
**Lab:** Tues, Weds, Thurs, Fri 2:00-4:50pm, BL-121; Thurs 9:30am-12:20pm, BL-121

**Lecturer and Coordinator:** Prof. Robert M. Jennings, Ph.D.

**Contacting me:** The best way is to email me at rob.jennings@temple.edu. I am happy to answer questions, schedule times to meet, and try to resolve any issues, as time permits.

**Office Hours:** Fridays 10-11am in my office, BIOSCI 248-G, or by appointment.

### **Course Description and Motivation:**

Invertebrate organisms make up over 90% of all animal species on the planet (including over 6 million species of insects alone!), and their 500-million-year evolutionary history far exceeds our own. Invertebrates exhibit a huge array of body shapes, organs and sensory structures, and behavioral abilities, and have successfully adapted to almost every habitat on the planet, from the highest mountain forests to the deepest trenches of the ocean. Moreover, many invertebrates possess abilities and systems we often think are found only humans (or our fellow vertebrates); in reality, many inverts possess well-developed immune systems, complex myelinated neurons, and eyes and muscle innervations surpassing our own in complexity and adaptability.

This course will examine the major phyla of invertebrates, and some “obscure but cool” lesser-known ones. We will explore the fundamentals of invert morphology and build a comparative picture of form, from the entirely soft-bodied, gelatinous jellyfish, to the amazing camouflaging skin of octopods, to the “jointed armor” of insects and crustaceans. We will use an evolutionary framework to animate these morphologies into evolutionary narratives of e.g. the origin and development of organ systems, cognition, and colonial/communal organisms. We will examine the physical environments in which invertebrates live, in the context of understanding what life is like in these habitats—for instance, why do small marine organisms perceive ocean water the way we would corn syrup? In addition to exploring the complex and surprising features mentioned above, we will explore behavior, social structure, learning and signaling, parasitism, predation and defense, and reproductive strategies. The lab complements and supports these topics through dissections, (non-harmful) experiments with live organisms, and appreciation of the diversity of invertebrate life through interaction with our extensive in-house live specimens.

### **Material:**

**Required for lecture:** “Biology of the Invertebrates” by Jan Pechenik, 7<sup>th</sup> edition. ISBN: 978-0073524184. The 6<sup>th</sup> edition should be OK, as long as you are willing to do a little “translating” of page numbers and some content differences.

**Canvas:** I will maintain a Blackboard (Bb) site for the class. On the website you will find this Syllabus document, lecture & lab schedules, PDFs of the lecture slides, reminders of upcoming assignments/events, study guides for exams... and more. Check Bb often—content will be updated constantly!

**Lectures:** I will be using PowerPoint presentations, including images from our textbook, as well as some material and images from other sources. The slides will be available on Bb, **no later than the night before each class**. You can print these files out and use them as a starting place to take notes ... but **BE WARNED!** These slides are a poor substitute for actually being in class. The PDFs are “bare bones” images with minimal text. Class time is invaluable for you to ask

questions big and small, and you will gain the greatest understanding by listening to the material actually being presented, not just skimming the images on the slides.

**Exams:** Two in-class exams will be given, as well as one (non-cumulative) final exam during the finals period. There will be **no make-up exams** unless you can **document** that the absence was for legitimate and serious reasons, e.g. medical emergency, bereavement, family emergency. If you know of an exam conflict **in advance**, we can try to schedule a date for you to take the exam **before the exam date**.

**Online Quizzes:** To reinforce the lecture material, a brief quiz will be posted each week on Bb, to be completed on Bb. These brief (4-5 question) quizzes are open-book and open-notes, and will cover the major topics from the previous week's lectures. Announcements of each quiz will go out automatically when posted. More details will be presented in class once the quizzes start.

**Lab:** Lab is a critical component of Invertebrate Biology. The labs will consist of a variety of live and preserved organisms, as well as models and prepared microscope slides. Lab assignments may consist of morphological drawings, live experiments/observations (including data analysis), dissections, and other activities. All materials required for lab will be supplied in the lab; you are not required to purchase any materials for lab. In general, assignments will be turned in at the conclusion of each lab (i.e. before you leave), although some write-up or analyses may be due at the start of the following week's lab.

**Grades (your grades will be posted to you on Canvas):**

- 200 In-class Exam I (plus extra credit)
- 200 In-class Exam II (plus extra credit)
- 200 Final Exam (plus bonus)
- 300 Lab (14x 21pts, plus 6 free pts)
- 100 Online quizzes (10x 10pts)
- 1000 total points

**Course Schedule:**

| Month | Date    | Topic                                                       | Chapter |
|-------|---------|-------------------------------------------------------------|---------|
| Jan   | 14 Mon  | Introduction                                                | 1       |
|       | 16 Weds | Environments                                                | 1       |
|       | 18 Fri  | Protozoan Relevance to Metazoans                            | 3       |
|       |         | LAB NO LAB                                                  |         |
|       | 21 Mon  | MLK Holiday                                                 |         |
|       | 23 Weds | Phylogenetic Trees, Fossil Record                           | 2       |
|       | 25 Fri  | Porifera: Phylogeny and Anatomy                             | 4       |
|       |         | LAB Protists                                                |         |
|       | 28 Mon  | Porifera: Ecology and Immunity                              | 4       |
|       | 30 Weds | Introduction to the hydrostatic skeleton; Cnidaria Overview | 5       |
| Feb   | 1 Fri   | Cnidaria: Scyphozoa and Cubozoa                             | 6       |
|       |         | LAB Porifera                                                |         |
|       | 4 Mon   | Cnidaria: Other Medusozoa, and Anthozoa                     | 6       |
|       | 6 Weds  | Ctenophora: Overview                                        | 7       |

|         |                                                  |                                                             |    |
|---------|--------------------------------------------------|-------------------------------------------------------------|----|
| Mar     | 8 Fri                                            | Ctenophora: Physiology, Ecology                             |    |
|         |                                                  | LAB Cnidaria I                                              |    |
|         | 11 Mon                                           | Phylogeny of Basal Metazoans                                |    |
|         | 13 Weds                                          | Review                                                      |    |
|         | 15 Fri                                           | EXAM 1                                                      |    |
|         |                                                  | LAB Cnidaria II, Ctenophora                                 |    |
|         | 18 Mon                                           | Platyhelminthes                                             | 8  |
|         | 20 Weds                                          | Three Phyla in a Day: Mesozoa, Rotifera, and Acanthocephala | 9  |
|         | 22 Fri                                           | Chaetognatha                                                | 18 |
|         |                                                  | LAB Platyhelminthes                                         |    |
|         | 25 Mon                                           | Mollusca: Overview; Polyplacophora & Monoplacophora         | 12 |
|         | 27 Weds                                          | Mollusca: Aplacophora, Scaphopoda, Cephalopoda              |    |
|         | 1 Fri                                            | Mollusca: Bivalvia                                          |    |
|         |                                                  | LAB Virtual Lab                                             |    |
|         | 4 Mon                                            | <b>SPRING BREAK</b>                                         |    |
| 6 Weds  |                                                  |                                                             |    |
| 8 Fri   |                                                  |                                                             |    |
| 11 Mon  | Mollusca: Gastropoda                             | 12                                                          |    |
| 13 Weds | Annelida: Overview                               | 13                                                          |    |
| 15 Fri  | Annelida: Polychaetes I                          |                                                             |    |
|         | LAB Mollusca                                     |                                                             |    |
| 18 Mon  | Annelida: Polychaetes II                         | 13                                                          |    |
| 20 Weds | Nemertea                                         | 11                                                          |    |
| 22 Fri  | Lophophorates                                    | 19                                                          |    |
|         | LAB Annelida                                     |                                                             |    |
| 25 Mon  | Review                                           |                                                             |    |
| 27 Weds | EXAM 2                                           |                                                             |    |
| 29 Fri  | Sampling the Deep-Sea                            |                                                             |    |
|         | LAB Arthropoda I                                 |                                                             |    |
| Apr     | 1 Mon                                            | Arthropoda: Overview                                        | 14 |
|         | 3 Weds                                           | Arthropoda: Trilobita, Chelicerata                          |    |
|         | 5 Fri                                            | Arthropoda: Myriapoda, Hexapoda I                           |    |
|         |                                                  | LAB Phylogenetics                                           |    |
|         | 8 Mon                                            | Arthropoda: Hexapoda II, Crustacea I                        | 14 |
|         | 10 Weds                                          | Arthropoda: Crustacea II                                    |    |
| 12 Fri  | Nematoda; Invertebrate Contributions to Medicine | 16                                                          |    |
|         | LAB Arthropoda II                                |                                                             |    |
| 15 Mon  | Intro to Deuterostomes, Echinodermata Overview   | 20                                                          |    |

|     |    |      |                                                    |    |
|-----|----|------|----------------------------------------------------|----|
| May | 17 | Weds | Echinodermata: Crinoidea, Holothuroidea            |    |
|     | 19 | Fri  | Echinodermata: Echinoidea, Asteroidea, Ophiuroidea |    |
|     |    | LAB  | Sea Urchin Fertilization                           |    |
|     | 22 | Mon  | Hemichordata                                       | 21 |
|     | 24 | Weds | Cephalochordata and Urochordata I                  |    |
|     | 26 | Fri  | Urochordata II and "The Path to Vertebrates"       | 23 |
|     |    | LAB  | Echinodermata                                      |    |
|     | 29 | Mon  | Review                                             |    |
|     | 30 | Tues |                                                    |    |
|     | 1  | Weds |                                                    |    |

STUDY DAYS

NON-CUMULATIVE Final Monday 6 May 8:00am-10:00am