Zoology 301: Invertebrate Biology and Evolution Lab – Spring 2017

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Office: 352 Birge Hall
Office hours: By appointment

Teaching Assistant: TBA

2 credits (spring term)

Labs: Wednesdays 1-5 PM

Grading (100 points)

25 pts	Lab notebook (illustrations and identifications)
25 pts	Computer lab practicals (5 x 5 pts)
50 pts	Exam (lab practical)

Grading scale: A (93-100%), AB (87-92%), B (83-86%), BC (77-82%), C (70-76%), D (60-70%), F (<60%).

Overview

This course provides an introduction to invertebrate diversity and biology, with emphasis on anatomy, development, and systematic relationships of the main animal phyla. Phyla are discussed in the context of major themes in animal evolution, such as the origin of tissue layers, the diversity of feeding mechanisms, the evolution of terrestrialization, patterns of diversification through time, and the conservation of transcriptional circuitry. The aim of this course is to understand animal diversity from a phylogenetic and developmental perspective.

Prerequisites: Zoology 101/102, 151/152 or Biocore 381, and concurrent enrollment in Zoology 300.

Course enrollment limit: 20.

Learning outcomes

Four major learning outcomes are established for this course.

1. Students will be able to recognize the differences between animal phyla
2. Students will be able to identify key morphological structures and/or developmental phenomena that distinguish major divisions of the animal tree of life
3. Students will be able to describe early development in study species
4. Students will be able to generate image data from biological samples

Readings

Mandatory textbooks: None.

Recommended textbooks: The following texts are strongly recommended as helpful resources and/or background reading. These will be placed on reserve at the Memorial and Steenbock Libraries.

Brusca, R. C. and G. J. Brusca. 2016. Invertebrates, 3rd edition. Sinauer Associates, Sunderland.

Gilbert, S. F. and A. M. Raunio. 1997. Embryology: Constructing the Organism. Sinauer Associates, Sunderland.

Minelli, A. 2009. Perspectives in Animal Phylogeny & Evolution. Oxford University Press, Oxford.

Nielsen, C. 2012. Animal evolution: interrelationships of the living phyla, 3rd edition. Oxford University Press, Oxford.

Labs

Lab 1: Fossils: Precambrian and Cambrian metazoans

- Collections/tour of the Geology Museum

Out-of-class lab notebook activity:
Draw five fossils observed in the Geology Museum

Lab 2: Principles of phylogenetics

- Coding morphological characters (computer lab)
- Tree of basal Metazoa
- Mapping characters on molecular phylogenies

Out-of-class lab notebook activity:
Generate 20 morphological characters for the caminalcules and compute the most parsimonious phylogeny for your dataset

Lab 3: Sponges and cnidarians

- Dissection and peroxide clearing for spicules (use of compound microscopes)
- Introduction to gene expression data

Out-of-class lab notebook activity:
Read and summarize one paper on sponge biology published in the last three years. Describe major findings and list two follow-up questions about the work.

Lab 4: Annelida and allied taxa

- Patterns of segmentation
- Sipuncula and Echiura
- Homonomy and heteronomy
- Regeneration: epimorphosis and morphallaxis
- *Notch* pathway and gene expression data in *Platynereis* and *Capitella*

Out-of-class lab notebook activity:
Read and summarize one papers on annelid biology published in the last three years.

Describe major findings and list two follow-up questions about the work.

Lab 5: Mollusca and Brachiopoda

- Body plans of mollusk classes
- Character convergence
- Spiral cleavage
- Log lineage through time plots and calculating diversification rate change (computer lab)

Out-of-class lab notebook activity:

Read and summarize one paper on mass extinction published in the last three years. Describe major findings and list two follow-up questions about the work.

Lab 6: Platyhelminthes, Nemertea, and the other lophophorates

- Dugesia regeneration
- Stem cells and blastemas (use of compound microscopes)
- Parasitic flatworms
- Construction of the lophophore

Out-of-class lab notebook activity:

Design three experiments you would conduct to test the mechanisms and processes underlying regeneration in flatworms. List each hypothesis and how resulting data would favor or reject the hypothesis.

Lab 7: Panarthropoda

- Tardigrada
- Onychophora
- Arthropoda
- Arthropod embryos: *Parasteatoda, Centruroides, Lithobius, Parhyale, Gryllus, Oncopeltus*
- Gene expression data for appendage patterning and Hox genes

Out-of-class lab notebook activity:

Infer the Hox gene expression domains for three arthropod species with unusual patterns of tagmosis (e.g., crabs, remipedes, ostracods). Justify each prediction using previously described expression data.

Lab 8: Ambulacraria

- Observations and dissections of the five extant classes
- Sea urchin fertilization
- Endoderm specification in sea urchin embryos
- Hemichordata

Out-of-class lab notebook activity:

Read and summarize one paper on echinoderms published in the last three years. Describe major findings and list two follow-up questions about the work.

Lab 9: Chordata

- Cephalochordates and urochordates
- Gene orthology and axis inversion in protostomes vs. deuterostomes

Out-of-class lab notebook activity:

Research the mechanisms underlying dorso-ventral axis patterning in protostomes and deuterostomes. Explain whether this mechanism is homologous, and at what level.

Lab 10: Phylogenomics and evolutionary inference

- Inferring tree topologies
- Molecular dating
- Inference of ancestral states/areas

Out-of-class lab notebook activity:

Read and summarize one paper on phylogenomics published in the last three years. Describe two major challenges encountered by the authors in analyzing large molecular datasets.

Lab 11: Lab practical exam