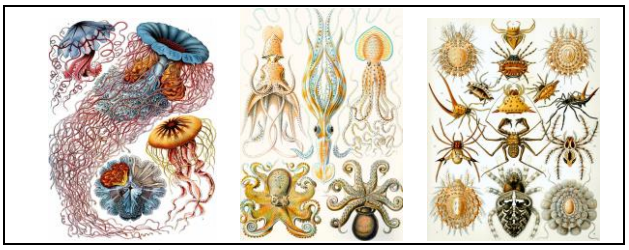
**SPRING 2023** **BIOLOGY OF INVERTEBRATES** **BIOLOGY 346**
**SYLLABUS**

**Lecture: ISC 136**
**MWF 10:30-11:20**

**Lab: ISC 105**
**Thursday 9:30 - 12:20**
**2:30 - 5:20**

***Instructor:*** Isidro Bosch ISC 260
e-mail contact: bosch@geneseo.edu
Phone: 585-245-5303
Office hr. M: 3:00-4:00
T 1:00-2:30
W 1:30-3:00



*Drawings of medusas, octopi and arachnids.*

## Course Description:

This course offers students an opportunity to study the great diversity of animal phyla and to investigate how different lineages are designed to function as integrated units that we refer to as a 'body plan". As you learn about the body plans of the most diverse among the nearly 36 animal phyla, we will also study their evolution, the position that individual lineages hold in the tree of life (that is, their phylogeny), and aspects of their physiology, development and ecology. This is not a traditional zoology course- taxonomic names and anatomical nomenclature are not the fundamental learning outcomes. Instead, taxonomic names and nomenclature will serve as the basic language you will need to understand broader aspects of biology, such as diversity, form-function relationships, evolutionary history, regulation of development and more.

The laboratory portion of this course offers an opportunity to observe first-hand many of the animals studied in lecture, thus providing context to abstract lecture concepts. Lab activities provide a moderately-structured learning experience that encourage inquiry and independent-learning rather than following specific protocols. A limited number of dissections will be used to understand details of internal anatomy of selected groups. There are two major assignments associated with the laboratory portion of the course. One is a poster presentation on a current topic in the field and the other is the taxonomic identification and description of an aquatic species collected from a local stream habitat. Field outings for collection stream invertebrates are scheduled for the last week of April.

All of the materials in this course including lectures, laboratory handouts, papers for weekly readings and more will be posted on our Canvas Course.

## Books and Supplies:

1. Required Textbook: "Biology of the Invertebrates" by J.A. Pechenik
7th Edition, William C. Brown Publishers, 2015. Used hard cover, paperback international editions and even an ebook are available for the 7th edition at a lower cost. All of these alternatives are acceptable for use. This book will serve as a useful reference for course content, and we will use it to provide background for class discussions.

2. A bound dedicated laboratory notebook . This lab book should hold a record of your observations in the laboratory. Lab quizzes are "open lab notebook". At the end of the semester your lab notebook will be collected for grading.

**Intended Learning Outcomes:**

To demonstrate minimum competence a student must be able to accomplish the following:

- Characterize the evolutionary history of early animal life; evaluate conflicting hypotheses about the timing of major historical events and the processes that contributed to them.
- Categorize the range of diversity and functional attributes of animal body plans and identify key characters that define the body plans of major phyla.
- Summarize the phylogeny of the major animal groups (e.g. phyla, classes) and critically analyze evidence that contributes to our understanding of these relationships.
- Create, analyze, and interpret evolutionary trees.
- Describe the patterns of animal development from gametes to juvenile, identifying key attributes of different evolutionary lineages.
- Explain the role that developmental modifications have played in shaping the evolution of animal body plans and identify key developmental mechanisms that contributed to these evolutionary changes.
- Demonstrate aptitude in interpreting function/phylogeny on the basis of observations of animal form.
- Maintain an organized and practical written record of activities and observations in the laboratory.
- Demonstrate. progress in ability to analyze and communicate biological information at a level appropriate for this course.

Success in meeting the intended learning outcomes will be evaluated through lecture exams, discussions, and laboratory activities, quizzes and assignments.

**Evaluation:**

1. Lecture exams: 3 semester exams, Feb 20, Mar 27, Apr 24, worth 12%, 15%, and 15% of the final grade and a fourth exam during finals week on May 15 worth 10%.
2. Homework assignments (9% three assignments)
3. In-class writing assignments related to readings (5%)
4. Laboratory quizzes (10%) and laboratory notebook (4%)
5. Group Projects (descriptions below)
   Poster presentation on May 12 (10 %), Species Description on May 9 (5 %)
6. Contributions to class and laboratory activities/discussions (5 %)

Generally speaking, your work in the classroom will count toward 2/3 of your grade, and laboratory work with related projects will count for 1/3 of your grade. The grading scale will follow the standard Geneseo distribution with some minor deviations. There will be no curve, and no set letter grade allotment.

| Total Score | Grade |
|---|---|
| 93-100 % | A |
| 89 - 92 | A- |
| 86 - 88 | B+ |
| 82 - 85 | B |
| 79 - 81 | B- |
| 76 - 78 | C+ |
| 71 - 77 | C |
| 66 - 70 | C- |
| 61 - 65 | D |
| < 61 | E |

## Shared Responsibilities to Our Learning Community:

Ideally our class will function as a learning community in which we work together to achieve intellectual growth and academic success, individually and collectively, as we try to explore the learning outcomes of this course. To achieve this goal as a group, each of us must give their best to the community. For my part, I promise to work hard to offer an organized course that will deliver intellectually interesting and biologically important content. I also commit to treating everyone with respect and as equal members of our learning community. Finally, I commit to listening to your ideas, concerns and constructive criticism and to try and understand things from your perspective. Below I outline some of what you might consider your individual responsibilities to the course and all its members.=

Responsibility to prioritize everyone's health and wellbeing

If at any time you fall ill, we ask that you protect our community and yourself by not coming to class. Lecture materials including presentation slides will be posted on Canvas. Should you miss a class due to illness it is important that you try to get additional notes from other students and that you check Canvas or ask your professor about any work you might have missed. Unfortunately, it will be very difficult to make up labs, but I promise I'll do everything possible to keep an excused absence from adversely affecting your performance in the course.

Responsibility to promote learning

Please arrive to class on time, stay through class, use your laptop and other technology only for class-related activities, and turn off your cell phone ringtones (including vibration mode). Technology can be beneficial to the process of your education. For this reason, laptops and smartphones are permitted so you can take notes and view classroom materials. Please refrain from using your phone for any reason not related to class (e.g., social media websites, e-mail, playing games, cell phone photography). These diversions can jeopardize your learning and also distract those around you. Our class will be held in a small classroom. From my vantage point I can very easily tell who is using their technology in ways that are incongruent with the flow of the class. Any student who disrupts lecture or distracts others will be cautioned, and if the behavior continues eventually the student will be asked to leave the classroom. If the behavior of other students around you affects your learning, please tell them and tell us.

We understand that in some emergency situations a student may need to leave a cell phone turned If that is the case, tell your instructor before class that you may be contacted.

Responsibility to Maintain Academic Integrity

We value academic integrity because dishonesty devalues the work of other students. College procedures to address serious academic dishonesty can be found at the Dean of Academic Planning and Advising's webpage.

Responsibility to Support Diversity and Equity

It is our intent to create a learning environment that supports all students. We believe the diversity that you bring to this class should be viewed as a resource, strength, and benefit. We strive to present materials and activities that are respectful of gender identity, sexuality, disability, age, socioeconomic status, ethnicity, race, nationality, religion, and culture. Your suggestions are encouraged to improve the course's effectiveness personally, or for other students or student groups. For ideas, questions, or concerns related to diversity, equity, and inclusion in the Biology Department, please reach out to bio-diversity@geneseo.edu.

**Laboratory Syllabus:**

The laboratory portion of the course will give you the opportunity to observe first-hand many of the organisms you will learn about in lecture. You are asked to participate in 3 dissections, two of fixed animals (squids and crayfish) and one of an anesthetized earth worm. If you have legitimate personal conflicts that preclude participation in dissections let your instructor know and may be assigned alternative activities.

One of your primary responsibilities in lab will be to keep a laboratory notebook as your record of significant concepts and observations from the laboratory. It should include primarily original drawings and observations (not copied from books). You will be able to use your lab notes as reference during laboratory quizzes. This is a privilege that may be revoked if students are found to be copying information from other sources into the notebook. A pre-lab summary paragraph of the planned activities should be written prior to each lab meeting.

**Laboratory Schedule**

| Date | Topic for Laboratory | Pre-Lab Read |
|---|---|---|
| Jan 26 | Introduction/Assignments | #1 Guide |
| Feb 2 | Phylogeny Exercise | #2 Guide |
| 9 | Protista and Sponges | #3 Guide |
| 16 | Cnidaria | #4 Guide |
| 23 | Fertilization & Embryology | #5 Guide |
| Mar 2 | Flatworms and Parasitism | #6 Guide, Quiz 1 Embryology |
| 9 | Molluscs I: Clams & Squid | #7 Guide, Quiz 2 Parasitism |
| 16 | Spring Break | |
| 23 | Molluscs II: Snails | #8 Guide, Quiz 3 Snails |
| 30 | Annelid Diversity | #9 Guide, Quiz 4 Annelids |
| Apr 6 | Aquatic Arthropods | #10 Guide, Quiz 5 Crustaceans |
| 13 | Land Arthropods; Insects | #11 Guide, Quiz 6 Insects |
| 20 | Stream Invert Collection | Field Trip |
| 27 | Species I.D./Poster Prep | (Due on Monday, May 8) |
| May 4 | Poster Session | |

You are asked to participate in two collaborative projects. The projects are intended to cultivate particular process skills needed in the study of biology while emphasizing different aspects of animal diversity.

Project 1: Description of Stream Invertebrate Species (5 % of score due Mon May 8)

For this project you are asked to collect and identify (using taxonomic keys) an invertebrate species from local aquatic habitats and to submit a formal written description of the species of no more than 5 pages. Examples of successful species descriptions from previous years and a grading rubric for the assignment will be provided. The report will be graded on overall organization, the analysis of key characters and a description of what other information is available on your species. To complete the project each group must submit a representative specimen preserved in 70% ethanol and stored in a vial labeled with the taxonomic order and species name, date, and the name of at least one student who participated in the identification.

Project 2: Poster Presentation (10% of total Score, due in Thursday May 4.

You are asked to explore an integrative question in the areas of phylogeny (taxonomic classification, relationships between different groups), evolution, or comparative function and form of invertebrates. Your sources for this research project must include a minimum of five peer-reviewed technical scientific papers (journal articles). Other sources (*e.g.,* web sites) are acceptable only as supplements to the primary literature. The tentative date for the poster presentation is during the last lab meeting on Thursday, May 4. On that same day you should turn in a 2 page summary of your presentation with an annotated bibliography.

**Tentative Schedule of Articles to Read for Friday Class Discussions**

| | Date of Article (Fridays) | Title/Topic | Student Leaders |
|---|---|---|---|
| 1 | Feb 3 | Multicellularity:" The momentous transition to multicellular life may not have been so hard after all" | |
| 2 | Feb 10 | Sponge "Feeding evolution: filter feeding to carnivory" (on Canvas) | |
| 3 | Feb 24 | Ernst Haeckle: History of Science | |
| 4 | March 3 | Regeneration: "Flatworms, the masters of regeneration- but nothing can happen without stem cells" (on Canvas) | |
| 5 | March 10 | Intelligence: "The mind of an octopus" | |
| 6 | March 31 | Leeches and Blood Feeding: "Blood Sucking Creatures" | |
| 7 | April 14 | Flight: "The double identity of insect wings" (Canvas) | |
| 8 | April 21 | Round worm lab rats: "Genetic regulation of organ development and programmed cell death" (Canvas) | |
| 9 | May 5 | Chordate nervous system- CNS evolution: New insight from the mud (Canvas) | |

**Tentative Lecture/Lab and Reading Schedule for Bio 346 Spring 2023**

## Part I

| Lec # | Date | Topic | Readings (Ch are from Textbook) |
|---|---|---|---|
| **Week 1- Jan 23** | | | |
| 1 | Jan 25 W | Course Overview | Preface: About this Book |
| 2 | 27 F | Animal Diversity | Ch 1: 1-2; 4-6 |
| **Week 2- Jan 30** | | | |
| 3 | 30 M | Classification and Phylogeny | Ch 2: 18-24; *Hwk #1 Due 2/6* |
| 4 | Feb 1 W | Evolutionary History | *Read Sokol (2018)* |
| 5 | 3 F | Evolutionary History | *Discussion 1:Evolution of Multicellularity* |
| **Week 3- Feb 6** | | | |
| 6 | 6 M | Protists and Multicellularity | Ch 3: 36-43 *Hwk #1 due* |
| 7 | 8 W | Porifera | Ch 4:77-91 |
| 8 | 10 F | Porifera and Placozoa | *Discussion 2: Carnivorous Sponges* |
| **Week 4 Feb 13** | | | |
| 9 | 13 M | Cnidaria Body Plan, Scyphozoa | Ch 6: 99-102, 102-108 |
| | 15 W | Diversity Summit- No classes | |
| 10 | 17 F | Cnidaria Hydrozoa, Anthozoa | Ch 6: 109-114, 117-126 |
| **Week 5 Feb 20** | | | |
| **11** | 20 M | **Exam I (**Lec 1-10**)** | |

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## Part II

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|---|---|---|---|
| **Week 5 Feb 20 Continued** | | | |
| 12 | 22 W | Embryology and Phylogeny | Ch 2: 9-17 |
| 13 | 24 F | Embryology and Phylogeny | *Discussion 3:Ernst Haeckel* |
| **Week 6 Feb 27** | | | |
| 14 | 27 M | Comb Jellies (Ph. Ctenophora) | Ch 7: 135-144; Hwk #2 Due 2/7 |
| 15 | **Mar** 1 W | Flatworms, Parasites | Ch 8:147-148; 156-168 |
| 16 | 3 F | Free Living Flatworms | *Discussion 4: Tree of Life* (*Cannon 2016)* |
| **Week 7 Mar 6** | | | |
| 17 | 6 M | Flatworms and Phylogeny | Ch 8 149-155 |
| 18 | 8 W | Mollusca, Cephalopods | Ch 12:215-218, 255-264 |
| 19 | 10 F | *Article Discussion 4: Cephalopods* | Hwk #3 Due Wed, 3/23 |
| **Week 8 March 11-18 Spring Break NO Class** | | | |
| **Week 9 March 20 (Welcome back!)** | | | |
| 20 | 20 M | Bivalves, Gastropods | Ch 12: 224-250 |
| 21 | 22 W | Evolution of Eyes | Hwk #3 Due |
| 22 | 24 F | Evolution of Eyes, Exam Review | |
| **Week 10 March 27** | | | |
| **23** | 27 M | **Exam II (**Lec 12-22**)** | |

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## Part III

| Lec # | Date | Topic | Readings |
|---|---|---|---|
| **Week 10 cont** | | | |
| 24 | Mar 29 W | Annelid Body Plan, Diversity | Ch 13 : 295-304; 318-325 |
| 25 | 31 F | Annelid Oligochetes | *Discussion 5: Blood Sucking Creatures* |
| **Week 11 April 3** | | | |
| 26 | 3 M | Ecdysozoa and Arthropods | Ch 14:341-348 |
| 27 | 5 W | Arthropod: Crustacea | :373-390 |
| 28 | 7 F | Arthropods: Hexapods | :359-364 |
| **Week 12 April 10** | | | |
| 29 | 10 M | Insect Development | Ch 14:367-371 |
| 30 | 12 W | Evolution of Flight | :364-367 |
| 31 | 14 F | Flight continued | *Discussion 6: Evolution of Wings* |
| **Week 13 April 17** | | | |
| 32 | 17 M | Chelicerates | Ch 14 : 351-358 |
| 33 | 19 W | Nematodes | Ch 16: 431-445 |
| 34 | 21 F | Exam III Review | *Discussion 7: Programmed Cell death* |
| **Week 14 -April 24** | | | |
| 35 | 24 M | **Exam III (Lec 25 -35)** | |

## Part IV

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|---|---|---|---|
| **Week 14 cont** | | | |
| 36 | 26 W | **No Classes – GREAT Day** | |
| 37 | 28 F | Deuterostomes and Echinoderms | Ch 20: 497-500 |
| **Week 15- May 1** | | | |
| 38 May | 1 M | Echinoderm Lecture | Ch 20: 500-509; 509-520 |
| 39 | 3 W | Evolution of Development | Ch 24: 567-577 |
| 40 | 5 F | Hemichordates | Ch 21: 529-535 |
| **Week 16- May 8** | | | |
| 41 | 8 M | Chordate Characters | Ch 23: 539-545 *Discussion 8: Evolution of the CNS* |
| 42 | 10 W | Chordate Evolution | Ch 23: 548-560 |

**Final Exam (Monday May 15th 8:00-11:20)**
**(Lec 37 -42 + final in-class essay)**