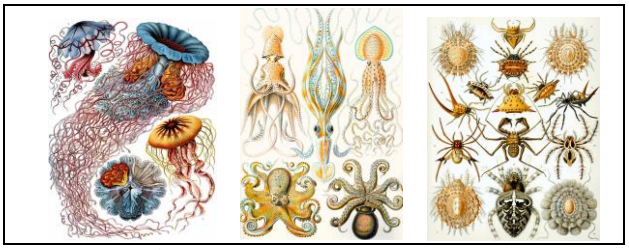
SPRING 2021 **BIOLOGY OF INVERTEBRATES** **BIOLOGY 346**
SYLLABUS

Lecture: ISC 105
MWF 10:30-11:20

Lab: ISC 105
Th 10:00-12:50 or 2:30-5:20

Instructor: Isidro Bosch ISC 260

e-mail contact: bosch@geneseo.edu
Phone: 585-245-5303
Virtual Office hr: M 1:30-2:30,
T 2-3 , F 1-2 PM



Drawings of medusas, octopi and arachnids by Ern

Course Description:

This course offers students an opportunity to study the great diversity of animal phyla and to investigate how different groups are designed to function as integrated units 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 in that taxonomic names and anatomical nomenclature are not the fundamental learning outcomes. Instead, the 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 is 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 investigative observation 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 and the other is a 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.

Hybrid Format

For the spring semester 2021 this course will follow a hybrid format. Lectures will be video recorded and posted as .mov files that will be archived in YouTube and accessible through Canvas. In-person class meetings to complement the recorded lectures will be held on Monday and Wednesday, with half the class attending on each day. These sessions will be held in lab ISC 105 (not in Bailey 104), where we'll have the opportunity to view specimens and engage in active learning activities that will complement the more traditional lecture format. Friday classes will be virtual and consist primarily of discussions of scientific literature, exam reviews, and rarely lecture-style material. With the exception of week 1, laboratory sessions will be held in person.

The video lecture format of hybrid courses has many pros and cons. Students benefit by being able to view lectures at your convenience and your preferred pace, and the recordings are always available for review. On the flip ("con") side, without regularly scheduled lecture times it is more important than ever that you stay motivated and keep up with your coursework. The content of video lectures, in-class meetings and labs are integrated and complementary and if you fall

behind in one it will affect your preparation and learning in another. Another pitfall of the hybrid format is the lack of equivalency between video lecture time and class time – we all know by now that it takes a lot longer than "real time" to get through a lecture video. I have considered all of these complications in restructuring the course for a hybrid format. For example, with few exceptions, all video lectures will run under 20 minutes. Furthermore, because you have two formal class meetings a week (one in person and a Friday virtual meeting), I will do my absolute best to keep the total weekly video lecture content to 45 minutes or less (3 x 15 minutes is my target).

I greatly value the opportunity to have our in-person class meetings. We will use this time to build on materials covered in the textbook and video lectures. The COVID-19 pandemic presents challenges to in-person learning, but by working together we can make this a safe experience. It is essential that we follow some basic processes to help keep everyone safe. Although these processes may seem inconvenient, they reflect current public health guidance that helps minimize the spread of coronavirus. Please incorporate these essential health and safety measures into your normal routine, consider the ways that your actions may affect the health and wellbeing of those around you, and try to approach this semester with a spirit of empathy and compassion.

Health and Wellbeing in a Stressful Time

The changes brought on by COVID-19 have impacted us all in many ways, and will continue to do so at various times and to varying degrees during the upcoming semester. Your health and wellbeing are foundational to your ability to learn, and if you find that you are feeling unwell (physically or mentally) and it is impacting your ability to complete your coursework, please communicate any concerns and any issues you might be facing to someone who can help. We need to help one another to successfully overcome this crisis. If there's anything I can do to promote your wellbeing and your success then, as much as possible, I will help. The Dean of Students (585-245-5706) can assist and provide direction to appropriate campus resources. The college also has collected resources in a Coping with COVID webpage. (https://www.geneseo.edu/health/copingwithcovid).

In a similar way, I will occasionally ask for some patience and flexibility on your part. It has taken a great deal of time to redesign this course for a hybrid format and I'll be working hard to record lectures and organize in-person activities as we progress through the semester. The pandemic is affecting faculty as well as students and creating demands that would not be present in an ordinary semester. If will respond fairly quickly to email, but if I take some time to grade an assignment, if I am a bit late posting a video lecture, please be patient (and feel free to send me a 'nudge'; I will not be offended). You will never suffer any disadvantage in the course because of delays on my part. I know it may seem like a tired phrase, but we are all in this together and I am ready to work with you to make your introduction to the biology of invertebrates a fruitful and enjoyable learning experience.

Books and Supplies:

1. Required Textbook: "Biology of the Invertebrates" by J.A. Pechenik
7th Edition, William C. Brown Publishers, 2015. A new hard cover edition of this book is fairly expensive, but 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.

2. A bound dedicated laboratory notebook (Good drawing pencils are recommended). This lab book will contain your observations. You are encouraged to be thorough in taking notes. Lab quizzes are "open lab notebook". At the end of the semester your lab notebook will be collected for grading. There is no required lab textbook.

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, laboratory exercises, quizzes, species description and a research poster presentation.

Evaluation:**

1. Lecture exams: 3 semester exams, 12%, 16%, and 16% of the final grade and a final exam worth 10%
2. Group Projects (descriptions below)
   Poster presentation (10 %), Species Description (5 %)
3. Contributions to class and laboratory activities/discussions (5 %)
4. Laboratory quizzes (12%) and laboratory notebook (5%)
5. Homework assignments (9% three assignments)

**Make-up exams or assignments may be scheduled at the discretion of the instructor when legitimate written medical or personal justification is provided. There are no provisions for making up laboratory activities. Field outings postponed due to weather may be rescheduled outside of the regular lab period.

Laboratory Syllabus:

The laboratory portion of the course is being run primarily in-person so you will still be able to observe first-hand the many organisms you will learn about in lecture. You are expected to be involved in 3 dissections, two of fixed animals (squids and crayfish) and one of an anesthetized earthworm. Those of you who may have legitimate personal conflicts that preclude participation in dissections may be assigned alternative activities. Please alert me to these conflicts at the start of the semester to allow ample time for preparation of other activities. Due to the difficulty of setting up laboratories, no make-up labs can be scheduled.

One of your primary responsibilities in lab will be to keep a laboratory notebook. Your lab-book will serve as your record of significant concepts and observations from the laboratory. It should include primarily original drawings and observations (not copied from books) that you will be able to use 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 their lab notebook. A pre-lab summary of the planned activities should be written prior to each lab meeting.

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. Below is a brief description of each project. More details are to be provided during the semester.

Project 1: Description of Stream Invertebrate Species (5 % of score due Mon May 10th)

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 Wed. May 12, which is designated as a Thursday on the schedule)

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 Wednesday May 12th. On that same day you should turn in a 2 page summary of your presentation with an annotated bibliography.

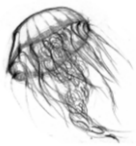
Laboratory Schedule

Date	Topic for Laboratory	Pre-Lab Read
Feb 4 Th	Introduction/Assignments	#1 Lab Guide
11	Phylogeny Exercise	#2
18	Protista and Sponges	#3
25	Cnidaria	#4
Mar 4	Fertilization & Embryology	#5
11	Flatworms and Parasitism	#6 Quiz 1 Embryology
18	Molluscs I: Snails	#7 Quiz 2 Parasitism
25	Molluscs II: Clams & Squid	#8 Quiz 3 Snails
Apr 1	Annelid Diversity	#9 Quiz 4 Annelids
8	Aquatic Arthropods	#10 Quiz 5 Crustaceans
15	Land Arthropods; Insects	#11 Quiz 6 Insects
22	NO LAB; Rejuvenation day	
29	Collection of Stream Inverts	
May 6	Species I.D. (due M 10th)	
12 W	Poster Session	

Tentative Lecture/Lab and Reading Schedule for Bio 346 **Fall 2021**

Part I

Lec #	Date	Topic	Readings (Pechenik_7th ed.
1	**Feb 1** M	Course Overview (Synchronous)	Preface: About this Book
2	3 W	Animal Diversity (Asynchronous)	Ch 1: 1-2; 4-6
Lab 1	4 Th	Introduction/Lab Projects (Synchronous)	**Lab Guide #1**
3	5 F	Classification and Phylogeny (Asynchronous)	Ch 2: 18-24;
4	8 M	Evolutionary History (AM Lab group)	*Read Sokol (2018)*
5	10 W	Evolutionary History (PM Lab group)	
Lab 2	11 Th	Phylogenetic Analysis *Hwk #1 Due 2/19*	**Lab Guide #2**
6	12 F	*Paper Discussion 1:Evolution of Multicellularity*	
7	15 M	Protists and Multicellularity	Ch 3: 36-43
8	17 W	Porifera and Placozoa	Ch 4:77-91
Lab 3	18 Th	Protista and Sponges	**Lab Guide #3**
9	19 F	*Paper Discussion 2: Carnivorous Sponges*	
10	22 M	Cnidaria Body Plan and Scyphozoa	Ch 6: 99-108
11	24 W	Cnidaria Hydrozoans and Anthozoans	Ch 6: 109-126
Lab 4	25 Th	Cnidarians	**Lab Guide #4**
12	27 F	Catch up and Exam I Review	
13	**Mar** 1 M	**Exam I (**Lec 1-12**)**	



Part II

Lec #	Date	Topic	Readings (Pechenik_7th ed.
14	**Mar** 3 W	Embryology and Phylogeny	Ch 2: 9-17
Lab 5	4 Th	Fertilization and Embryology	**Lab Guide #5**
15	5 F	*Article Discussion 3: Ctenophore's Brain* Hwk #2 Cue 2/10	Ch 7: 135-144
16	8 M	Flatworm Parasites	Ch 8:147-148; 156-158
17	10 W	Free Living Flatworms	Ch 8: 149-155
Lab 6	11 Th	Flatworms and Parasitism	**Lab Guide #6**
	12 F	*Paper Discussion 4: Tree of Life* (*Cannon et al. 2016)*	
18	15 M	Mollusca Body Plan; Gastropoda	Ch 12:215-218, 224-236
19	17 W	Mollusca: Bivalves and Cephalopods	Ch 12: 243-251, 255-264
Lab 7	18 Th	Diversity of Gastropods	**Lab Guide #7**
20	19 F	*Article Discussion 4: Cephalopods*	
21	22 M	Evolution of Eyes	Hwk #3 2/26
22	24 W	**Rejuvenation Day**	
Lab 8	25 Th	Clams and Squid dissections	**Lab Guide #8**
23	26 F	Catch up and Exam II Review	
24	29 M	**Exam II (**Lec 14-24**)**	

Part III

Lec #	Date	Topic	Readings (Pechenik_7th ed.)
25	Mar 31 W	Annelid Body Plan, Diversity	Ch 13 : 295-304; 318-325
Lab 9	1 Th	Annelid Diversity	**Lab Guide #9**
26	Apr 2 F	*Article Discussion 5: Blood Sucking Creatures*	
27	5 M	Ecdysozoa and Arthropods Intro	Ch 14: 341-348
28	**7** W	Arthropod: Crustacea	: 373-390
Lab 10	8 Th	Aquatic Arthropods	**Lab Guide #10**
29	9 F	Hexapods	Ch 14: 359-364
30	12 M	Insect Development	Ch 14: 367-371
31	14 W	Evolution of Flight	Ch 14: 364-367
Lab 11	15 Th	Hexapods and Chelicerates	**Lab Guide #11**
32	16 F	*Article Discussion 6: Evolution of Flight*	*Averof and Cohen*
33	19 M	Chelicerates	Ch 14 : 351-358
34	21 W	Nematodes	Ch 16: 431-445
	22 Th	Rejuvenation Day- No Lab	
35	23 F	Catch up and Exam III Review	
36	26 M	**Exam III (Lec 25 -35)**	

Part IV

Lec #	Date	Topic	Readings (Pechenik_7th ed.___
37	28 W	Deuterostomes and Echinoderms	Ch 20: 497-500
Lab 12	29 Th	Field Collections	
38	30 F	Echinoderm Lecture	Ch 20: 500-509; 509-520
39	May 3 M	Evolution of Development	Ch 24: 567-577
40	5 W	Hemichordates	Ch 21: 529-535
Lab 13	6 Th	Project Work for Lab	
41	7 F	Chordate Characters	Ch 23: 539-545
42	11 T	Chordate Evolution	Ch 23: 548-560
Lab 14	12 W	Lab Poster Session	
43	May 20 Th	**Final Exam (Th 8:00-10:30)**	
		(Lec 37 -42 + final in-class essay)