

SYLLABUS

MAR215/315 Invertebrate Zoology

TR 10:30-12:50 & T 08:30-10:20

(T 08:30-11:50 Lab plus T 12-12:50 & R 10:30-12:50 Lec)

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and by appointment

Prerequisite: SC101, SC102 or SC203, plus MT231 (for upper division students only).

Required Text:

R. S. K. Barnes, P. Calow, P. J. W. Olive, D. W. Golding, J. I. Spicer (Eds). The Invertebrates :
A Synthesis. Blackwell Science Inc; 576 pages 3rd edition (2001).

Wallace, R.L., & W. K. Taylor. 2002. Invertebrate Zoology: A laboratory manual. 6th Ed.
Prentice Hall, N.J. 356 pp.

Course Description:

200-level Invertebrate Zoology & Care in Captivity: A survey of invertebrate animal diversity and functional biology in the class and laboratory. Animal phyla are examined with respect to anatomy, systematics and evolutionary relationships, geographic distribution, ecology, and behavior. The theory and practice of captive marine invertebrate care and management are introduced.

300-Level - Invertebrate Zoology with Laboratory Techniques: This course covers the same material as the 200-level version, but students also learn laboratory research techniques for examining invertebrate ecology and behavior.

Course Objectives:

This course will give the student an understanding and familiarity with invertebrate animal:

- evolution, classification, diversity, and identification;
- ecology and behavior;
- care, maintenance, and behavior in captive saltwater settings;
- lab techniques for ecological and behavioral research in captive settings (300-level)

We will achieve these by three methods, each requiring substantial student initiative. First, you will learn many facts about invertebrates, about their anatomy, feeding, movement, reproduction, habitats, and evolution. This material will be drawn largely from the texts.

Second, we will be engaged in an ongoing intellectual discussion about these facts. This discussion will require you to THINK about these facts, about what they mean, about how to organize them, and about how you can use them to keep these animals, or to learn more about them. This discussion will take place mostly during Tuesday and Thursday classes; *you are expected to come to class prepared to contribute to it.*

Third, you will be engaged in a series of hands-on explorations about these animals, particularly their behavior. How do they respond to changes in their environment? To food, to light, to disturbance? How do these behaviors reflect their normal habitats, lifestyles and evolutionary history? These explorations will be initiated by you, and will require some preparation and dedication on your part to come out well. This will occur during Tuesday labs and outside of class time.

A note about Zoology courses: At many Universities, courses called Invertebrate Zoology focus on the anatomy and physiology of invertebrate animals; the main learning mode is lecture; the main lab activity is the microscopic inspection and dissection of invertebrates, with heavy emphasis on anatomy. Be aware that this course differs in the following ways: (1) Classroom time is organized around student-led discussions, not lecture. **Every** student must contribute, especially with a small group. (2) We will focus on live organisms (I and many students are opposed to unnecessary killing of animals); (3) We will emphasize aspects of ecology and behavior, rather than anatomy (I am sensitive to chemicals used in specimens prepared for dissection, a knowledge of prepared specimens is not all that helpful in examining unprepared specimens, and behavior and ecology are more interesting to me than comparative anatomy); and (4) this requires the use of captive animals. On the whole, I find the keeping of live animals both more interesting and morally more defensible than the killing of animals for use as classroom materials. Some feel that even the keeping of live animals is ethically unacceptable. I disagree, provided that such animals are well cared for and obtained with proper regard for wild populations. Please strive to provide the best possible care to our live specimens during this course, so that they or their descendants may be here next year.

Assignments:

Reading: We will cover much of the textbook, plus an additional one or two handouts.

At each class meeting, a number of discussion questions will be given about the reading assigned for the following meeting. At each meeting, students will lead a classroom discussion of the topics. Everyone is expected to participate. Use the text glossary REGULARLY; work through the assigned material and questions before class.

Discussion questions - Periodically, written answers to one or more discussion questions will be due. The intent of these assignments is for you to work with the material from the text and labs. Grading will be based on the thoughtfulness and completeness of your answer, appropriate use of new terminology, and correct representation of the material.

Mini-projects - A mini-project will take no more than one lab session to set up; and no more than one week to complete. They differ from a more typical zoology lab only in that they are partially student-designed. For each mini-project, turn in the Mini-Project Design sheet in advance of setting up your project and turn in a write-up of your project within one week of the FIRST day that you start the project (the day you set it up). Mini-project write ups should be short (about 2 pages, see Expectations for formatting), present the relevance of your project to the course, discuss your methods, results, and findings, and defend the success of your project. The **Sensory Systems of Anthozoans** activity will serve for each student as the 1st of three mini-projects. You must give a class presentation about one or more of your mini-projects.

Practical exams - Students will both write and take the exams. In small groups, students will write and prepare practical exams questions. Each student will answer the exam questions written by other students, and will grade the results of question their group wrote. Exam grades will be based both on the quality of the exam prepared, and quality of answer to questions written by other students.

Class Projects - Care, maintenance & behavior (lower division), Lab Research (upper division). Each student must complete a class project, set up the project, collect and analyze data, and interpret the results. *Most project will require putting in time outside of class.*

Each project begins with a project proposal, in which you follow the design principles learned during your three mini-projects. Use your text as a source, but you will need additional more specialized sources. Please consult me to obtain initial references; conduct a follow-up search on your own for further material. Write an introduction addressing the need and significance of your project and providing background information. Describe your proposed methods, and your expected results (especially how they address the identified needs). Include a complete bibliography. This is a substantial assignment; this material will also form the skeleton of your Final Report. *Please do not wait until the last week before the due date to get started!*

Your draft analysis should include a copy of your raw data; any graphs, charts or tables you intend to include in your report, statistical or graphical analyses, and an explanation of how you interpret the data. This material will complete the skeleton of your final report.

The proposal and draft analysis together make a first draft of your project report. Your Final Report should address any comments from me on the earlier assignments and convey your final description and interpretation of your project. Unless your proposal and draft analyses were returned without red marks (I have yet to see this happen!), the Final Report should be a significantly improved and cleaned up description of your project.

Student presentation: Each student will present one mini-project and their class project in formal seminars. Visual aids are mandatory; computer-aided graphics encouraged. You will be graded on the effectiveness, clarity, and appropriateness of your visuals. However, the main grading criteria for Presentations will be how well you convey the story of your project. Your presentation should include introduction, methods, results, and discussion. Why was the project of interest? What exactly did you do, and how did you do it? What did you find out? What does it mean; and why is that important? Did your findings satisfy the original need for the project? Think of these projects and presentations as practice runs for your Senior Project, which you must present to the campus community in a public seminar.

Materials and equipment will be available for the following types of projects, depending on exact circumstances (ask if you are in doubt): care and propagation, feeding and diet choice, growth, energetics, behavioral response to stimuli, behavioral ecology, defense, comparative anatomy (external) and taxon descriptions, locomotion and physiology. Equipment includes microscopes, scales, aquariums, live animals, lights, grow-out tanks, video camera, a bomb calorimeter, and a drying oven. I will be happy to assist you in obtaining digital photographs of your work, including digital microscopy photos.

Grading:

Discussion questions (5 @ 3% ea)	(15%)
Mini-projects (3 design sheets @ 2.3% ea plus 3 reports @ 6% ea)	(25%)
Lab practical (2 @ 10% ea)	(20%)
Student project	
Proposal, including Introduction, Methods & Bibliography	(5%)
Draft analysis	(5%)
Final report	(10%)
Student presentations (2 @ 10% ea)	(20%)

Course Expenses:

A course fee of \$75 was collected when you registered. This fee supports the costs of purchasing, shipping, and keeping live invertebrate animals, including both culture and aquarium specimens, as well as materials for student projects.

SCHEDULE

Week 0:

Thurs, 03 Feb - Course introduction; Introduce form and function, homologous structures, classification of organisms. **Assign mini-project 1.**

Week 1:

Tues, 08 Feb - Ch 1 Basic Approach, Ch 3 p39-53 on PARAZOA (sponges) & PLACAZOA. Diversity of life overview (kingdoms, animal phyla). Principles of animal ecology (physical support, motion, energy, reproduction).

LAB Exercise 2 PORIFERA. Design mini-project 1.

Thurs, 10 Feb - Ch 3 p 54-58 on diploblastic animals: CNIDARIA, Classes HYDROZOA, SCYPHOZOA, CUBOZOA. **Mini-Project 1 design sheet due. Discussion question 1 due.**

Week 2:

Tues, 15 Feb - Ch. 3 p 58-68 on CNIDARIA sub-phylum ANTHOZOA, CTENOPHORA & etc. **Discussion question 2 due.**

LAB Exercise 3 CNIDARIA & 4 CTENOPHORA. Mini-project 1. Discuss mini-project 2.

Thurs, 17 Feb - Ch 3 p 68-79 on PLATYHELMINTHES.

Week 3:

Tues, 22 Feb - Ch. 2. Body cavities & invertebrate relationships.

LAB Exercise 5 PLATYHELMINTHES, & 8 ROTIFERA. Student projects. **Mini-project 1 due. Design sheet due for Mini-Project 2.**

Thurs, 24 Feb - Ch. 4 p 80-100 on NEMERTEA & GNATHOSTOMULA (retain flatworm characteristics), and NEMATODA thru ACANTHOCEPHALA (pseudocoelomate). Understanding taxonomy.

Week 4:

Tues, 01 Mar - Ch 4 p 101-117 on Sipuncula thru ANNELIDA (protostome schizocoelomate). Discuss student project design. Distribute evolution handout.

LAB Exercise 11 ANNELIDA, Classes POLYCHAETA, OLIGOCHAETA, HIRUDINEA. Start mini-project 2. **First lab practical. Design sheet for Mini-Project 3 due.**

Thurs, 03 Mar - ANNELIDA: Class POLYCHAETA. **Discussion question 3 due.**

Week 5:

Tues, 08 Mar - Discuss Evolution handout & presentations.

LAB: Student project proposals. Start mini-project 3. **Mini-project 2 due.**

Thurs, 10 Mar - Evolution continued. **Project proposal due.**

Week 6:

Tues, 15 Mar - **Mini-project presentations.** Ch. 5 p 118-133 Molluscs.

LAB Exercise 10 MOLLUSCA: POLYPLACOPHORA, GASTROPODA. **Mini-project 3 due.**

Thurs, 17 Mar - Ch. 5 MOLLUSCA: minor classes, POLYPLACOPHORA, GASTROPODA.

----- SPRING BREAK: 20 to 27 March -----

Week 7:

Tues , 29 Mar - Ch 5 MOLLUSCA classes BIVALVIA, CEPHALOPODA. Discussion question 4 due.

LAB Exercise 10 MOLLUSCA: BIVALVIA, CEPHALOPODA. Class projects.

Thurs, 31 Mar - Video: Aliens from Inner Space/Fastest Claw in the West.

Week 8:

Tues , 05 Apr - Ch 8 p 191-206 CRUSTACEA Discussion question 5 due.

LAB Exercise 16 ARTHROPODA class UNIRAMIA, class CRUSTACEA, Class projects.

Thurs, 07 Apr - Ch. 8 CRUSTACEA, cont.

Week 9:

Tues , 12 Apr - Ch 8 continued, p 168-191 TARDIGRADA thru UNIRAMIA. Draft analyses due.

LAB: Class projects. **Second lab practical.**

Thurs, 14 Apr - Ch 6 LOPHOPHORATES

Week 10:

Tues , 19 Apr - Senior project presentations, no class.

Thurs, 21 Apr - Ch. 7 p 146-159 DEUTEROSTOMES: ECHINODERMATA.

Week 11:

Tues , 26 Apr - Project presentations.

LAB Exercise 22 ECHINODERMATA **Project Final Reports due.**

Thurs, 28 Apr - Ch. 7 p 159-167 DEUTEROSTOMES: HEMICHORDATA & CHORDATA
Wrap up.

LAB SCHEDULE

Week 1 **Tues** , 08 Feb

LAB Exercise 2 PORIFERA.. Examine sponge anatomy with examples from each Class. Design mini-project 1.

Invertebrate Husbandry: Water changes, water quality & Clean technique

Lab techniques: Water changes, water quality & clean technique

Week 2 **Tues** , 15 Feb

LAB Exercise 3 CNIDARIA & 4 CTENOPHORA. Mini-project 1; Discuss mini-project 2.

Invertebrate Husbandry: Cleaning tanks, the role of live rocks & sediment

Lab techniques: Quantitative observation

Week 3 **Tues** , 22 Feb

LAB Exercise 5 PLATYHELMINTHES, & 8 ROTIFERA. Student projects. **Mini-project 1 due.**

Design sheet due for Mini-Project 2.

Invertebrate Husbandry: Cleaning devices, about skimmers, pre-filters and pumps

Lab techniques: In-fauna & meso-fauna extraction or surveys

Week 4 **Tues** , 01 Mar

LAB Exercise 11 ANNELIDA, Classes POLYCHAETA, OLIGOCHAETA, HIRUDINEA. Start mini-project 2. **First lab practical. Design sheet for Mini-Project 3 due.**

Invertebrate Husbandry: Maintenance of light & motion

Lab techniques: Manipulation of spawning

Week 5 **Tues** , 08 Mar

LAB: Student project proposals. Start mini-project 3. **Mini-project 2 due.**

Invertebrate Husbandry: Invertebrate nutrition, supplements & health

Lab techniques: Culturing - Start brine shrimp culture

Week 6 **Tues** , 15 Mar

LAB Exercise 10 MOLLUSCA: POLYPLACOPHORA, GASTROPODA. **Mini-project 3 due.**

Invertebrate Husbandry: Observation on live animals

Lab techniques: Analyses of diet

----- SPRING BREAK: 23 to 30 March -----

Week 7 **Tues** , 29 Mar

LAB Exercise 10 MOLLUSCA: BIVALVIA, CEPHALOPODA.

Class projects in Husbandry & Techniques.

Week 8 **Tues** , 05 Apr

LAB: Exercise 16 ARTHROPODA class UNIRAMIA, class CRUSTACEA.

Class projects in Husbandry & Techniques.

Week 9 **Tues** , 12 Apr -

LAB Second lab practical. Draft analyses due.

Class projects in Husbandry & Techniques.

Week 10 **Tues** , 19 Apr

Senior project presentations, no class.

Week 11 **Tues** , 26 Apr

Project presentations.

LAB Exercise 22 ECHINODERMATA **Project Final Reports due.**