Freshwater Science 650

Invertebrate Structure, Function, and Evolution
3 credits U/G

Dr. Jerry L. Kaster
School of Freshwater Sciences, room 3033
jlk@uwm.edu (highlight with ‘STUDENT’ on subject line.)
Class location: Lapham 264
Thursday 9:00 - 11:40 Sec. 001
Office Hours: By appointment; call, email or contact me during lab.

Class Description: Structure, function, and ecology of invertebrates.

GOALS OF THIS COURSE

Invertebrate biology can be a fascinating, but often challenging field of study, as the processes and organisms are not always readily observable. Most people have some exposure to the wide diversity of invertebrates around them. These form an integral part of the cycle of life on our planet, and are generally a joy and wonder to study. In this course you will learn much about invertebrate biology in freshwaters, marine and terrestrial habitats. You will learn about the structure, function, evolution and ecology and how they form the sequential advancements for all multicellular life. I hope, at the end of the semester, you will have a rich appreciation for the invertebrates that set the stage for your own existence.

By the end of this course, you should:

- be able to identify invertebrates to higher taxa levels and use invertebrates to ask evolutionary and ecological questions crossing over many fields of study (e.g., understand the phylogeny, life histories, behaviors, trophic importance, adaptations to life in strange environments, and conservation significance of invertebrates).

ESTIMATED STUDENT WORKLOAD

The estimated workload for activities associated with the course are as follows:

Attendance at lectures 15 hours
Attendance at lab 30 hours
Reading assigned material 37 hours
Exam preparation 20 hours
Project work 20 hours
Extra assignments for all students 24 hours
Total 146 hours

GRADING

The University grading scale will be used.

http://www4.uwm.edu/secu/acad-admin_policies/S29.htm
EXAM SCHEDULE
Lec Exam I, 7 week
Lab Exam I, 7 week
Lec Exam II, 15 week
Lab Exam II, 15 week

Exam Point Distribution: Each Lec & Lab Exam will be 100 points.

GRADUATE STUDENT REQUIREMENT – Research project, presentation, and paper
All graduate students in the class will be expected to conduct, write up and give an oral report on an independent research project regarding invertebrate ecology. There will be two weeks during the second half of the semester in which the laboratory section of the class will be available for work on the projects. Projects may be done in pairs (actually this is encouraged) BUT each student will write their own 1600-2000 word research paper (double spaced, 12 point font, not including references or graphs/charts/figures) DUE ON THE LAST DAY of the regular term. Research Presentations will be given to the class during lab section of the last two weeks of the semester and can be done in teams, although all students MUST participate equitably in the reporting.

The research paper must follow the standard scientific research paper format and include the following items:
A. Abstract (approx. 10 sentence summary of project) (should be its own page)
B. Introduction (a general literature review of the topic ending with an introduction of the research)
C. Methods (description of, where, when, how the research was conducted)
D. Results (what was found by your study)
E. Discussion (what your results mean and how they fit into the general scheme you laid out in the introduction and how you might change things if you were to do it over.
F. List of peer-reviewed references (research papers and books) cited in the report
G. Figures graphs or charts that enhance the readers understanding of the project (avoid 3-d and pie charts unless absolutely necessary)

You will have 15 min total for the oral report (12 for the report and 3 for questions) in which you will summarize for the rest of the class what you did, why you did it, what you found and why your results are interesting. Your report should start with an introduction to your research and why it’s interesting, provide the details of the research, and then summarize the results and conclusions.

All projects MUST BE APPROVED BY ME BY October 10th. STUDENTS MUST TURN IN AN ABSTRACT PARAGRAPH DESCRIBING WHAT YOU PLAN TO DO BY
September 3rd. This means that you must develop an idea BEFORE you start work. You can therefore start work early in the semester if you desire.

REQUIRED READING
Current readings will be assigned and discussed in class.

ATTENDANCE

While you are not graded based on attendance, there is a strong correlation of attendance with your final grade. You should contact me by email (JLK@uwm.edu or phone (262-949-0842) if you are unable to attend class.

LEARNING IMPAIRMENTS

Students with learning impairments should let me know immediately. The University of Wisconsin does not tolerate discrimination against those with learning impairments.

DISCRIMINATION

The University of Wisconsin does not tolerate discrimination in any form. If you have been discriminated against, immediately report the incidence to the Departmental Chair or the Dean of the College of Letters and Sciences.

ACADEMIC MISCONDUCT

In this course you are expected to perform to the best of your ability in an honest manner. Cheating, plagiarism, or any other acts of misconduct will result in a severe penalty to you per UWS Chapter 14.

SAFETY

Should you be injured in any way, report it to me or the TA and the Department of Biological Sciences office. If you have special medical concerns, report them to me immediately, e.g., sensitivity to formalin.

FIELD TRIPS

Field trips are not part of this class.

LABORATORY PROTOCOL

Specimens should be returned to their proper location, e.g., slides to the correct slide tray. Please clean your work area at the end of class.
POLICY

COMPLAINT PROCEDURE
Students may direct complaints to the head of the academic unit or department in which the complaint occurs. If the complaint allegedly violates a specific university policy, it may be directed to the head of the department or academic unit in which the complaint occurred or to the appropriate university office responsible for enforcing the policy.

GRADE APPEALS PROCEDURE
A student may appeal a grade on the grounds that it is based on a capricious or arbitrary decision of the course instructor. Such an appeal shall follow the established procedures adopted by the department, college, or school in which the course resides. These procedures are available in writing from the Academic Dean of the College/School. A more detailed description of the grade Appeal Policy may be found in UWM Selected Academic and Administrative Policies, Policy #S-28 and UWM Faculty Document #1243.

ATTENDANCE
You are expected to attend class. While you are not graded based on attendance, there is a strong correlation of attendance with your final grade. You should contact me at JLK@uwm.edu if you are unable to attend class.

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University Policies. Link to the Secretary of the University web site (http://www4.uwm.edu/secu/news_events/upload/Syllabus-Links.pdf) that includes the following University syllabus policies:

Syllabus Links

1. Students with disabilities. Notice to these students should appear prominently in the syllabus so that special accommodations are provided in a timely manner. http://www4.uwm.edu/arc

2. Religious observances. Accommodations for absences due to religious observance should be noted. http://www4.uwm.edu/secu/docs/other/S1.5.htm

3. Students called to active military duty. Accommodations for absences due to call-up of reserves to active military duty should be noted. Students: http://www4.uwm.edu/academics/military.cfm


4. Incompletes. A notation of "incomplete" may be given in lieu of a final grade to a student
who has carried a subject successfully until the end of a semester but who, because of illness or other unusual and substantiated cause beyond the student's control, has been unable to take or complete the final examination or to complete some limited amount of term work. https://www4.uwm.edu/secu/docs/other/S_31_INCOMPLETE_GRADES.pdf

5. Discriminatory conduct (such as sexual harassment). Discriminatory conduct will not be tolerated by the University. It poisons the work and learning environment of the University and threatens the careers, educational experience, and well-being of students, faculty, and staff. https://www4.uwm.edu/secu/docs/other/S_47_Discriminada_sect_Policy.pdf

6. Academic misconduct. Cheating on exams or plagiarism are violations of the academic honor code and carry severe sanctions, including failing a course or even suspension or dismissal from the University. http://uwm.edu/academicaffairs/facultystaff/policies/academic-misconduct/

7. Complaint procedures. Students may direct complaints to the head of the academic unit or department in which the complaint occurs. If the complaint allegedly violates a specific university policy, it may be directed to the head of the department or academic unit in which the complaint occurred or to the appropriate university office responsible for enforcing the policy. https://www4.uwm.edu/secu/docs/other/S_47_Discriminada_sect_Policy.pdf

8. Grade appeal procedures. A student may appeal a grade on the grounds that it is based on a capricious or arbitrary decision of the course instructor. Such an appeal shall follow the established procedures adopted by the department, college, or school in which the course resides or in the case of graduate students, the Graduate School. These procedures are available in writing from the respective department chairperson or the Academic Dean of the College/School. http://www4.uwm.edu/secu/docs/other/S28.htm

9. Other The final exam requirement, the final exam date requirement, etc. http://www4.uwm.edu/secu/docs/other/S22.htm

If you have any concerns regarding violation of these policies immediately report the situation to the Dean of the School of Freshwater Sciences, Val Klump (vklump@uwm.edu) and Associate Dean of Academics Tim Grundl (grundl@uwm.edu).

DISCRIMINATION
The University of Wisconsin does not tolerate discrimination in any form. If you have been discriminated against, immediately report the incidence to the Dean of the School of Freshwater Sciences, Val Klump (vklump@uwm.edu) or Associate Dean of Academics Tim Grundl (grundl@uwm.edu).

SEXUAL HARASSMENT
Sexual harassment is reprehensible and will not be tolerated by the University. It subverts the mission of the University and threatens the careers, educational experience, and well-being of students, faculty, and staff. The University will not tolerate behavior between or among members of the University community which creates an unacceptable working environment
ACADEMIC MISCONDUCT
The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others' academic endeavors. A more detailed description of Student Academic Disciplinary Procedures may be found in Regents Policy Statements, UWS Chapter 14 and UWM Faculty Document #1686.

SAFETY
Should you be injured in any way, report it to me and the SFS general office. If you have special medical concerns, report them to me immediately, e.g., sensitivity to formalin.

LABORATORY PROTOCOL
Specimens should be returned to their proper location, e.g., slides to the correct slide tray. Please clean your work area at the end of class.

Other Class Policy Notes
1. Return all equipment and materials to their proper location and clean your space of debris and refuse.
2. Please discuss any special circumstances with your instructor.

Lecture Outline
1. Introduction
2. The Protozoa: Prototype for metazoans.
3. The Sponges: Not protozoan but not yet metazoan.
5. The Metazoa: Multicellular life.
6. The Flatworms: Nervous system evolution and regression.
7. The Nemerteans: It’s one-way traffic.
8. The Aschelminths: Body cavity evolution.
9. The Annelids: Metamerism - ultimate segmentation
10. The Mollusks: Small food is good.

13. The Lophophorates: The evolutionary dichotomy.

14. The Echinoderms: Headed to a higher evolutionary ground.

15. The Lesser Deuterostomes: Humble chordate beginnings.
The Protozoa

Phylum Sarcomastigophora
Subphylum Mastigophora
   Class Phytomastigophora: *Euglena, Volvox, Ceratium*
   Class Zoomastigophora: *Trypanosoma, Giardia*

Subphylum Sarcodina
   Superclass Rhizopoda
      Class Lobosa
         Subclass Gymnamoeba
            Order Amoebida: *Amoeba, Chaos, Entamoeba*
         Subclass Testacealobosa
            Order Testacida: *Arcella, Difflugia*

   Class Granuloreticulosa
      Order *Foraminiferida*

Superclass Actinopoda
   "Class" *Radiolaria* (actually 3 classes)
      Class Heliozoa: *Actinosphaerium*

Phylum Ciliophora
   Subclass Gymnostomata: *Didinium*
   Subclass Suctoria: *Ephelota*
   Subclass Hymenostomata (Holotrichia): *Paramecium*
   Subclass Peritricha: *Vorticella*
   Subclass Spirotrichia
      Order Heterotrichia: *Stentor*
      Order Hypotrichia: *Euploites*

The Sporozoans

Phylum Apicomplexa
   Subclass Gregarina
   Subclass Coccidia: *Plasmodium, Cryptosporidium*
The Metazoans

Phylum Porifera
Class Calcaria *Leucosolenia, Grantia* (=Scypha, Sycon)
Class *Hexactinellida*
Class Demospongiae
   Family *Spongillidae*
   Family *Spongiidae*
Class Sclerospongiae

Phylum Cnidaria
Class Hydrozoa:
   Order Hydroida
      *Gonionemus*
      *Craspedacusta*
      *Hydra*
      *Aglaophenia*
      *Obelia*
   Order Siphonophora
      *Physalia*
Class Scyphozoa: *Aurelia*
      *Cassiopea*
Class Anthozoa: *Metridium*
   Subclass Alcyonaria
      *Tubipora*
      Gorgonian coral - Sea fan coral
   Subclass Zoantharia
      *Metridium*
      *Fungia*

Phylum Ctenophora: *Pleurobrachia*

Phylum Platyhelminthes
Class Turbellaria
   Order Acoela
   Order Rhabdocoela
   Order Lecithoepitheliata
   Order *Tricladia, Planaria*
   Order Polycladia
Class Monogenea
Class Trematoda: *Clonorchis, Fasciola*
Class Cestoda: *Taenia*

Phylum *Rhynchocoela* (=Nemertea)

Phylum Gastrotricha

Phylum *Rotifera*

Phylum Gnathostomulida

Phylum Acanthocephala

Some minor phyla:
Phylum Loricifera
Phylum Priapulida
Phylum Kinorhyncha
Phylum Nematoda: *Ascaris, Necator, Trichinella, Trichuris*

Phylum Sipuncula: *Phascolosoma*

Phylum Annelida
Class Polychaeta: *Nereis, Amphitrite, Chaetopterus, Aphroditia, Arenicola*
Class Clitellata
Subclass *Oligochaeta*
Subclass *Hirudinea*

Phylum Pogonophora

Phylum Mollusca
Class Polyplacophora
Class Gastropoda
Subclass Prosobranchia *Haliotis, Turbo*
Subclass *Opisthobranchia* (nudibranches)
Subclass *Pulmonata* (limpets and other snails)
Class Bivalva (=Pelecypoda)
Subclass Pteriomorphia *Mytilus, Pecten, Ostrea*
Subclass Palaeoheterodonta
Family *Unionidae* (most large freshwater forms)
Subclass Heterodonta *Ensia, Mya, Teredo, Dreissena*
Class Cephalopoda
Class Scaphopoda

Phylum Tardigrada
Phylum Onychophora: *Peripatus*

Phylum Arthropoda (overview)

Phylum Ectoprocta (=Bryozoa)
Class Phylactolaemata: *Plumatella*
Class Gymnolaemata: *Bugula*

Phylum Branchiopoda: *Lingula, Terebratella*

Phylum Chaetognatha: *Sagitta*

Phylum Echinodermata
Class Stelleroidea
Subclass Asteroidea
Subclass Ophiuroidea
Class Echinoidea
Class Holothuroidea
Class Crinoidea

Phylum *Hemichordata*

Phylum Chordata
Subphylum *Urochordata*
Subphylum *Cephalochordata*
Subphylum Vertebrata (non-invertebrate group)