FW 4401/ 5401 Fish Physiology and Behavior, 2 credits
Green Hall 19, Thursdays 4:45-6:30, St. Paul.
Prerequisites: FW3136/ 5136, or BIOL3211, or Permission of Instructor

Instructor: Professor Peter W. Sorensen, 104 Hodson Hall, St. Paul (lab 132 Hodson)
Soren003@umn.edu; 612-224-4997, Office Hours: 3:30-4:30 on Mondays or By Appointment.

Goal: This course seeks to instill an appreciation of the mechanisms which govern fish well-being, behavior, and distribution. It builds upon students’ existing basic understanding of fish biology and physiology (specifically that acquired though FW3136/5136) to empower ‘why’ and ‘how’ questions about fish biology and aquatic life. Ecologically relevant links between fish biology and their application to fisheries ecology, management and aquaculture are emphasized while topics already covered by Fish Biology (FW3136/5136) are not. Graduate students (who must take FW5401) will also learn how to address a research question of their choosing by writing a research proposal. Several topics on fish biology will be explored by this course: 1) Homeostasis (ex osmo-regulation, gas exchange), 2) Neurobiology; 3) Bioenergetics (i.e. growth, feeding); 4) Reproduction; 5) Movement; 6) Ecotoxicology. All groups of fish (marine vs. freshwater, ancient vs. advanced, etc.) are addressed. This course meets the undergraduate Fisheries student requirements for comparative physiology. At the end of this course students should:
  ● Understand general principals of fish behavior and physiology
  ● Be asking great questions about fish biology and know how to find answers
  ● Understand and be able to discuss how fish survive and thrive in aquatic environments
  ● Understand and discuss how fish sense the aquatic world and its importance to their behavior
  ● Understand and be able to discuss the movement and migratory patterns of fish
  ● Understand and be able to discuss how fish reproduce and processes that regulate reproduction
  ● Understand and be able to discuss the constraints the aquatic environment imposes on life
  ● Understand and be able to discuss how and why water quality is important to fish biology
  ● Understand and be able to discuss how and why fish obtain food and grow in the manners that they do
  ● Understand how the environment and evolutionary pressure influence fish physiology, behavior and genetics, and visa versa.

Readings: One-two textbook chapters are assigned each week. The material is found on line with University e-reserve at: http://eres.lib.umn.edu/eres/coursepage.aspx?cid=1796. The class password for this website is: uwds9B4. On occasions, optional readings will be listed. Students are responsible for all assigned material.

Web Support: Class material (instructor presentations, updated syllabus, misc readings, grades, etc.) will be available on the class Web Vista site. Instructor presentations will be posted on the web in advance of class to assist students with note taking but this means that these versions will usually not be up-to-date; class attendance is important.
FW4401 vs. FW5401: The class may be taken in two ‘flavors’: FW4401 is for undergraduate students, while FW5401 is intended for graduate students and senior undergraduates who have special interest in the topic. FW4401 requires 1-5 page paper (see below, and accompanying document) while FW5401 requires students to both write a 10-20 page research proposal (see accompanying document) and take a special seminar FW5292 ‘Advanced topics and discussion in fish biology’. The seminar is S/N. Students from FW4401 and 5401 are graded independently of each other and according to different grade scales (see below).

Class Presentations: All students (FW4401 and FW5401) are required to give one 10-15 min class presentation. This presentation will review an original research paper which addresses a topic previously discussed in class. The instructor will suggest and provide 1-3 papers the week before presentations. Talks may NOT run more than 15 min. They should start with a brief overview of the topic, present the hypothesis being addressed and then the data that supports or refutes it. Presentations should encourage questions and discussion and must be provided to the instructor for posting on the web.

Class Papers (FW4401) and Research Proposals (FW5401): Students in FW4401 must write a brief 5 page review paper on a well defined topic of their choosing (details are in document entitled: FW4401 Class Paper’). Students in FW5401 must write a 10-20 page research proposal (details are in document entitled: FW5401 ‘Research Proposal’). Papers will be penalized in handed in late. To assist with papers, students are encouraged to submit a suggested paper topic for instructor review. A class is also set aside for in-class review of draft student papers (mandatory). Finally, FW5401 students are required to take a 1-credit (S/N) seminar FW5292 ‘Advanced topics and discussion in fish biology’ where they are required to discuss their research proposal in some detail.

Exams: There will a mid-term and final, each of which will cover all material up to the time of the exam. Exams will require multiple choice and short answer responses, perhaps a short essay. Material from assigned readings and student presentations may also be included on those exams.

Class Participation: All students are expected to be on time to all classes and to actively participate by asking questions and making comments.

Optional seminar. A one credit seminar (FW5292 ‘Advanced topics and discussion in fish biology’) is offered in conjunction with this class to provide additional opportunities for discussion. This seminar is S/N and is required for FW5401 students who are expected to us it to develop their research proposals.

GRADING:

**FW4401: A-F:**
- 30% Mid-term
- 30% Final exam
- 10% Class presentation
- 20% Short review paper
- 10% Class participation
- 100%*

**Grading for FW5401: A-F:**
- 25% Mid-term
- 25% Final exam
- 10% Class presentation
- 30% Research grant
- 10% Class participation
*Bonus of 5% may be given for students who demonstrate special effort and/or progress.

Grading and Attendance Policy:
Attendance is required. Makeup exams will only be allowed if a student is sick or has a family emergency, and the student provides written documentation (i.e. doctor’s excuse). If a student knows they must miss a quiz or exam because of an unavoidable conflict (University activity, medical treatment, etc), the student must inform the instructor by email at least 2 weeks in advance and be willing to take the exam early. Grades will be scaled to make the highest grade an A+ (if necessary) and then awarded as follows:

A—outstanding achievement relative to the level necessary to meet course expectations and requirements (see above).
B—achievement that is significantly above the level necessary to meet course expectations.
C—achievement that meets the course requirements in every respect.
D—achievement that is worthy of credit even though it fails to meet fully the course requirements.
S—achievement that is satisfactory, which is equivalent to a C- or better (achievement required for an S is at the discretion of the instructor but may be no lower than a C-).
F (or N)—Represents failure (no credit) and signifies that the work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I (see also I).
I—(Incomplete) Assigned at the discretion of the instructor when, due to extraordinary circumstances, e.g., hospitalization, a student is prevented from completing the work of the course on time. This requires a **written agreement** between instructor and student. Incomplete coursework is a major inconvenience for students and instructors.

Grade Disputes: If a student wishes to dispute the grade assigned, they must do so **in writing** 24 hours after the exam has been returned. They should include a specific rationale for why their answer is correct, or why the paper deserves a higher grade. The instructor reserves the right to re-grade the entire exam if an exam grade is disputed.

Academic Integrity:
Scholastic misconduct is broadly defined as "any act that violates the rights of another student in academic work or that involves misrepresentation of your own work." Scholastic dishonesty includes, but is not necessarily limited to: cheating on assignments or examinations; plagiarizing, which means misrepresenting as your own work any part of work done by another; submitting the same paper, or substantially similar papers, to meet the requirements of more than one course without the approval and consent of all instructors concerned; depriving another student of necessary course materials; or interfering with another student's work. Academic dishonesty in any portion of the academic work for a course shall be grounds for awarding a grade of F or N for the entire course.

Disabilities Statement:
It is university policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities are encouraged to contact the instructor to discuss their individual needs for accommodations.

PWS Feb 8, 2010
Syllabus FW4401/ FW5401

PART I. INTRODUCTION
1. Jan 21 Introduction

PART II. HOMEOSTASIS
   Example of student talk presentation, Instructor

3. Feb 4 Osmoregulation (Moyle & Cech 2005, Hydromineral balance [chapter 6])
   Student talks: 1
   Ionoregulation

4. Feb 11 Temperature (Hazel 1993, Thermo Biology)
   Antifreezes –guest lecture by Scott O’Grady
   Stress (Iwama et al., 2006. Stress)

5. Feb 18 Biorhythms (Helfman et al. 2009, Cycles, chapter 23)
   Student talks: 2

PART III. NEUROBIOLOGY
5. Feb 18 Cognition (Braithwaite, 2006, Cognition)

6. Feb 25 Olfaction and taste (Sorensen & Caprio 1997, Chemoreception)
   Student talks: 3

   Hearing and Mechanoreception (Higgs et al. 2006, Hearing)
   Student talks: 4
   Exam Review

8. Mar 11 Student talks: 5, 6, 7
   MID-TERM EXAM

*March 15 is last day to drop class without permission*

March 15-22 SPRING BREAK

PART IV. BIOENERGETICS
9. Mar 25 Food and Feeding (Bone & Moore, 2008. Food and feeding [Chapter 7])
Class review of Midterm exam results
Fish as prey and predators (Helfman et al. 2009, Predators [19], Prey [20]).

**Paper topic proposals due (optional)**

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| 10. Apr 1 | Metabolism (Diana 1995. Balanced energy [2], Metabolism [3]) Guest lecturer: Dr. Bajer  
Student talks: 8  
Growth (Mommsen 1998. Growth) |

**PART V. **

**REPRODUCTION**

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| 11. Apr 8 | Introduction to endocrinology (Bone & Moore, 2008. Endocrinology [Chapter 9])  
Student talks: 9, 10  
Lecture on Good Writing Skills/ Practice |
| 12. Apr 15 | Gender Determination/ strategies (Helfman et al., 2009; Social animals [21])  
Student talks: 11  
Gonads and reproductive maturation (Jobling 1995, Reproduction [chapter 9]) |
| 13. Apr 22 | Reproductive behavior and pheromones (Stacey & Sorensen, 2006, Pheromones)  
_In class peer review of student papers_  
Eggs and larvae (Jobling 1995, Eggs [chapter 10]) |

**PART VI. **

**MOVEMENT**

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| 14. April 29 | Shoaling and Migration (Hinch et al. 2006, Migration…)  
Student talks: 12, 13  
PAPERS AND PROPOSALS DUE |

**PART VIII. **

**ECOTOXICOLOGY**

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| 15. May 6 | Endocrine disruption (Sloman & Wilson, 2006, Anthropogenic…)  
Student talks: 14, 15, 16  
Final exam review |

May 13  **FINAL EXAM: 4:45 PM-6PM**