Undergraduate Seminar

Crossed listed with BIOL 495 (undergraduates) and fulfills seminar requirement for Neuroscience (as alternative to NEURO 661 Current Topics in Neurobiology).

Open to graduate students as well as upper level undergraduate students. It is suggested that undergraduate students have completed BIOL 315 and/or BIOL 314

Course Overview: Sensory biology is a discipline with the aim to understand how organisms extract information from their environment. Organisms must be able to interface with stimuli, transduce the information into a neural signal, interpret the neural input, and initiate appropriate behavioral responses. In this class, we will explore some of the common sensory systems including electromagnetic reception (vision, heat and electroreception), mechanoreception (hearing, vibration and tactile reception), chemoreception (smell, taste, and others). Using Tinbergen’s four-question schema, we will explore sensory modalities under both ultimate and proximate explanations. Students will be expected to organize information in four categories: causation, ontogeny, adaptation and evolutionary history. This organizational system will provide students an integrative, cross-disciplinary foundation of the material as well as highlighting both strengths and gaps in our knowledge of the different sensory modalities.

Learning Outcomes:
1. Identify the basic types of sensory systems available to organisms and explain how they function, including physical properties of signal media and taxonomic diversity in sensory systems.

2. Explain how and why different organisms rely on different sensory systems.

3. Understand the importance of signals in a variety of contexts including predator/prey, social, and mating signals.

4. Explain how sensory systems, and the reliance on a particular sense, may evolve and what drives these changes.

5. Apply the concepts and techniques above to your research problems and/or area of interest.

Course structure: The class will meet twice a week and alternate between instructor-lead lectures and student-lead discussions based on primary literature readings. The first part of the course we will follow a lecture and discussion format to introduce the basic aims, topics and methods of sensory biology.

For several meetings students will take on a reading from the literature to lead class discussion for 1/2 class period (two discussions/class). Students are responsible for leading one discussion.

Student led Discussions: The main goal of the student led discussions is to apply the topics covered in the first portion of the class to student-selected areas of interest. For example, someone interested in systematics could lead a discussion on the application of phylogenetic methods to the evolution of sensory systems, someone with a more medical bent could look at chemical mimicry in disease organisms, etc. One of the main goals of this course is to develop an appreciation for the importance of gathering information from the environment, and the many ways information can be acquired. Whatever your area of interest, you should be able to find something that you can cover related to sensory biology.

For each discussion, the student leaders need to prepare by selecting a topic and 1-3 papers for the class to read at least one week prior to the discussion. Leaders must also prepare a one page "prep sheet" to turn into the instructor. This sheet must include at least 2 major goals for the discussion, and at least 3 questions that
they plan to ask the class as "discussion starters".

The discussion leader gives context for the paper and provides questions to lead the discussion. The leader should explain how the paper fits into the field, why this paper was chosen, and the impact of this paper on the field of sensory biology. Additional information about the research group, cited papers or papers that have cited the article may be included if relevant. To lead a discussion, you should ask questions of your classmates and provide help so as to walk us through the purpose, methods, results and interpretations found in each paper. The discussion leader will monitor the discussion to keep all class members involved.

**Term paper:** If you are taking this course for two-credit hours, a literature-based paper on a topic of your choice is required in this class. The intent is to relate a behavioral topic, technique or concept to a specific organism, system, or problem. Before beginning your paper, you must have the topic approved by the instructor. A one-paragraph prospectus describing your topic (with references!) must be submitted to the instructor by **25 February.** A complete first draft of your paper is due on **23 March.** In addition to written feedback on your draft, you will meet with me to discuss strategies toward improving your paper for the final submission. Please note that "first draft" does not translate to "rough draft" in the sense of an unpolished manuscript. Your first draft should be your best work. A minimum 10 peer-reviewed references should be included. Paper will be graded for content (depth and quality of information, original synthesis of information, clarity, consistency) and form (correctly citing sources, organization, style). Peer evaluations will also be considered. Suggested citation indices are Pubmed, Web of Science, Biosis, Current Contents.

The final version of term paper is due by **4 May.** The text of paper will not exceed 10 pages single-spaced (plus references). The paper can either be in the form of a literature review or represent results of original research. Each student will present a brief (10 min) summary of their topic during the last weeks of class.

**Grading:** Assignments, participation in discussion, and class attendance will be considered together as evidence of your active involvement in the course.

- Student led discussions (including prep sheet): 10%
- Annotated Outline/ prospectus: 10%
- Class participation: 30%
- Final paper: 50%

**Selected readings from textbooks** (optional, can be provided by instructor):
- Stevens M. 2013 *Sensory Ecology, Behavior, and Evolution* Oxford University Press

**Topics:**

1a. Membrane physiology and signal transduction (GPCRs) (Sherwood Ch 3)

1b. Neuronal physiology (Sherwood Ch 4)

2-3. Chemoreception: taste and smell (Sherwood Ch 6)

4-5. Mechanoreception:

   - Touch, pressure; plant movement (Scorza et al 2011)
   - Ears and hearing; lateral line; echolocation (Parker et al 2013)
6-7. Photoreception:
   Plants – UV reception; growth and reproduction (Rizzini 2011; Christie 2012)
   Animals - vision and circadian rhythms
8. Electoreception
9. Thermoreception: infrared sensing
10. Links between sensory modalities (e.g., Liu et al. 2010, Zhang et al. 2010)
   Co-option of receptors (light v temperature; light v chemosensory)
11. Environmental affect on sensory modalities: signal transmission, noise, and tuning (Stevens Ch 10)
12-13. Signalling and Communication: costs and eavesdropping (Stevens Ch 5, 7)
14. Evolution and expansion of the senses
   Hybrid Sensory Expansion hypothesis (Sandham et al. 2013)

**Academic Dishonesty:** The class will follow Iowa State University’s policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office. [http://www.dso.iastate.edu/ja/academic/misconduct.html](http://www.dso.iastate.edu/ja/academic/misconduct.html)

**Students with Disabilities:** Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. All students requesting accommodations are required to meet with staff in Student Disability Resources (SDR) to establish eligibility. A Student Academic Accommodation Request (SAAR) form will be provided to eligible students. The provision of reasonable accommodations in this course will be arranged after timely delivery of the SAAR form to the instructor. Students are encouraged to deliver completed SAAR forms as early in the semester as possible. SDR, a unit in the Dean of Students Office, is located in room 1076, Student Services Building or online at [www.dso.iastate.edu/dr/](http://www.dso.iastate.edu/dr/). Contact SDR by e-mail at disabilityresources@iastate.edu or by phone at 515-294-7220 for additional information.

**Dead Week:** This class follows the Iowa State University Dead Week guidelines as outlined in [http://catalog.iastate.edu/academiclife/#deadweek](http://catalog.iastate.edu/academiclife/#deadweek)

**Harassment and Discrimination:** Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email dso- sas@iastate.edu, or the Office of Equal Opportunity and Compliance at 515-294-7612.

**Religious Accommodation:** If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request. You or your instructor may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.
Contact Information: If you are experiencing, or have experienced, a problem with any of the above issues, email academicissues@iastate.edu.