Teaching Neurobiology at Swarthmore College
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Enrollment = 20–25 Biology majors

Weekly meetings = 2 x 90-min lectures + 3-h LAB

Prerequisite = Biology 1: Cellular and Molecular Biology
Crucial Decisions about your Course

What material to cover? = content

How to grade the students? = assignments
MAIN GOAL: Students will learn how to think like neuroscientists

To appreciate the complexity of brain function at many levels…
- principles of neuronal signaling
- principles of coding & processing information in neural systems
MAIN GOAL: Students will learn how to think like neuroscientists

To appreciate the complexity of brain function at many levels…
- principles of neuronal signaling
- principles of coding & processing information in neural systems

To recognize the power of multidisciplinary approaches

To develop critical thinking and scientific communication skills
Crucial Decisions about your Course

What material to cover? = content
- principles of neuronal signaling
- systems that illustrate principles of coding & information processing
- emphasize diverse experimental approaches

How to grade the students? = assignments
- assignments that demand active, critical thinking and communication
1. An action potential is the product of positive and negative feedback interactions involving three basic bioelectric parameters of the membrane. Use a flow-chart type of diagram to illustrate the positive feedback interactions among the membrane properties that are responsible for generating the depolarizing phase of an action potential.

2. If you build an artificial phospholipid bilayer with equal numbers of sodium and chloride channels, and put 50 mM potassium chloride on one side and 50 mM sodium chloride on the other side, which ions will flow across the membrane?
   A. Sodium ions will flow in one direction and potassium ions will flow in the opposite direction.
   B. Only sodium ions will flow.
   C. Sodium and chloride ions will both flow until the membrane arrives at equilibrium.
   D. Potassium ions will flow until the membrane arrives at the potassium equilibrium potential.
Writing Quiz Questions and Homework Problems


- R.W. Murray (1983) Test your understanding of Neurophysiology

- Instructors’ CDs for textbooks, e.g. Test Generator CD for Bear et al., Neuroscience Exploring the Brain
Neurons in Action
Computer Simulations with NeuroLab

by John W. Moore and Ann E. Stuart

NeuroLab simulations are interactive, hyperlinked tutorials designed for exploration of neurophysiological problems.

This new learning tool uses the Netscape browser to launch simulation experiments programmed with NEURON's tools.
HOMEWORK #4
Neurons in Action: A SIMULATION OF HODGKIN & HUXLEY’S VOLTAGE CLAMP EXPERIMENTS ON SQUID AXONS
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Students as Teachers:
GROUP PRESENTATIONS
Neural Basis of Behavior

1. **Research the literature.** Apply your understanding of cellular neurobiology to investigate the neural basis of a specific behavior.

2. **Oral presentation.** Communicate what you learn to the entire class in a well integrated group presentation.
Students propose specific “behaviors” to study.

Topics of successful presentations in past years:

- Olfactory processing in fish
- Cognitive maps in the rodent hippocampus
- Echolocation in bats
- Flight in insects
- Song learning in male songbirds

Include abstracts of at least 3 good sources for your research.
Establish clear grading criteria

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<th>Clear introduction, sufficient background</th>
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<td>Choice of subject matter, selectivity</td>
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<td>Integration of individual presentation with group</td>
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<td>Rational organization of information</td>
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<td>Rigorous treatment of data</td>
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<td>Clear delivery</td>
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<td>Clear and effective visual aids</td>
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Laboratory Teaching - Goals

Acquire a physical understanding of neuron, ganglion, nerve, etc.

Understand strengths and limitations of different experimental approaches

Develop scientific thinking and communication

“This is awesome!”
Laboratory Teaching - Resources

Discovering Neurons
The Experimental Basis of Neuroscience
Carol Ann Paul
Barbara Beltz
Joanne Berger-Sweeney

The Crawdad Manual
A CD-ROM Lab Manual for Neurophysiology
by
Robert Wytelbach, Bruce Johnson, Ronald Hoy

Cornell University

Sinauer Associates

Biological Sciences 330/331, Smith College | Neurophysiology
Laboratory Instructions and Videos
Specialized Goals for Different Students

Future neuroscientists…
Future plant biologists, ecologists, etc.…
Future science teachers…
Those who pursue careers outside of science…