# Neuroscience 101 (NEU101 / MOL110) Spring 2010
# Neuroscience and Everyday Life

## Class meeting times

Two 80-minute lectures (MW 11:00-12:20, Lewis Library 121).

One three-hour laboratory (with preceding discussion). Attendance at lab is mandatory. Lewis Thomas Laboratory 016 or Green Hall, depending on week.

The NEU 101 Lab Manual will be available at your first laboratory session.

## Textbook

There is no textbook. Suggested readings will be posted on Blackboard. You are only responsible for material covered during lecture and laboratory exercises.

Please follow neuroscience blogs, as listed in class. These will be discussed on Wednesdays.

## Course website

The Princeton University Blackboard website will be used to post slides after each lecture, and sometimes before. If you would like a copy of the slides for note taking you will need to print your own copy prior to class. We will use the Blackboard site to collect lab reports, post course announcements, and confidentially distribute exam grades.

## Grading

| | |
|---|---|
| Exam 1 | 20% of final grade |
| Exam 2 | 25% of final grade |
| Final Exam | 30% of final grade |
| Lab/Precept | 20% of final grade |
| Class participation | 5% of final grade (no Internet, Web, Facebook, or texting in class please) |

*Exam policy*: If you have a valid conflict on the date of an exam you must make arrangements for a make-up at least three days before the scheduled exam. Please contact one of the Assistants in Instruction for such arrangements. Students may be excused from exams for health-related reasons on the day of the exam only with a note from a physician.

## How to get in touch with us


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|---|---|---|---|
| **Professor Sam Wang** | 7 Guyot Hall | x0388 | sswang@ |
| **Professor Alan Gelperin** | 116A Moffett | x5112 | gelperin@ |
| **Alex Kloth (AI)** | 224 Moffett | | akloth@ |
| **Sean Baron (AI)** | 3-S-4 Green Hall | | sbaron@ |


Office hours by appointment only.

## CLASS SCHEDULE

| # | Day | Date | Topic |
|---|---|---|---|
| 1 | M | Feb. 1 | How neuroscientists study the brain |
| 2 | W | Feb. 3 | Evolution, energetics, and the ten percent myth |
| 3 | M | Feb. 8 | Neurons and the chemical basis of brain signaling |
| 4 | W | Feb. 10 | Sensation |
| 5 | M | Feb. 15 | Perceptions: illusions, tickling, and pain |
| 6 | W | Feb. 17 | Decisions, attention, and reward |
| 7 | M | Feb. 22 | Movement |
| 8 | W | Feb. 24 | **EXAM 1** |
| 9 | M | Mar. 1 | Memory |
| 10 | W | Mar. 3 | Learning |
| 11 | M | Mar. 8 | Self-control and willpower |
| 12 | W | Mar. 10 | Stress and adaptation |
| | | | **SPRING RECESS** |
| 13 | M | Mar. 22 | Infancy |
| 14 | W | Mar. 24 | Early development and childhood |
| 15 | M | Mar. 29 | Aging |
| 16 | W | Mar. 31 | Genes, environment, intelligence, and personality |
| 17 | M | Apr. 5 | **EXAM 2** |
| 18 | W | Apr. 7 | Emotions and mood |
| 19 | M | Apr. 12 | The social brain |
| 20 | W | Apr. 14 | Gender differences |
| 21 | M | Apr. 19 | Sex, love, and friendship |
| 22 | W | Apr. 21 | Humor, math, and other evolutionary curiosities |
| 23 | M | Apr. 26 | Consciousness and free will |
| 24 | W | Apr. 28 | Spirituality, religion, and near-death experiences |

## LABORATORY SYLLABUS

Week 1 Lab orientation

*Get acquainted with the data acquisition system, which will be used throughout the semester in both animal and human experiments. Interface the system with the students' laptop computers, and acquire basic EKG and EEG data.*

**SINGLE-CELL RECORDING**

Week 2 Action potential recording (earthworm).

*This exercise will explore the fundamental unit of brain signaling, the action potential, as well as concepts such as conduction velocity and the refractory period. Students will learn how to acquire and analyze electrophysiological data.*

Week 3 Sensory responses (insect leg). Demonstration: Intracellular recording.

*This exercise will demonstrate basic properties of sensory physiology and synaptic integration.*

Week 4 Prepulse inhibition (EMG and/or EEG). Demonstration: Visual illusions, including the Stroop task.

*This exercise will demonstrate mechanisms of sensory integration and suppression at multiple levels of brain processing, as well as inferences that the brain makes in order to form perceptions.*

**OPTICAL AND GENETIC METHODS**

Week 5 Manipulating behavior with light: channelrhodopsin-expressing fruit flies.

*Students will work with flies expressing a protein that causes neurons to fire when they are exposed to light. The protein, channelrhodopsin, exemplifies the recent revolution in using optical methods to probe brain function.*

**BRAIN ANATOMY AND EVOLUTION**

Week 6 Brain dissection.

*This exercise will acquaint students with the major divisions and pathways of the mammalian brain.*

**FUNCTIONAL MRI**

Week 7 Handedness and hemispheric language representation. Demonstration of fMRI.

*Students will analyze functional MRI data of language processing by left-handed and right-handed student volunteers. The assignment will be to explore the sidedness of language representation.*

**CELLULAR IMAGING**

Week 8 Learning to use a microscope: brightfield, image acquisition with CCD camera, demonstration of fluorescence microscopy.

Week 9 Neurons in big brains (microscopic tracing of the anatomy of single neurons). Demonstration: Confocal and multiphoton microscopy.

*Students will use microscopes and perform quantitative image analysis with NIH ImageJ to answer an open-ended question.*

**COGNITIVE: EEG**

Week 10 Emotions and decision-making - Iowa Gambling Task.

*Students will measure behavioral, neural, and conscious changes that occur in response to the feeling of being cheated. They will attempt to replicate the finding that the conscious ability to report these changes comes last.*

Set up ongoing experiment in reaction time learning and "brain training."

*This exercise will test the magnitude of "brain training" effects, including reaction time learning, and test which effects show any cross-training effect.*

Week 11 Assessment of reaction time learning and "brain training."

*This exercise completes the experiment set up in the previous week.*

Week 12 Reaction times and conscious awareness - the Libet experiment.

*This exercise will measure neural correlates of reaction to a stimulus and compare them to conscious report of the stimulus. Prior work suggests that conscious awareness comes after action.*

## NEU101 READING

There is no textbook. We will suggest reading from popular and technical books and articles. You may find it useful to refer to *Neuroscience: Exploring The Brain* by Mark Bear, Barry Connors, and Michael Paradiso (http://is.gd/7mFNz) as a reference for unfamiliar terminology or concepts. This book will be on reserve in Lewis Library.

An excellent way to keep track of neuroscience "current events" is to follow the many excellent neuro/psych blogs around the Web. On Wednesdays we will take brief time to discuss items from these blogs, including whatever questions you may have. Therefore please follow these sites on a regular basis.

**TOP NEUROSCIENCE/PSYCHOLOGY BLOGS**

Mind Hacks (http://is.gd/6wIZk)

The Neurocritic (http://is.gd/6wIfm)

Neurophilosophy (http://is.gd/6wIJy)

The Neuroskeptic (http://is.gd/6wIxW)

Cognitive Daily (inactive but contains many good entries; http://is.gd/6wImC)

Here are some interesting books from which readings will be drawn.

**NON-TECHNICAL BUT THOUGHT-PROVOKING READS (ON RESERVE, LEWIS LIBRARY)**

**The Scientific American Day in The Life of Your Brain* by Judith Horstman (http://is.gd/7sqSk)

**Welcome to Your Brain* by Sandra Aamodt and Sam Wang (http://is.gd/6wP2u)

**Phantoms In The Brain* by V.S. Ramachandran and Sandra Blakeslee (http://is.gd/7srha)

*The Accidental Mind* by David Linden (http://is.gd/6wP9A)

*The History of Neuroscience in Autobiography*, ed. Larry Squire (http://is.gd/7mFpl)

*Brain-Wise: Studies in Neurophilosophy* by Patricia Churchland (http://is.gd/6wOBK)

**NEUROSCIENCE/PSYCHOLOGY BOOKS (ON RESERVE, LEWIS LIBRARY)**

*The Synaptic Organization of the Brain* by Gordon Shepherd (http://is.gd/6wNh7)

*Descartes' Error: Emotion, Reason, and the Human Brain* by Antonio Damasio (http://is.gd/6wNzW)

*Decisions, Uncertainty, and the Brain: The Science of Neuroeconomics* by Paul Glimcher (http://is.gd/6wO5K)