

## SYLLABUS: Neurobiology, BIOL 635, Spring 2012

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**Web Site (with associated stream video lectures and labs):**

<http://www.biol.sc.edu/~vogt/courses/neuro/neuro.html>

**Times: Lecture/discussion (CLS 303)** Tuesday and Thursday, 11:00 - 12:15

**Lab (CLS 303)**, Tuesday and Thursday 2:00 - 4:45 (open at all times)

**Text (order on line, save money, buy used) (alternate texts on page 3):**

*From Neuron to Brain, 5ed* by John G. Nicholls, John G. Nicholls, Bruce G. Wallace, Paul A. Fuchs, A. Robert Martin, (2011), Sinauer <http://www.sinauer.com/detail.php?id=6090>

### WEEK 1 1/10, 1/12

**Essay #1 (Due Tuesday 1/24)** (5 pages). Ionic/molecular basis of **RESTING POTENTIAL**.

**Lectures:** Electrical properties of cells: Nernst equation; Goldman Equation; Resting potential; Action potential.

**Lab:** Orientation, Cricket Courtship Behavior – establish mating colonies of crickets.

### WEEK 2 1/17 1/19

**Problem set #1 (Due Tuesday 1/17).** Use Nernst Equation Calculate Equilibrium Potentials for  $K^+$ ,  $Na^+$ ,  $Cl^-$ ,  $Ca^{++}$  for concentrations given for Squid Axon.

**Lectures:** Voltage Sensitive Ion Channels: Biophysics and Molecular Genetics.

**Lab:** Cricket sensory integration.

<http://www.biol.sc.edu/~vogt/courses/neuro/neuro-vid.html#lab3>

### WEEK 3 1/24, 1/26

**Problem set #2 (due Tuesday 1/31).** Shapes of action potentials in the presence of different ion channels.

**Lectures:** More Ion channels.

**Lab:** Cricket sensory integration - wind sensitive cerci.

<http://www.biol.sc.edu/~vogt/courses/neuro/neuro-vid.html#lab3>

### WEEK 4 1/31, 2/2

**Essay #2 (Due Thursday 2/10)** (10 pages) Ionic/molecular basis of **ACTION POTENTIAL**.

**Lectures:** Dynamics of electric fields: graded currents in dendrites; propagation of action potentials. The Synapse, Neurotransmitters, Receptors.

**Lab:** Cricket sensory integration - presentations.

### WEEK 5 2/7, 2/9

**Lectures:** Chemoreception in Vertebrates and Insects

**Lab:** Drosophila - Molecular Neurobiology

### WEEK 6 2/14, 2/16

**Lectures:** Chemoreception in Vertebrates and Insects

**Lab:** Drosophila - Molecular Neurobiology

**WEEK 7 2/21, 2/23**

**Lectures:** Synapse, Dendritic Integration, Neuronal Decision Making, Neuronal Dynamics

**Lab:** Cricket sensory integration - vision (resource to be added to web page).

**WEEK 8 2/28, 3/1**

**Essay #3 (Due Friday 3/16)** (10 pages): **SYNAPTIC TRANSMISSION / PLASTICITY**

**Discussions:** A reductionist review of how nerve cells act and interact to accomplish decision making.

**Lab:** Cricket sensory integration - vision (resource to be added to web page).

**WEEK 9 3/6, 3/8**

**SPRING BREAK**

**WEEK 10 3/13, 3/15**

**Term Paper:** **NEUROETHOLOGY - NEUROPLASTICITY AND/OR BEHAVIOR.**

**Discussions:** Neuroplasticity and Behavior

**Lab:** Independent project.

**WEEK 11 3/20, 3/22**

**Discussions:** Neuroplasticity and Behavior

**Lab:** Independent project.

**WEEK 12 3/27, 3/29**

**Discussions:** Neuroplasticity and Behavior

**Lab:** Independent project.

**WEEK 13 4/3, 4/5**

**Discussions:** Neuroplasticity and Behavior

**Lab:** Presentations

**WEEK 14 4/10, 4/12**

**Discussions:** Term Paper presentations, discussions Oral Reports (15 min + discussion).

**Lab:** Presentations

**WEEK 15 4/17, 4/19 (last class)**

**Discussions:** Term Paper presentations, discussions Oral Reports (15 min + discussion).

**Written Term Papers; (any revisions due by 5/5)**

**Lab:** Presentations / Cleanup

**COMPOSITION OF COURSE. No exams, but...**

**Lectures (Before Spring Break):**

lectures on nervous system basics.

**Discussions (After Spring Break):**

Behavior, Plasticity, Higher Brain Function.

Discussions based on readings in chapters, and specific papers.

**Course assignments:**

2 Problem Sets (nernst/goldman potentials - shapes of action potentials)

3 Short Writing Assignments: lengths as indicated above - recapitulate class discussions

Term Paper: Neuroplasticity and Behavior (20 pages including references).

1. Orientation: Week 10 (following Spring Break)

2. Outlines and literature list. Due Week 12

3. Oral presentations Week 14-15 (15 min presentations) in class.

4. Turn in written version: Last class day (any revisions due by scheduled exam day).

**Laboratory:**

**Guided Projects before Spring break, Independent Projects after Spring Break.**

**GRADES.**

Grades will be assigned based on class participation and performance on assigned activities.

**LECTURES**

**Phase 1 (before Spring Break):**

I will present a series of lectures / discussions (8 weeks) delving into the mechanisms underlying action potentials, synapses and simple neural networks. Students will write essays reviewing this material to demonstrate level of understanding.

**Phase 2 (after Spring Break):**

Students and instructors will read and discuss scientific papers together, learning how to perform effective literature research and how to read and evaluate content of scientific literature as well as web accessible resources. Students will be evaluated with respect to participation, and the application of skills and knowledge learned in the development and performance on lab projects and term papers.

**LABORATORY**

The laboratory consists of informal exercises and independent projects, ending around Spring Break (presentations following Spring Break. Students are expected to maintain a record of their efforts (written or on computer). Students are expected to master the preparation quickly and design a small, quantifiable experiment to test some aspect of the preparation.

<b>I</b>	<b>Cricket Courtship Behavior (Week 1)</b> Set up a terrarium in which cricket courtship and mating behavior can be observed; use web resources (start - google "breeding crickets") Record using cell phone cameras.
<b>II</b>	<b>Cricket Cerci (Weeks 2-4)</b> <i><a href="http://www.biol.sc.edu/~vogt/courses/neuro/neurolabs.html#lab3">http://www.biol.sc.edu/~vogt/courses/neuro/neurolabs.html#lab3</a></i> stimulate wind sensitive sensory hairs, record from abdominal nerve cord hook electrodes, suction electrodes, extracellular recordings explore sensory maps, stimulation thresholds, stimulus strength properties, etc. neuroanatomy
<b>III</b>	<b>Drosophila Molecular Neurobiology (Weeks 5-6)</b> Support Info pending
<b>IV</b>	<b>Cricket Vision (Weeks 7-8)</b> Support Info pending
<b>V</b>	<b>Independent Project (Weeks 7-8)</b>
<b>VI</b>	<b>Presentations, Lab Cleanup (Week 10, after Spring Break)</b>

**GRADUATE STUDENTS / GRADUATE CREDIT:**

Biol 635 is available for graduate student credit, and in general, more will be expected of Graduate Students than of Undergraduate Students, especially in terms of effort and leadership. Regarding Term Papers and Lab projects, Graduate Students are expected to integrate these efforts into their graduate research projects in an appropriate and professional manner, such that the possibility of transferring knowledge gained in this course to their graduate research is clear and evident.

**LEARNING OBJECTIVES.**

Students will develop an understanding of the mechanisms by which neurons function and communicate, in a manner allowing translation of these processes to higher neuronal function, including sensory integration, behavior and learning and memory. Students will develop skills working with instrumentation and experimental design, and will develop independent writing and hands on laboratory projects. Students will further develop their communication skills in writing and oral presentation.

**Alternative Texts...**

- Fundamental Neuroscience, 3ed*** (2008) by Larry R. Squire, Darwin Berg, Floyd Bloom, Sascha du Lac, Anirvan Ghosh, Nicholas C. Spitzer. Elsevier. (\$32 used from Amazon)  
[http://www.elsevier.com/wps/find/bookdescription.cws\\_home/713893/description#description](http://www.elsevier.com/wps/find/bookdescription.cws_home/713893/description#description)
- Neuroscience (Book with CD-ROM) 5ed*** (2011) by Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel LaMantia, James O. McNamara, Leonard E White. Sinauer Assoc. (new edition)
- Neuroscience (Book with CD-ROM) 4ed*** (2008) by Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel LaMantia, James O. McNamara, Leonard E White. Sinauer Assoc. (\$64 used from Amazon: [http://www.amazon.com/Neuroscience-text-only-Fourth-Purves/dp/B004KKMKCW/ref=sr\\_1\\_12?s=books&ie=UTF8&qid=1326130347&sr=1-12](http://www.amazon.com/Neuroscience-text-only-Fourth-Purves/dp/B004KKMKCW/ref=sr_1_12?s=books&ie=UTF8&qid=1326130347&sr=1-12))
- \**The Neuron: Cell and Molecular Biology*** by Levitan & Kaczmarek. Oxford University Press (2002) (older but excellent - \$32 used at Amazon)
- From Neuron to Brain, 4ed*** (2001) by John G. Nicholls, A. Robert Martin, Bruce G. Wallace, Paul A. Fuchs. Sinauer Assoc. (\$5 used from Amazon)
- Principles of Neural Science 4ed*** (2000) by Eric R. Kandel, James H. Schwartz, Thomas M. Jessell. McGraw-Hill/Appleton & Lange. (\$65 used from Amazon)(Kindle edition \$90)

**JOURNALS**

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|---|--|
| <i>Annual Review of Neuroscience</i>        | <i>Journal of Neurobiology</i>   |
| <i>Behavioral and Brain Science</i>         | <i>Journal of Neuroscience</i>   |
| <i>Behavioral Brain Research</i>            | <i>Journal of Neurophysiology</i>  |
| <i>Biological Bulletin</i>                  | <i>Journal of Physiology Learning and Memory</i>   |
| <i>Brain Research</i>                       | <i>Life Sciences</i>   |
| <i>Cell</i>                                 | <i>Nature</i>  |
| <i>Cell and Tissue Research</i>             | <i>Nature Neuroscience</i>   |
| <i>Cellular Signaling</i>                   | <i>Nature Reviews Neuroscience</i>   |
| <i>Chemical Senses</i>                      | <i>Neurobiology of Aging</i>   |
| <i>Comparative Biochem &amp; Physiology</i> | <i>Neuron</i>  |
| <i>Current Biology</i>                      | <i>Neuroscience</i>  |
| <i>Current Opinions of Neurobiology</i>     | <i>Neuroscience Letters</i>  |
| <i>Development</i>                          | <i>Peptides</i>  |
| <i>Developmental Biology</i>                | <i>Phil. Transactions of the Royal Society of<br/>London, Series B (Biological Sciences)</i> |
| <i>Developmental Brain Research</i>         | <i>Physiology and Behavior</i>   |
| <i>Developmental Dynamics</i>               | <i>Proceedings of the National Academy of<br/>Sciences (USA)</i>                             |
| <i>EMBO Journal</i>                         | <i>Science</i>   |
| <i>Endocrinology</i>                        | <i>The Scientist</i>   |
| <i>Experimental Neurology</i>               | <i>Trends in Neurosciences</i>   |
| <i>Journal of Experimental Biology</i>      | <i>Trends in Pharmacological Science</i>   |
| <i>Journal of Experimental Zoology</i>      |  |
| <i>Journal of Insect Physiology</i>         |  |
| <i>Journal of Insect Science</i>            |  |
| <i>Journal of Comparative Physiology</i>    |  |
| <i>Journal of Neuraltransmission</i>        |  |