

**Biology 178: Neurobiology**  
**Class Schedule**  
**Spring 2007**  
**Seaver North 202**  
**Instructors: Karen Parfitt and Kevin Jones**

<u>Session</u>	<u>Date</u>	<u>Topic</u>	<u>Reading*</u>
1	Jan. 16	Course Intro;cell/mol bio review	course syllabus
2	Jan. 18	Neurons and Glia	LK Ch1,2
3	Jan. 23	Signaling in the nervous system	LK,Ch. 3
4	Jan. 25	Signaling in the nervous system	LK,Ch. 3
5	Jan. 30	Ion Channels and signaling	LK Ch 4,5
6	Feb. 1	Ionic basis of the resting potential	LK Ch 6
7	Feb. 6	Voltage-dependent membrane permeability	LK Ch 6,7
8	Feb. 8	Discussion: Ion channels	Stuhmer et al., Nature 339: 597
9	Feb. 13	<b>Exam I</b>	
10	Feb. 15	Synaptic transmission I      KP	LK Ch 8,9
11	Feb. 20	Synaptic transmission II      KP	LK Ch 8,9
12	Feb. 22	Synaptic transmission III      KP	LK Ch 8,9
13	Feb. 27	Neurotransmitters I      KJ	LK Ch 10
14	Mar. 1	Neurotransmitters II      KJ	LK Ch 10
15	Mar. 6	"Fast" Neurotransmitter Receptors      KJ	LK Ch. 11
16	Mar. 8	G protein coupled receptors      KP	LK Ch. 12
	Mar. 13,15	Spring break	
17	Mar. 20	signal transduction I	LK Ch. 12; KSJ Ch. 13
18	Mar. 22	signal transduction II	LK Ch. 12; KSJ Ch. 13
19	Mar. 27	<b>Exam II</b>	
20	Mar. 29	Molecular Mechanisms of Memory	LK Ch. 20; KSJ Ch 63
21	Apr. 3	Molecular Mechanisms of Memory	LK Ch. 20; KSJ Ch 63
22	Apr. 5	Molecular Mechanisms of Memory	LK Ch. 20; KSJ Ch 63
23	Apr. 10	Independent seminars 1	to be announced (TBA)
25	Apr. 12	Independent seminars 2	TBA

**\*Supplementary reading, e.g. papers from the primary literature, may be assigned for some lectures or discussions**

Session    Date                      Topic                                      Reading

26	Apr. 17	Independent seminars 3	TBA
27	Apr. 19	Independent seminars 4	TBA
28	Apr. 24	Independent seminars 5	TBA
29	Apr. 26	Independent seminars 6	TBA
30	May 1	Wrap-up/evaluations	

**Final Exam** Tuesday May 8<sup>th</sup>, 9 a.m. (Seniors: final exam in week of April 30<sup>th</sup>; time TBA)

**Texts:**

**Required:**

Levitan, Irwin B. and Kaczmarek, Leonard K. (2002) **The Neuron: Cell and Molecular Biology**, 3<sup>rd</sup> Ed., Oxford University Press (=LK)

**Optional:**

*(On reserve in Neurobiology lab):*

Calabrese, R., Gordon, J., Hawkins, R. and Qian, N. **Essentials of Neural Science and Behavior: Study Guide and Practice Problems**, Appleton & Lange.

Kandel, Eric, Schwartz, James, and Jessell, Thomas. **Principles of Neural Science and Behavior**, Appleton & Lange (=KSJ)

Nicholls, John G., Martin, A. Robert, Wallace, Bruce G., and Fuchs, Paul A. **From Neuron to Brain**, 4<sup>th</sup> ed., Sinauer Press. (=NMWF)

Purves, Dale et al (2004) **Neuroscience**, 3<sup>rd</sup> Ed., Sinauer Associates, Inc

**Instructor Contact info:**

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**Kevin Jones**  
**Thursday**  
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**Wednesday or Thursday 1:15 pm  
Spring 2007**

<u>Date</u>	<u>Activity</u>	<u>Assignments this week</u>
Jan. 17 or 18	No lab	
Jan.. 24 or 25	Orientation to Electrophysiology equipment; Membrane Properties	Answer lab manual questions in your lab notebook
Jan. 31; Feb. 1	Crayfish Motor Neuron Physiology	Answer lab manual questions in your lab notebook Identify seminar topic (2/2)
Feb. 7 or 8	Ionic Basis of Resting Potentials	State hypothesis to be tested next week
Feb. 14 or 15	Ionic Basis of Resting Potentials	Exam I (2/13)
Feb. 21 or 22	Synaptic Potentials at Crayfish NMJ	Lab Paper 1 (2/21 or 22; resting pot'ls)
Feb. 28; Mar. 1	Synaptic Potentials at Crayfish NMJ	outline for seminars—rough (3/2)
Mar. 7 or 8	Hippocampal recording: Inhibition and Facilitation	turn in lab notebooks (3/7 or 8)
Mar. 14 or 15	Spring break	
Mar. 21 or 22	Hippocampal recording: Long term potentiation	data analyzed; work on independent seminar
Mar. 28 or 29	Hippocampal recording: pharmacology	Exam II (3/27)
Apr. 4 or 5	Hippocampal recording	Outline for seminars—detailed (4/6)
Apr. 11 or 12	plan/begin final projects	Lab Paper 2 (Apr. 11 or 12)
Apr. 18 or 19	final projects	data analyzed; plan for this week
Apr. 25 or 26	final projects	data analyzed; plan for this week
May 2 or 3	no lab—reading days	Oral presentation on final project (Sunday April 29; Time TBA); turn in lab notebook.

**Laboratory Materials**

For the lab component of the course you will need a lab notebook that is **bound** at the left edge (not a spiral notebook). Computer printouts from experiments should be affixed to your lab notebook pages. See comments on p. 5 regarding information that should be recorded in a lab notebook. A looseleaf binder containing the lab manual will be provided.

**Description and Goals:**

In this course we will apply principles learned in introductory biology to develop an understanding of how the nervous system functions on a molecular and cellular level. Through the

combination of lectures and discussions of original scientific papers on topics related to the lecture material, we will cover not just *what* we know about neurons and glia, but *how* we know what we know. Are questions in the field being addressed in the best possible way? In one semester it would be impossible to cover all of the cool topics in neurobiology. To assure that we touch on your interests, you will have the opportunity to study a topic in depth and present that topic to your classmates in a 20-minute seminar. In addition you will have ample opportunity in lab to pose your own hypotheses, and design and execute experiments to address those hypotheses. Throughout these studies, keep your eyes and ears tuned to where the holes are in this field-- what are some of the unanswered questions in neurobiology today?

Before setting out in this course, you must recognize that the area of molecular and cellular neurobiology is in its infancy. The recent development of more powerful techniques in molecular biology, patch clamp electrophysiology, cellular imaging, and biochemistry have enabled neurobiologists to look directly at the structure and function of individual molecules. Such studies would have been impossible thirty years ago! The current explosion in information in this area provides for an extremely exciting, challenging pursuit. It also dictates that one have strong scientific training, particularly in chemistry, physics, computer science, genetics and other biological sciences, and mathematics. While the development of these exciting new techniques can tell us a lot about how certain molecules control certain cell functions, we must be careful not to lose sight of the forest for the trees. We should continually ask how the function of the whole nervous system--and the whole organism, if possible--might be influenced by changes taking place at the molecular level. Some frustration in this area, however, comes from the fact that we *don't know* at this point how molecular processes may contribute to complex physiological processes and behaviors.

The first 10 weeks of the course will consist of lectures and/or discussion each week, T-Th at 9:35 a.m., with one lab session per week. The final weeks of the course will consist of oral student presentations on topics of interest. In the laboratory, you will use electrophysiological techniques in crayfish motor neurons and muscle, and in mammalian (rat) brain, to study neuronal activity and synaptic transmission. Students who have difficulties working with live animal preparations, or who find public speaking particularly challenging, or who have issues with other aspects of the course should talk to us early in the semester about these issues. Chances are good that we have had to overcome some of the same challenges!

## **Responsibilities:**

### ***I. Examinations***

There will be two midterm exams and a final exam. Conflicts regarding the scheduling of these exams must be discussed and addressed within the first two weeks of class (Aug. 30-Sept. 9th). There will be no make-up exams for the midterms or the final. Students seeking exception to this must provide a note from the dean's office or from Baxter. Students with undocumented absences for exams will receive a grade of zero for that exam. The first two exams will be 75 minutes long and held during the class sessions listed above. The final exam, on December 15th (9 am), will cover material since the second exam (50%) as well as material presented over the entire course (50%).

### ***II. Independent Seminars***

Throughout the semester you will be reading in depth about a topic of interest to you, and in April you will give a 20-minute seminar on this topic to the class. By **Feb. 2<sup>nd</sup>**, you need to identify your seminar topic and turn in a 1-paragraph summary of the major question(s) in the field and a list of at least 5 relevant references that you have been reading. Shortly thereafter we will generate a schedule

for the seminars, grouping related topics together. By **March 2<sup>nd</sup>** you must submit a rough outline for your seminar, and by **April 6<sup>th</sup>** you must submit a detailed outline for your seminar, along with a pdf copy of a primary paper from the literature or a relevant review article that will be helpful for other members of the class, as these topics will be covered on the final exam. Discuss your reading choice with us and we will make it available to the class. See “Neurobio 178 Independent Seminar Guidelines” for further description of this assignment.

### ***III. Laboratory work***

You will be responsible for 2 full (5-7 pages, not counting figures and tables) written lab reports, which will be in the form of standard scientific papers (containing an abstract, introduction, methods, results, discussion, and references) and will provide an opportunity to practice writing this type of paper. The lab papers will also demonstrate that you are reading the background literature and understanding the course material. Lab Paper 1 will cover your results from the crayfish resting potential experiments, and Lab Paper 2 will cover synaptic plasticity experiments in rat hippocampal slices. The experiments for each of these papers and your data analysis will be done in collaboration with your lab partner, but the papers will be written independently. It is expected that your introduction and discussion include references to work related to the question you addressed with your experiments. All lab papers will be due on the day of your designated lab in the weeks indicated on the lab schedule. However, everyone is allotted three (3) "Late Days" (LDs) at no penalty. Each day that your paper is late (including weekend days) will cost you 1 Late Day. Once your LDs are all spent, you will lose 20% credit for each day that a paper or assignment is late. (Late days can be used for Independent seminar proposals and outlines, too).

The most important aspect of the lab component of the course is how you interpret and present the data that you gather. You should talk about your data and your ideas with other lab groups, and acknowledge these discussions in your paper. Bear in mind that the most successful lab papers are those that are reviewed by classmates before they are submitted for a grade. Scientists never submit a paper for publication without having a colleague read it first!

The last three sessions in the lab are dedicated to a project of your own design. Most students carry out a project involving synaptic pharmacology and/or synaptic plasticity in hippocampal slices, but you may use a different system if you prefer. Together with your lab partner you will be responsible for doing some background reading during the planning of your project, and need to clearly state your hypothesis, rationale for your hypothesis, and predictions before initiating the project. In addition, we will need to know in advance what special reagents or equipment you will need for your project. During the last week of classes you and your partner will give an oral presentation on your project to the whole class, in which you will describe background work that lead to your project, your approach, your data (including statistics, where appropriate), and interpretation of your data.

Last but not least, you will be expected to keep a good lab notebook stating the hypothesis being tested each week, rationale behind your hypothesis, your predictions, methods used to test your hypothesis, comments as you carry out the dissections and experiments, your raw data (including points at which manipulations were made, and calculations), your analyzed data, and your interpretations/conclusions for each experiment. The first two lab sessions for this course are not really hypothesis-driven. For those sessions, state the objective(s) of that afternoon's activities, provide your raw and analyzed data and comments, and answer the questions posed in the lab manual in your notebook. In subsequent weeks, when you are planning an experiment and interpreting your data, you'll want to jot down references that have been helpful, so that you can find them again when you're writing up the work. It is also helpful to jot down a few notes regarding why that reference was relevant. Computer printouts of data should be affixed to your notebook. Also indicate in your lab

notebook the file names that your raw data and analyzed data were saved under, and location. Data should be saved in more than one place -- on the computer hard drive, on your user space, and/or on a zip disk or CD or thumb drive. You are responsible for saving all data and notebooks until you have received a grade for the course.

### **Evaluation:**

Your grade for the course will be determined by the following:

Exam I:	10%	Lab Paper 1:	10%
Exam II:	10%	Lab Paper 2:	10%
Seminar:	10%	Lab Notebook:	10%
Final Exam:	25%	Lab Oral report:	10%
Participation in classroom and lab discussions: 5%			

*Please turn in your laboratory papers directly to your lab instructor, into our departmental mailbox, or slide the paper under our office door if the door is closed. If our office is open, put the paper on the main chair where we will see it. Be sure to label the paper with the **date of submission**, AND send an electronic copy as a Word attachment (to [kparfitt@pomona.edu](mailto:kparfitt@pomona.edu) or [Kevin.jones@pomona.edu](mailto:Kevin.jones@pomona.edu)) to verify the time of submission. A networked laser printer is available for your use in the Neurobiology lab. It prints double-sided—save paper!*

*All written and oral work must be completed in order to pass the course.*

*Students **must retain all laboratory records**—notebooks and computer files containing experimental data-- until a grade for the course has been received from the registrar. Save your data on CDs or zip disks or a thumb drive!*

Extra credit option: Several biology and neuroscience seminars will be scheduled throughout the semester. A one-page synopsis of each talk can be submitted for extra credit for this class. These summaries should include a description of the speaker's research goals, the work described, questions that you asked or would have liked to have asked, and your general reaction to the talk. Each summary can boost your grade one percentage point, and you may submit up to 3 summaries. If you are attending a seminar to fulfill a requirement for another course, you cannot receive extra credit for this course (i.e., no double-dipping!). Attendance at invited talks in neurobiology will be required for the course, unless you have a bona fide conflict with the seminar time.

I will announce upcoming seminars in advance, in class and via email.

### What do I need to know before taking Neurobiology?

The prerequisites for this course are Pomona's Bio 40 and Bio 41M (now Bio 41C), or the equivalent. In particular, you should be able to answer the following questions:

1. One of the simplifying principles of biology is that all living organisms are made of four principle types of molecules– nucleic acids, polysaccharides, peptides, and phospholipids. Describe these polymers and the monomers from which they are synthesized. Where might these polymers and monomers be found in neurons? What are some examples of each, and functions that they serve in neurons?
2. How is molecular information encoded in cells? Describe the Central Dogma of molecular biology. In addition, discuss the basic structure (primary, secondary, tertiary, quaternary) of proteins, and factors that dictate the structure. Which amino acids are nonpolar, which are polar, and which are polar and charged? Which amino acid can form disulfide bonds, and which amino acids are substrates for phosphorylation? Can you think of any examples in which a change in protein structure results in a change in the protein's function?
3. Discuss how newly-synthesized and processed membrane proteins are trafficked in non-neural cells and in neurons. How is vesicle trafficking different in neurons? How is it the same? How could you investigate whether a substance is transported down axons, and the rate of this transport?
4. What are some important molecules that neurons require for (1) electrical signaling and (2) chemical communication with other cells? What categories discussed in question 1 do these special molecules fall into?
5. Discuss the various ways that a chemical signal acting upon a cell (e.g., a neuron) is “transduced” by molecules in the cell membrane, cytosol, and cellular organelles. For starters, how would you categorize the receptors that perceive the presence of the chemical signal?

Pomona's Bio 40 and 41M(41C) also involve the development of writing skills—i.e. learning how to write a lab paper for a molecular or cell biology course or journal. If you have not written many biology papers, seek help from your lab instructor, your colleagues in the course, and/or the writing center. The Writing Center (on the second floor of Smith Campus Center, above the Coop Fountain) offers students free, one-on-one consultations at any stage of the writing. The Writing Fellows-- Pomona students majoring in subjects including Molecular Biology, PPA, and Religious Studies-- will work with you on an assignment from any discipline. Consultations are available by appointment, which you can make online: <http://writing.pomona.edu/writingcenter>.