NEUROBIOLOGY--BIOLOGY 422
SPRING 2005
SYLLABUS

Instructor: Gary Reiness ***Office Location***: Room 221 Olin Building
Office Hours: TBA ***Phone***: X 7513 ***e-mail***: reinessATlclarkDOTedu
***Class Time and Location*:** TTh 9:40-11:10 AM in Howard Hall 101
Lab Time and Location: Th 12:40-4:00 PM in the "Green Lab" in basement of Bio-Psych
Textbook: *Neuroscience,* by Dale Purves, et al., Sinauer Press, 3rd Edition, 2004
Additional Readings on Electronic Reserve in Watzek Library

COURSE OVERVIEW

What is Neurobiology (a personal view)?

Modern Neurobiology (or, more generally, Neuroscience) is an attempt to understand the higher functions of the nervous system (such as memory, learning, perception, consciousness, behavior, etc.) in terms of the biology of nerve cells. It developed from several different lines of inquiry that have merged into the current diverse field. These include: Neuroanatomy--the macroscopic and microscopic study of brain structure; Neurophysiology--the study of electrical and chemical signaling mechanisms of nerve cells; Neuropharmacology--the study of the effects of various drugs--psychoactive, paralytic, anesthetic, etc.--on the function of the nervous system; and Psychology--the study of human behavior. In this course we will focus on the biology of nerve cells--their structure, their cell biology, their signaling mechanisms, and how they are affected by psychoactive drugs or disease. We will not spend much time discussing the macroscopic anatomy of the brain nor human behavior, except when these topics are necessary for us to understand the functions of neurons. I hope you will come away from the course with a conviction that studying the cell and molecular biology of small numbers of nerve cells will help us understand larger scale processes such as learning or mental illness.

What I Hope You Learn in This Course:

You will learn a great deal about the cells of the nervous system, about electrical signaling in neurons and about transmission of signals between cells at synapses in this course. However, the most important thing I want you to take away from this course is an understanding of how neurobiologists learn about the nervous system. Therefore, we'll spend a lot of time discussing particular experiments, what the results were, and how conclusions about the function of neurons (nerve cells), synapses, etc. were drawn from those results. It's important that you understand that the "facts" of neurobiology are really the accumulation of the conclusions from hundreds or even thousands of experiments over the years, and to appreciate that those conclusions might change on the basis of new information. Thus the "facts" can be revised over time, but the process by which knowledge is generated from experiment will remain relatively constant. Understanding the experimental basis of our current knowledge will allow you to judge whether an idea is solidly founded in data or based largely on speculation; that is, you will be able to assess the validity of different ideas.

I believe that what makes you a scientist is not what facts you know, but whether you can reason from raw data to carefully articulated conclusions and whether you can design experiments to answer unanswered questions. For that reason, my exams emphasize data analysis and experimental design over repetition of well-known information. I think that you should know more after you take an exam than you knew beforehand. As part of my philosophy of learning, I give open book examinations. That is, y**ou may consult your textbook or lecture notes during all exams**. Therefore, don't concentrate on learning facts and vocabulary when you are preparing for an examination; try to understand what the data were and how they were interpreted.

I try to emphasize developing your scientific and analytical skills in other areas of the course as well. I will ask you to analyze two current scientific papers in depth to enhance your ability to comprehend and interpret data. In the lab you will have the opportunity to devise your own experiments and to explain

your thinking to your classmates in oral reports. These are not intended as ways to squeeze some extra work out of you, but as ways to help you improve your scientific skills. As with any skill--in sports or music, for example--you don't really become proficient at science unless you frequently practice the skills that scientists use. Developing those skills is another important goal of this course.

Expectations About You That I Bring to the Course:

In order for you to derive the maximum benefit from this course, you must have the necessary background in coursework; you must make an effort to stay current with the reading assignments and lectures; and you should seek help from me whenever you don't understand something we're doing in the course, whether it's some topic we're discussing, how to interpret or write up you lab data, or whatever.

The prerequisite for this course is a lower division course in Cell and Molecular Biology, such as Biology 200 at Lewis & Clark or the equivalent. Feel free to talk with me if you're not sure whether you have the necessary background or if you think I am taking for granted that you know something you don't. I *will* assume that you are familiar with the components of cells (nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, vesicles, etc); the basics of molecular genetics (i.e., the role of DNA and RNA in protein synthesis); the elements of protein structure and function, especially the role of proteins as enzymes; and the structure of biological membranes. If you feel somewhat shaky about those topics, you should review them in your textbook from Bio 200. I will not consider those subjects in any detail in this course, but a thorough understanding of them is essential preparation for the topics that we do cover.

You will get a great deal more out of the course if you do the readings **prior to** the class for which the reading is assigned. That is, read the material on synaptic transmission before the lectures on that topic. You will be responsible for everything in the readings unless I specify otherwise in class. Therefore, if you read the assignment and don't understand something, and that point is not clarified by the lecture, you should ask me in class or during office hours to clear things up for you. Because the class size is small, I intend not to use the typical lecture format, but to try to interact with you and to have discussions about the material in class in order to clarify any misunderstandings that the textbook doesn't clarify. Thus, it's especially important that you come to class with the questions about the readings that you want answered.

Finally, I expect you to make clear to me when you don't understand something, preferably by asking questions in class, where other students will also benefit from clarification. Alternatively, come see me during my office hours or send me a note via e-mail. I can't know whether I have explained things clearly or not unless you give me feedback in the form of questions**.** It is my responsibility to help you learn, but what you learn will depend on your efforts in doing the reading assignments, attending class regularly, and asking for help when you need it. ***You should never feel that a question is too trivial***. If you understood everything about neurobiology, you wouldn't be taking this course.

Attendance in class is optional, but highly recommended. First, there is a strong correlation between attendance in class and course grades; you will simply do better in the course if you come regularly, take careful notes, and review your notes to be sure that they are clear and consistent. (It's a good idea to rewrite your notes after class to help organize them better and to fill in any material that you didn't have time to complete during class). I emphasize material that we cover in class on exams and demonstrate skills of data analysis in class that I expect you to emulate on exams. Second, I sometimes change the details of the syllabus in class and make announcements or assignments for which you will be held responsible, whether or not you are there. For example, I may change the schedule of topics shown in this syllabus if our experience shows that I have allowed too much or too little time for that topic. I may find outside readings that I think will help you understand something we are considering in class and put those on reserve. Perhaps an exam will need to be rescheduled. I will announce these kinds of changes in class. Obviously, not being in class would put you at a disadvantage if changes were made. Finally, part of the grade will depend on class participation, including small group discussions and answers to questions that I pose for the class. You will receive no credit for participation on days in which you miss class (I do take attendance mentally). **On the other hand attendance in the laboratories is mandatory; I will deduct 15 points if you miss any lab session, unless there is some unavoidable cause such as illness**. There are no "make-up" labs in this course.

Using the Textbook:

The textbook is a very well written, and extremely well illustrated, survey of several important topics in Neurobiology, with a focus on human and medically relevant topics. We will not use the whole book in the course, but you should browse through the whole book to see what is there. If you restrict yourself only to reading the assigned pages, you will derive less from the book than you could. But, of course, you should read the assigned sections of the book carefully. I will also be assigning a number of supplementary readings, which I'll put on reserve in Watzek library, to cover topics that are not included in the book or to bring you up to date on subjects where there is new information since the book was published. If you do not understand a reading in either the textbook or on reserve, don't hesitate to talk with me (or send an e-mail) so we can get things cleared up for you.

Grading:

Your grade will be based on the following factors:

Two Midterm Exams	100 pts. each	200 pts
One Cumulative Final Exam	150 pts.	150 pts
Two Term Papers	100 pts. each	200 pts
Two Written Laboratory Reports	50 pts. each	100 pts
Final Lab Presentation and Poster	75 pts.	75 pts
Class Participation	75 pts	75 pts
	TOTAL	800pts

Make up Exams:

I don't give make up exams because it's impossible to write a second exam that's equivalent in content and difficulty to the original. In rare cases, for sufficient reason, I will allow a student to take an exam early (*except the final exam)*; an example of a sufficient reason for taking the exam early is being out of town with a sports team at the time the exam is scheduled. **If you miss an exam, you will earn a zero for the test, unless you contact me *in advance* and provide sufficient reason why you must miss the exam.** A "sufficient reason" is some event that you could not anticipate that arises at the last minute to prevent your taking the exam--for example, your serious illness or a death in your immediate family. I will ask you to provide documentary evidence supporting your case, such as a note from a physician or the dean of students. In case of an excused absence, your grade on the missed exam will be the average of your grade on the other exams in the course. For example, if you miss a midterm, and earn an average of 85% on the other midterm and final, I will assign you a score of 85% on the missed midterm and then calculate your overall grade accordingly.

The final exam for Neurobiology is scheduled for May 2, the first day of finals.

Late Writing Assignments:

Make sure that you turn lab reports and term papers in on time. I will penalize you at the rate of 10% of the maximum grade (50 pts for lab reports and 100 points for term papers) for every calendar day that a paper is overdue. Reports are due by 5 P.M. on Monday. If they are turned in after that time, they're one day late; after 5 P.M. on Tuesday, two days late, etc. Computers crash, printers jam, networks go down, terrible things can happen at the last minute. These do not justify a late report. Plan ahead and complete the work early; finishing a report even a few hours before it's due can save you a lot of grief.

Courtesy:

Please arrive for class promptly and plan to stay for the whole hour and a half; late arrivals or early departures are disruptive to the whole class. Similarly, please turn off your cell phones, pagers, etc. for the duration of the class so as not to disturb others. Repeated disruptive behavior will lower your grade.

LECTURE SCHEDULE

DATE	TOPIC	ASSIGNED READING IN *Neuroscience* by Purves, et al.
Jan. 18	Introduction and Course Overview The Cells of the Nervous System	Pp. 1-10
Jan. 20	The Macroscopic Organization of the Brain and CNS	Pp. 10-27
Jan. 25	Resting Membrane Potential	Chapter 2
Jan. 27	Action Potential I: Generation	Pp. 47-56 plus Box B
Feb. 1	Action Potential II: Propagation	Pp. 56-67
Feb. 3	Ion Channels I. Voltage-gated Channels	69-85
Feb. 8	Ion Channels II: Ion Pumps	Pp. 86-90
Feb. 10	**FIRST MIDTERM EXAM**	
Feb. 15	Synaptic Transmission: Introduction and Axonal Transport	Pp. 93-102
Feb. 17	Transmitter Release	Pp. 102-115
Feb. 22	Postsynaptic potentials **FIRST TERM PAPER DUE**	Pp. 113-126 except 114-5
Feb. 24	Neurotransmitters I	Pp. 129-147
March 1	Neurotransmitters II	Pp. 143-162
March 3	Postsynaptic Action: Second Messengers **FIRST LAB REPORT DUE**	Pp. 165-178
March 8	Postsynaptic Action: Nuclear and Neuronal Signaling	Pp. 178-185
March 10	Schizophrenia and Affective Disorders Malfunctions of Synaptic Transmission **REVISED TERM PAPER DUE**	Pp. 148; Chapter 28 (skim)
March 15	**SECOND MIDTERM EXAM**	
March 17	Integrative Functions of the Nervous System Sensory Systems I	Chapter 8
March 22 and 24	**SPRING BREAK NO CLASS**	
March 29	Sensory Systems II: Pain Sensation	Chapter 9
March 31	Neural Development I: Neurons and Glia **SECOND LAB REPORT DUE**	Pp. 500-519

DATE	TOPIC	ASSIGNED READING
April 5	Neural Development II: Pathfinding	Pp. 520-525; 527-539
April 7	Neural Development III: Synapse formation and Stabilization **SECOND TERM PAPER DUE**	Pp. 539-555
April 12	Memory and Learning I: LTP	Pp. 575-592
April 14	Memory and Learning II: LTD and Plasticity	Pp. 592-609
April 19	Drugs of Abuse and Addiction	Pp. 134-5 and 160 and Nestler & Malenka, Scientific American, March 2005, 78-85. "The Addicted Brain". Online without illustrations at: http://www.sciam.com/print_version.cfm?articleID=0001E632-978A-1019-978A83414B7F0101 (but the illustrations are cool. Go to the library).
April 21	Neurological Diseases I **REVISED TERM PAPER DUE**	Chapter 17, pp. 424-431 (esp. Box A) , p. 391, Box C.
April 26	Neurological Diseases II	pp. 424-431, (esp. Box B), 750-751 (Box D), p. 66-7 (Box D); p. 444-4 (Box A)
April 28	Review and wrap-up	
May 2	**FINAL EXAM 8:30-11:30 AM**	

LAB SCHEDULE

Jan. 20	Introduction to Electrophysiological Equipment and MacLab
Jan. 27	Motor Nerve Recording: Crawdad Lab 2
Feb. 3	Resting Potential I: Crawdad Lab 4 (View the video Intracellular Recording from Crayfish Muscle Cells at this site: http://www.science.smith.edu/departments/NeuroSci/courses/bio330/labs.htm
Feb. 10	Resting Potential II: Crawdad Lab 4
Feb. 17	Action Potentials I: TBA
Feb. 24	Action Potentials II: Ionic Basis
Mar. 3	Synaptic Potentials I Crawdad Lab 8 **FIRST LAB REPORT DUE**
Mar. 10	Synaptic Potentials II: Crawdad Lab 9
Mar. 17	Synaptic Potentials III (or Stretch Receptor) Possibly Crawdad Lab 10

Mar. 31	Self-Designed Projects	**SECOND LAB REPORT DUE**
April 7	“	
April 14	“	
April 21	“	
April 28	Poster Session: presentations of Projects	