PSY 445/545: Brain Mechanisms of Behavior
Winter 2015

The schedule in this syllabus is preliminary and will definitely change.
Last updated Wednesday, January 7, 2015

check for the latest version of the syllabus here:
http://www.neuro.uoregon.edu/wehr/coursepapers/Syllabus2015.pdf

Overview	What are the neural mechanisms underlying behavior? How do neural circuits operate to achieve sensory processing, sensorimotor integration, motor control, and behavioral choice? How do neuroscientists investigate these questions? How can basic principles learned from particular species be applied to brain mechanisms in humans? In this course we will read original scientific research articles (many of them at the cutting edge) to try and answer these questions.
Objectives	To develop the tools and knowledge to ask meaningful questions about the neural mechanisms underlying behavior, how to frame these questions, and how one might attempt to answer them. After completing this course, you should be able to describe the neural mechanisms underlying behavior in a variety of model systems. You should also be able to read an original scientific research article, extract the background, main question, main experimental findings, and interpretations in the article, and clearly explain these in writing and orally.
Lectures	Monday & Wednesday 2:00–3:20 PM; 176 Education Lecture notes are available online and on Blackboard.
Instructor	Mike Wehr wehr@uoregon.edu Office hours: Monday 10:30-11:00 AM in 213 LISB or by appointment.
Teaching Assistant	Matt Robison mkr@uoregon.edu Office hours: noon-2pm Fridays, 248 LISB or by appointment
Textbook	none

Readings All required course readings will be available on Blackboard: https://blackboard.uoregon.edu. You should also be able to follow the links in this syllabus.
You should also check Blackboard frequently for announcements, course materials, etc.
There are also some optional readings in the excellent book "Behavioral Neurobiology" by Thomas Carew, which is on reserve at the Science Library.

Plagiarism Is taken very seriously and is grounds for failure or expulsion. You are responsible for understanding what constitutes plagiarism and how to avoid it in your work. Excellent guides on plagiarism can be found at http://libweb.uoregon.edu/guides/plagiarism/students/ and http://www.plagiarism.org. You will submit the term paper for this course using Blackboard's anti-plagiarism plugin ("SafeAssign").

Grading

Midterm Exam	25%
Final Exam	25%
Paper	25%
Problem Sets	25%
	100%

Expectations This course will be difficult. The material is advanced and the pace will be fast. The exams will be very challenging. Nevertheless, I expect that any student who does the readings, shows up to class, and asks questions should be able to master the material and succeed in the course. Typically, the top 20-25% students earn A's in the course. I do not take attendance, but there are no make-ups for in-class Problem Sets.

Exams
The midterm will be an in-class exam, on February 4th. The final will be a take-home exam, will cover the material from the entire course, and will be available on Blackboard after the last class on March 11, and due by 5 p.m. on Monday, March 16th. Both exams will include multiple choice, short answer, and brief essay questions.

Problem Sets
You must do the assigned reading *before* each lecture. There will be a problem set due almost every class day. There are no make-ups. Problem sets are open book and open notes. Usually the first question or two will help me make sure you understood the important points from the readings. Problem sets will often include some review questions from previous classes, in addition to the readings, so it helps to pay attention in class. The first problem set will be in-class. After that they will be online, on

Blackboard, and due before the start of class. The problem sets together count for 25% of your grade, so you should take them seriously. But because there are 17 of them, any one problem set only counts for 1.5% of your grade, so skipping one or two will not have a big impact on your grade. **There are no make-ups.** I will drop your lowest-scoring Problem Set, so don't worry if you miss one.

The purpose of the problem sets is fourfold: (1) Lots of relatively easy points (if you've done the reading) distributed daily throughout the term. This takes some pressure off the exams, in case you have a bad exam day. (2) Motivation to do the reading, show up to class, and pay attention. (3) Review concepts and material to help prepare for the exams. (4) Constant feedback to me about how much you're understanding, and what concepts need more emphasis in class.

Paper/Project
The paper or project write-up should be roughly 8-10 pages, double spaced, and is due at the beginning of class on February 25th (submit through Assignments on Blackboard). The topic can be anything related to the course. Regardless of which topic you choose, you must submit the topic for approval by February 11th. Topic submission should fit on one page, and should include your name, paper title, one paragraph abstract, and a bibliography of no less than 3 of the sources you plan to use. Submit your topic in Problem Set 11 on Blackboard.

Format for the term paper:

- The filename must include your last name, for example: smith-psy445-termpaper.doc
- Include page numbers.
- Include a header with your name and a shortened title (that fits on 1 line).
- Use .doc or .pdf

No matter how cool or interesting your project or paper, it must be well organized, clearly written, and grammatically correct. To get an idea of what criteria I will use to assess your writing, here is a good set of guidelines:
http://www.emich.edu/public/geo/geography/Mayda/gradecriteria.htm

You don't need to write yet another dull term paper on a topic that doesn't really interest you. In fact, you don't need to write a paper at all — below are some ideas for projects or presentations, as well as some starter ideas for paper topics that you can get excited about. *Be creative, find a topic you can get enthusiastic about, and then let that enthusiasm show in your work*. Here are some ideas for paper/project topics:

- Find an original research article that interests you, and read it. A good website to search for neuroscience articles is PubMed: http://www.ncbi.nlm.nih.gov/sites/entrez. Then read another article by a different author on a related topic (the references of the first article would be a good place to look). Compare and contrast the articles: Why did they do these experiments? How are their results related? Do their results

agree? Why or why not? Which methodology is better, or are they both flawed? What experiment should they do next, and why?

- Figure out what the next step should be in the series of experiments that have been done, and propose an experiment that can address that next step. This could be a real, doable experiment, or what is sometimes more fun is to imagine impossible thought experiments... if you could record from every neuron in the brain, what might you expect to see? What could you learn? Where are the real limitations in current understanding? The format for a research proposal often has the following sections: Abstract, Specific Aims, Background and Significance, Research Design and Methods. There are many, many websites with guidelines for how to write an effective grant proposal, for example: http://web.wm.edu/grants/PROP/success.htm, http://deainfo.nci.nih.gov/extra/extdocs/gntapp.htm. You may ignore non-scientific aspects of grants, such as budgets and deadlines, if you like (or you could try including a budget for your proposal, why not?).

- Find an issue on which some authors disagree. Controversies always make for a rousing paper. You can lay out the characters and their positions, build suspense, root for the underdog, etc.

- A vanilla review paper can still be fun to write (and to read) if you try to personalize it. Why did you start researching this topic? What were you hoping to find out more about? Did you? What did you learn and how does that relate to what motivated you in the first place? etc.

- Instead of writing a paper, you can give a presentation to the class. For example, you could pick one of the regularly scheduled lectures below, and teach the class. Depending on which one you choose, you may even be able to take advantage of slides and lecture notes that I have already prepared. Or you could choose any relevant article that interests you, make your own slides, and present it to the class. This way you don't have to write a paper at all.

- Creative response. The neural mechanisms of behavior are as intriguing to artists as they are to scientists, and have inspired great science fiction novels and short stories, performance art, and visual art. A creative response can be anything relevant to the course… perhaps a short story, or how about an interpretive dance of the crayfish escape response (in front of the class, of course!).

Tips for reading and presenting research articles:
Focus on the Introduction, Abstract, and Discussion (probably in that order). Try not to get hung up on methodological details or unfamiliar vocabulary. As you read, ask yourself: What did the authors basically do in the key experiment? Why did they choose to do this particular experiment? What were the major findings of this experiment? How did they interpret these findings, i.e., what did the results tell them? Is their interpretation reasonable? Do the data figures really support the authors' conclusions?

Schedule (subject to change: please be sure to download the Syllabus from http://www.neuro.uoregon.edu/wehr/coursepapers/Syllabus2015.pdf or from Blackboard for the most up-to-date schedule)

Hot new cutting edge research

Day 1.
Introduction to brain mechanisms of behavior
No reading

Day 2.
Optical microstimulation.
Reading: Sparse optical microstimulation in barrel cortex drives learned behaviour in freely moving mice
Daniel Huber, Leopoldo Petreanu, Nima Ghitani, Sachin Ranade, Tomás Hromádka, Zach Mainen & Karel Svoboda, 2008.
http://www.neuro.uoregon.edu/wehr/coursepapers/Huber-Svoboda-2008.pdf
lecture notes

Day 3.
Internally generated cell assembly sequences in the hippocampus.
Reading: Internally generated cell assembly sequences in the rat hippocampus.
Eva Pastalkova, Vladimir Itskov, Asohan Amarasingham, György Buzsáki, 2008.
http://www.neuro.uoregon.edu/wehr/coursepapers/Pastalkova-Buzsaki-2008.pdf
lecture notes

Day 4.
Reactivation in Human Hippocampus During Free Recall.
Reading: Internally Generated Reactivation of Single Neurons in Human Hippocampus During Free Recall.
Hagar Gelbard-Sagiv, Roy Mukamel, Michal Harel, Rafael Malach, and Itzhak Fried, 2008.
http://www.neuro.uoregon.edu/wehr/coursepapers/Gelbard-Sagiv-Fried-2008.pdf
lecture notes

Day 5. MLK Day - No Class.

Day 6. No Class.

Neuroethology

Day 7.
Neural mechanisms of escape behavior in crayfish 1.
Reading: Neural mechanisms for serial order in a stereotyped behaviour sequence.
Heinrich Reichert and Jeffrey Wine, 1982.
http://www.neuro.uoregon.edu/wehr/coursepapers/Reichert-Wine-1982.pdf
lecture notes

Day 8.
Neural mechanisms of escape behavior in crayfish 2.
No additional reading.

Day 9.
Neural mechanisms of echolocation in bats.
Reading: Neural axis representing target range in the auditory cortex of the mustache bat.
Nobuo Suga & William O'Neill, 1979.
http://www.neuro.uoregon.edu/wehr/coursepapers/suga-oneill-1979.pdf
lecture notes

Day 10.
Midterm in class
No reading

Day 11. Tuesday, May 3
Discuss midterm results
Finish Echolocation.
No reading

Day 12.
Paper topics due in class
Place fields, spatial navigation, and the hippocampus.
Reading: Increased attention to spatial context increases both place field stability and spatial memory.
Cliff Kentros, Naveen Agnihotri, Samantha Streater, Robert Hawkins, and Eric Kandel.
http://www.neuro.uoregon.edu/wehr/coursepapers/Kentros-Kandel-2004.pdf

Day 13.
Neural mechanisms of habituation and dishabituation in Aplysia.
Reading: Neuronal Mechanisms of Habituation and Dishabituation of the Gill-Withdrawal Reflex in Aplysia
Vincent Castellucci, Harold Pinsker, Irving Kupfermann and Eric Kandel, 1970.
http://www.neuro.uoregon.edu/wehr/coursepapers/Castellucci-Kandel-1970.pdf
lecture notes

Day 14.
Reading a neural code: flight control in the blowfly.
Reading: Reading a neural code.
William Bialek, Fred Reike, Robert de Ruyter van Steveninck, David Warland, 1991.
http://www.neuro.uoregon.edu/wehr/coursepapers/bialek-warland-1991.pdf
lecture notes

Day 15.
Mouse Attack.
Reading: Lin & Anderson, 2011, "Functional identification of an aggression locus in the mouse hypothalamus."
http://www.neuro.uoregon.edu/wehr/coursepapers/Lin-Anderson-2011.pdf
lecture notes

Decision-making in primates

Day 16.
Neural mechanisms for forming a perceptual decision.
Reading: Cortical microstimulation influences perceptual judgements of motion direction.
Dan Salzman, Ken Britten, & Bill Newsome, 1990.
http://www.neuro.uoregon.edu/wehr/coursepapers/salzman-britten-newsome-1990.pdf
lecture notes
Papers due by beginning of class. (in Assignments on Blackboard)

Day 17.
Neural mechanisms of decision-making in parietal cortex.
Reading: Neural correlates of decision variables in parietal cortex.
Michael Platt & Paul Glimcher, 1999.
http://www.neuro.uoregon.edu/wehr/coursepapers/platt-glimcher-1999.pdf
http://www.neuro.uoregon.edu/wehr/coursepapers/platt-glimcher-1999-nv.pdf
lecture notes

Day 18.
Field trip to Wehr Lab
Meet in 207 LISB at 2pm (click here for a map)

Sex, drugs, and the brain

Day 19.
Neural mechanisms of drug addiction.
Reading: Addiction as a Computational Process Gone Awry.
David Redish, 2004.
http://www.neuro.uoregon.edu/wehr/coursepapers/Redish-2004.pdf
lecture notes

Day 20.
Last class
Neural mechanisms of love.
Reading: Enhanced partner preference in a promiscuous species by manipulating the expression of a single gene.
Miranda Lim, Zuoxin Wang, Daniel Olazábal, Xianghui Ren, Ernest Terwilliger, and Larry Young.
http://www.neuro.uoregon.edu/wehr/coursepapers/Lim-Young-2004.pdf
lecture notes
Take home final exam becomes available

Final due by 5 p.m. the following Monday

Brain Mech **Calendar** **2015**

Sunday	Monday	Tuesday	Wednesday
January 4	5 Day 1 Introduction Problem Set 1 in class	6 Reading: Huber-Svoboda-2008	7 Day 2 Optogenetics Problem Set 2 due
11 Reading: Pastalkova-Buzsaki-2008	12 Day 3 Hippocampal replay Problem Set 3 due	13 Reading: Gelbard-Sagiv-Fried-2008	14 Day 4 Hippocampal recall Problem Set 4 due
18 No Reading	19 Day 5 **MLK Day - No Class** There is no Problem Set 5	20 No Reading:	21 Day 6 **No class** There is no Problem Set 6
25 Reading: Reichert-Wine-1982	26 Day 7 Crayfish escape 1 Problem Set 7 due	27 No additional reading	28 Day 8 Crayfish escape 2 Problem Set 8 due
February 1 Reading: Suga-O'Neill-1979	2 Day 9 Echolocation in bats Problem Set 9 due	3 No reading	4 Day 10 **Midterm**
8 Reading: Kentros-Kandel-2004	9 Day 11 Discuss midterm Finish echolocation Problem Set 10 due	10 Reading: Castellucci-Kandel-1970	11 Day 12 Place fields Problem Set 11 due **Paper topics due in Problem Set**
15 Reading: Castellucci-Kandel-1970	16 Day 13 Gill withdrawal in *Aplysia* Problem Set 12 due	17 Reading: Bialek-Warland-1991	18 Day 14 Spikes in blowflies Problem Set 13 due
22 Reading: Lin-Anderson-2011	23 Day 15 Mouse fighting Problem Set 14 due	24 Reading: Salzman-Newsome-1994	25 Day 16 Perceptual decisions Problem Set 15 due **Papers due by beginning of class**
March 1 Reading: Platt-Glimcher-1999	2 Day 17 Decision-making Problem Set 16 due	3 No Reading	4 Day 18 Field trip to Wehr Lab Meet in 212 Huestis
8 Reading: Redish-2004	9 Day 19 Addiction Problem Set 17 due	10 Reading: Lim-Young-2004	11 Day 20 Love Problem Set 18 due **Final available** **Final is due at 5 pm on Monday, March 16th**