

BIOLOGY 360 NEUROBIOLOGY

Autumn 2012 - SYLLABUS

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TEXTS (copies of all texts are on 2 hr reserve in the Science Library)

1) Kandel, Schwartz, and Jessell (KSJ), *Principles of Neuroscience*, 4th Edition, Elsevier (2000). Lucidly written, extremely comprehensive neurobiology text with more clinical coverage than other texts, but significantly more expensive. Recommended for those want a first-rate, wide-ranging neuroscience reference text.

2) Nicholls, Martin, Fuchs, Brown, Diamond & Weisblat (NMF), *From Neuron to Brain*, 5th edition, Sinauer (2012). Provides deeper coverage of fewer issues than Kandel. Experimental emphasis plus a more historical approach.

3) Sacks, *The Man Who Mistook His Wife For A Hat*, Harper and Row (1985). **REQUIRED READING.** This inexpensive paperback provides a very different view of neuroscience. The organization of the Sacks book does not correlate with that of the lecture schedule; hence it is impossible to associate specific lectures with individual chapters in his book. You are responsible for the material in the first half (chapters 1-12) of the book by the midterm, and for the second half of the text by the final.

LECTURE #, DATE, & SUBJECT (READING ASSIGNMENT)

- 1) **25 Sept** **COURSE OVERVIEW & INTRODUCTION:** history of neuroscience; structure of neurons; signaling in CNS; recording techniques; stretch reflex (KSJ, Ch. 1 & 2; NMF Ch. 1; Appendix A in KSJ and NMF).
- 2) **27 Sept** **IONIC BASIS OF RESTING POTENTIAL:** ionic distribution in neurons; Nernst equation (KSJ, Ch.7; NMF, Ch.4 & 6).
- 3) **02 Oct** **CONTROL OF IONIC PERMEABILITY:** action potentials; voltage clamp; Na-K pump (KSJ, Ch. 9; NMF, Ch. 7).
- 4) **04 Oct** **CHANNELS:** calcium action potentials; distribution of excitability (KSJ, Ch. 6; NMF, Ch. 5).
- 5) **09 Oct** **PASSIVE PROPERTIES OF NEURONS:** cable theory; time & length constants; action potential propagation (KSJ, Ch. 8; NMF, Ch. 8).
- 6) **11 Oct** **FILM: To be announced.**
- 7) **16 Oct** **SYNAPSES I:** electrical synaptic transmission; intro to chemical synaptic transmission; synaptic potentials (KSJ, Ch. 10 & 11; NMF, Ch.11).
- 8) **18 Oct** **SYNAPSES II:** reversal potentials; transmitter-dependent channels; IPSPs; post-synaptic

inhibition (KSJ, Ch. 12; NMF, Ch. 10 & 11).

- 9) **23 Oct** **SYNAPSES III:** control of transmitter release; quantal & vesicle hypotheses; MEPPs & role of calcium (KSJ, Ch. 14; NMF, Ch. 12 & 13).
- 10) **25 Oct** **TRANSMITTERS:** neurotransmitter criteria; acetylcholine, biogenic amines; amino acid transmitters; peptides (KSJ, Ch. 15; NMF, Ch. 14 & 15).
- 11) **30 Oct** **MIDTERM EXAM**
- 12) **01 Nov** **SENSORY SYSTEMS I:** General properties of sensory systems; chemical senses overview; olfaction (KSJ, Ch. 21, 22 & 32; NMF, Ch. 19).
- 13) **06 Nov** **SENSORY SYSTEMS II:** central processing of olfactory information; gustation (KSJ, Ch. 32; Ch.13; NMF, Ch. 19).
- 14) **08 Nov** **DEVELOPMENTAL NEUROBIOLOGY:** Guest lecture by Javier Fierro. Readings to be announced.
- 15) **13 Nov** **CONTROL OF MOTOR PATTERNS I:** reflexes; fixed action patterns; central pattern generators; simple neural networks (KSJ, Ch. 33-34 & 36; NMF, Ch. 24).
- 16) **15 Nov** **CONTROL OF MOTOR PATTERNS II:** Complex motor patterns; fish swimming; hatching in chicks; human infant behavior (KSJ, Ch. 36-37 & 42; NMF, Ch. 24).
- 17) **20 Nov** **NEURONAL PLASTICITY:** Memory systems; associative & non-associative learning; mechanisms underlying habituation, sensitization and dishabituation; long-term potentiation; other types of neural plasticity (KSJ, Ch. 13, 62-63; NMF, Ch. 16).
- 18) **22 Nov** **NO LECTURE** (Thanksgiving).
- 19) **27 Nov** **CNS DISORDERS:** Alzheimer's and Parkinson's (KSJ Ch. 35, 46, 60 & 65; NMF, not available)
- 20) **03 Dec** **COURSE WRAP-UP:** Discussion of Sacks book and movie; Brief overview of other areas of neuroscience; Discussion on the future direction of brain research. Is there a continuing need for animal research?

DISCUSSION SCHEDULE

Week 1: No discussion

Weeks 2-8: Discussion sections at usual times.

Week 9: No discussion (Thanksgiving week)

Week 10: Discussion sections at usual times.

ASSIGNMENTS

Grading of each paper will be based on the insightfulness and depth of your discussion and the clarity and quality of your writing. You will lose points if the paper is longer than the maximum length. PAPERS ARE DUE AT THE BEGINNING OF CLASS.

ASSIGNMENT #1: Report on a primary scientific paper (DUE DATE: 11 October; 3 double spaced pages maximum; 50 points possible). A prerequisite to being a Biologist of any sort (even a physician) is the ability to read and critically evaluate the primary scientific literature. The goal of this assignment is to help you develop these essential skills.

Your assignment is to read and write a short report on a primary scientific neuroscience paper. The key word here is "primary"; you must read and report on an experimental paper written by those who performed the work rather than a review of that work. A good rule of thumb is that if the paper has a materials and methods section, then it is a primary scientific paper. Papers can be on any neurobiological topic from any primary journal. You may choose a paper from a recent neuroscience journal such as *Journal of Neuroscience*, *Journal of Neurobiology*, *Neuron*, *Journal of Neurophysiology*, and *Neuron*. Other journals with neuroscience papers may also be used (e.g., *Journal of Experimental Biology*). *Nature* and *Science* are also good sources of interesting neurobiology papers. Review articles are not appropriate. If you are unsure about the paper, check with me first. You may also find it useful to read other papers related to the one you are reading. The most useful related papers are generally those cited in the references.

You must specifically and fully answer the following questions in order. Please number each answer.

1. What is the title of the paper, who are the author(s), and where was it published (journal, volume, page numbers, year)? Please attach a copy of the title page and abstract. (6 points)
2. What is (are) the major scientific issue(s) addressed by the paper? What is (are) the specific experimental question(s) asked by the paper? (8 points)
3. What were the results for each experiment? (12 points)
4. What did the author(s) conclude from the results? Are their conclusions justified? (12 points)
5. Based on these results, what experiments should the researchers do next? (12 points)

ASSIGNMENT #2: Discuss an unsolved neuroscience question (DUE DATE: 20 November; 3 double spaced pages maximum; 50 points possible). There are literally hundreds of intriguing neuroscience questions not yet understood. Choose one and write a short paper () describing it, its importance and possible approaches to its solution. At least 3 scientific references are required; Wikipedia is not allowed.

Your paper must have the following format (please organize your paper with the following subheadings):

- A. Background and Significance** (8 points): Be organized – use subheadings when possible. Make sure the significance of the topic is explicitly stated. Clearly state the gaps in knowledge.
- B. Main Hypothesis** (8 points): Clearly state your hypothesis. Briefly explain the experimental design to test the hypothesis (N.B., experimental design differs from the methods section. The former

describes the approach for testing the hypothesis not the technical procedural details of the experiment).

- C. Rationale** (8 points): How does the experimental design test your hypothesis? What is your reasoning?
- D. Methods** (12 points): List general approaches first, explaining why the methods you propose are the best available for your questions. Be as specific as space allows. Include your approaches to statistical analyses.
- E. Anticipated Results** (7 points): Explain how your data will be analyzed and all potential outcomes of your experiments and their likelihood. Explain your interpretation of the different possible results and how they relate to your hypotheses.
- F. Problems and Pitfalls** (7 points): This section serves as a reality test of your proposed experiment. Be honest and explain pitfalls and problems with your experiments and how alternative approaches will be used if they occur. All experiments have potential problems so not including these indicates you have not thought carefully about your experiment. If this section feels uncomfortable, it is because you are probably trying an experiment that is not feasible.

Common Mistakes

Background and Significance: Neither significant nor interesting; Lack of compelling rationale;

Incremental and low impact research; Lack of new or original ideas

Main Hypothesis: Too ambitious, too much work proposed; Unfocused aim, unclear goal; Limited aim and uncertain future direction

Experimental Design: Not enough detail; Lack of appropriate controls; Not directly testing hypothesis;

Correlative or descriptive data; Experiments not directed towards mechanisms

Methods: Not enough detail (as space allows)

Anticipated Results: Insufficient discussion of proper data analysis and interpretation of data

Problems and Pitfalls: No discussion of potential pitfalls and alternative models or hypotheses

Formatting Problems: Exceeds 3 pages; Grammatical/spelling errors

GRADING POLICY

The course grade is based on the results from the two exams and the two written assignments.

EXAMS: Each exam will count 50% towards your final grade. **There are no make-up exams.** The class will choose whether the midterm will be open or closed book exam. The class will also vote on whether the final exam will be an open book, 24 hr take home exam handed out the final day of class or a closed book exam given during the regularly scheduled period in exam week. Exams are graded on a modified curve; everyone can receive an "A" if earned. Improvement between the midterm and final will be taken into account when assigning the course grade. You also have the option of not taking the final exam and receiving your midterm grade for the course grade if you submit a 5 page paper on a neurobiological topic of your own choosing.

ASSIGNMENTS: There are 2 papers (100 points total) that contribute to your final grade. If you earn 90 points or better ($\geq 90\%$), your final course grade will be raised by 1/3 of a letter grade. If you earn less than 70 points ($< 70\%$), your final course grade will be lowered by 1/3 of a letter grade. **Assignments submitted late will have 5 points deducted from the final score.**