

Columbia University
BIOLUN3005_001_2020_1 - NEUROBIO II: DEVPT & SYSTEMS

Spring 2020
Syllabus 1/20/20

Lectures: Tu./Th. 10:10-11:25 Room: 501 Schermerhorn Hall
Auditors allowed after permission is granted.

Course website: <https://courseworks.columbia.edu/>

Instructor: Rafael Yuste, rmy5@columbia.edu

Office Hours: By appointment through email.

Teaching Assistants:

Fabian Muniz, <fm2481@cumc.columbia.edu>
James Priestley <jbp2150@columbia.edu>
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Sebastian Rolotti <srolotti@gmail.com>
Fabio Stefanini <fs2545@cumc.columbia.edu>
Nefeli Slavi <ns3377@columbia.edu>

REQUIREMENTS: This course is the "capstone" course for the Neurobiology and Behavior undergraduate major at Columbia University. It is designed for advanced undergraduate and graduate students. Knowledge of Cellular Neuroscience (how an action potential is generated and how a synapse works) will be assumed. It is strongly recommended that students take BIOL UN3004 Neurobiology 1: Molecular and Cellular Neuroscience, or a similar course, before enrolling in BIOL UN3005. Students unsure about their backgrounds should check a representative syllabus of BIOL UN3004 in <http://www.columbia.edu/cu/biology/courses/w3004/index.html> and study independently chapters 1-8 of the textbook.

TEXT (Required): Neuroscience: Purves et al, 2018, Oxford University Press, 6th edition. ISBN 9781605353807

<https://global.oup.com/ushe/product/neuroscience-9781605353807?q=purves&lang=en&cc=us>

The text is available at the Columbia Bookstore and also in Book Culture. Several copies should be on reserve at the NWC Science Library. Students are expected to read the corresponding chapters for each lecture.

Students are highly encouraged to review the online textbook resources, including Flashcard questions: https://oup-arc.com/access/neuroscience-sixth-edition-student-resources#tag_animations

TESTS: This course has no final exam. Instead, three tests are given during class time. Each non-cumulative test covers material discussed in class and primary research articles discussed in the recitations. **Rescheduling of tests is only granted under exceptional circumstances, in cases of serious illness or personal crisis, and the student is required to present a letter from the undergraduate dean as well as supporting evidence (such as doctor's notes, etc.).** Please note all test dates ASAP and make travel arrangements accordingly.

DISSABILITY OFFICE TESTS: Tests at the disability office will NOT start early and will be given exactly at the same time as the class. No exceptions will be made. Students with potential time conflict with prolonged testing times should NOT register for the class.

GRADING: The tests will contribute 35%, 20% and 35% towards the semester grade. Participation in the recitations is required for a passing grade and will determine the remaining 10%.

RECITATIONS: During the weekly recitations, students will present and discuss papers from the primary literature posted on the course website: <https://courseworks.columbia.edu/> Weekly attendance at the recitations is mandatory for a passing grade and active participation counts in the final grade. Students will fail the class if they don't attend recitations regularly. Recitations will take place on:

BIOLUN3005 students:

Mondays 9-10am, Fairchild 1000, Fabian Muniz, fm2481@cumc.columbia.edu,
Tuesdays 9-10am, Fairchild 1000, James Priestley<jbp2150@columbia.edu>
Tuesdays 6-7pm, Fairchild 900: Daniel Virga<dmv2123@columbia.edu>
Wednesdays 9-10am, Fairchild 1000, Kevin Gonzalez <kg2685@cumc.columbia.edu>
Thursdays 9-10am, Fairchild 1000, Sebastian Rolotti<srolotti@gmail.com>
Fridays 9-10am, Fairchild 1000, Fabio Stefanini <fs2545@cumc.columbia.edu>,

BIOL5005 and 6005 students:

Thursdays 5.40-7PM, Fairchild 1000: Nefeli Slavi<ns3377@columbia.edu>

All students need to sign up for one recitation emailing the corresponding TA and are required to attend that recitation till the end of the semester. Tests will incorporate material from the recitations. The first recitations will be January 27th- 31st.

LECTURE PLAN

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|---|----------------------|
| 1. Brain Anatomy
Chapter 1 and Appendix | Jan 21 st |
| 2. Neurons, and Synapses
Chapters 1- 4 | Jan 23 rd |
| 3. Neural Circuits
Chapters 5- 8 | Jan 28 th |
| 4. Neural Networks
Yuste Chapter | Jan 30 th |
| 5. Early Brain Development
Chapters 22 | Feb 4 th |
| 6. Construction of Neural Circuits
Chapters 23 | Feb 6 th |

7. Circuit Differentiation Chapters 24	Feb 11 th
8. Developmental Plasticity Chapters 25	Feb 13 th
9. Repair and Regeneration in the Nervous System Chapters 26	Feb 18 th
Test 1	Feb 20th
10. Retina Chapters 11	Feb 25 th
11. Vision Chapters 12	Feb 27 th
12. Audition Chapter 13	March 3 rd
13. Olfaction and Taste Chapter 15	March 5 th
14. Somatosensation and Proprioception Chapter 9	March 10 th
15. Pain Chapter 10	March 12 th
SPRING BREAK	Mar 17th-19th
Test 2	March 24th
16. Reflexes Chapter 16	March 26 th
17. Upper Motor Chapter 17	March 31 st
18. Basal Ganglia Chapter 18	April 2 nd
19. Cerebellum	April 7 th

Chapter 19	
20. Emotions Chapter 31	April 9 th
21. Learning and Memory Chapter 30	April 14 th
22. Sleep Chapter 28	April 16 th
23. Attention Chapters 27 and 29	April 21 st
24. Thinking Chapters 32	April 23 rd
25. Speech Chapter 33	April 28 th
Test 3	April 30th

Recitation papers:

January 20th-24th: No recitations

1. Jan 27th – 31st:

Paper: Markram H, Lubke J, Frotscher M, Sakmann B. (1997) Regulation of synaptic efficacy by coincidence of postsynaptic APs and EPSPs. Science 275:213-5.

<https://science.sciencemag.org/content/275/5297/213/tab-pdf>

2. Feb 3rd - 8th:

Paper: Hopfield JJ, Tank DW. (1986) Computing with neural circuits: a model. Science 233: 625-33.

<https://science.sciencemag.org/content/233/4764/625.long>

3. Feb 10th – 14th:

Paper: Wiesel TN, Hubel DH. (1965). Comparison of the effects of unilateral and bilateral eye closure on cortical unit responses in kittens. J Neurophysiol. Nov;28(6):1029-40.

<https://www.physiology.org/doi/abs/10.1152/jn.1965.28.6.1029>

February 17th -21st : No recitations, Test week

4. Feb 24th – February 28th

Paper: Hecht S, Shlaer S, Pirenne MH. ENERGY AT THE THRESHOLD OF VISION. Science. 1941 Jun 20;93(2425):585–587

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2142545/pdf/819.pdf>

5. March 2nd - 6th:

Paper: Linda Buck, Richard Axel, (1991). A novel multigene family may encode odorant receptors: A molecular basis for odor recognition, *Cell*, Volume 65, Issue 1, Pages 175-187,
<https://www.sciencedirect.com/science/article/pii/009286749190418X?via%3Dihub>

6. March 9th – 13th

Paper: Mountcastle J *Neurophysiol.* 1957 Jul;20(4):408-34. Modality and topographic properties of single neurons of cat's somatic sensory cortex.
<https://www.physiology.org/doi/abs/10.1152/jn.1957.20.4.408>

March 16th -20th : No recitations, Spring break

March 23rd- 27th: No recitations, Test week

7. March 30th- April 3rd:

Paper: Caggiano, V., Leiras, R., Goñi-Erro, H. et al. Midbrain circuits that set locomotor speed and gait selection. *Nature* 553, 455–460 (2018).
<https://www.nature.com/articles/nature25448.pdf>

8. April 6th – 10th

Paper: Hollerman, J., Schultz, W. Dopamine neurons report an error in the temporal prediction of reward during learning. *Nat Neurosci* 1, 304–309 (1998) doi:10.1038/1124
https://www.nature.com/articles/mn0898_304.pdf

9. April 13th – 17th:

Paper: Liu, X., Ramirez, S., Pang, P. et al. Optogenetic stimulation of a hippocampal engram activates fear memory recall. *Nature* 484, 381–385 (2012) doi:10.1038/nature11028
<https://www.nature.com/articles/nature11028>

10. April 20th – 24th:

Paper: Sergent C, Baillet S, Dehaene S. (2005). Timing of the brain events underlying access to consciousness during the attentional blink. *Nat Neurosci.* 8:1391-400.
<https://www.nature.com/articles/mn1549.pdf>

April 28th- May 1st: No recitations, Test week