Columbia University
BIOLUN3005_001_2022_1 - NEUROBIO II: DEVPT & SYSTEMS **Spring 2022**
Syllabus 1/19/22

Lectures: Tu./Th. 10:10-11:25 Room: Fayerweather Hall Room 310
Auditors allowed after permission is granted.

Online Zoom link:

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

Instructor: Rafael Yuste, rmy5@columbia.edu

Office Hours: By appointment through email.

Teaching Assistants:
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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 and study independently chapters 1-8 of the Purves textbook.

TEXT 1 (Required): **Lectures in Neuroscience, Yuste** (in press), Columbia University Press. A pdf of the preliminary version of the book will be available in CourseWorks. Students are expected to read the corresponding chapters for each lecture.

TEXT 2 (Recommended): **Neuroscience: Purves et al,** Oxford University Press, 6th edition. 2018, 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 (store pickup service NEUROSCIENCE - https://www.bookculture.com/book/9781605353807). Several copies are also on reserve at the NWC Science Library and as an eBook. The book is very well written and students are encouraged to read the corresponding chapters for each lecture, as it will help their understanding of the material. Students are also encouraged to review the online textbook resources, including Flashcard questions: https://oup-arc.com/access/neuroscience-sixth-edition-student-resources#tag_animations

TEXT 3 (Recommended): **Principles of Neural Science**, **Kandel et al.** Sixth Edition 6th Edition, 2021, McGraw Hill. ISBN-13: 978-1259642234 ISBN-10: 1259642232

The text is available at the Columbia Bookstore and also in Book Culture (store pickup service: PRINCIPLES OF NEURAL SCIENCE 6 - https://www.bookculture.com/book/9781259642234). Several copies are also on reserve at the NWC Science Library and as an eBook. This text is encyclopedic, more like a Handbook of Neuroscience, and should only be consulted for in depth study of selected topics.

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 SERVICES OFFICE TESTS: Tests at the Disability Service Office will NOT start early and will be given exactly at the same time as the class. No exceptions will be made. Students with time conflicts with prolonged testing times and other classes should NOT register for the class.

GRADING: The three tests will contribute 30% 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. Recitations will take place on:

BIOLUN3005 students: UN3015 Neurobiology II Recitation

Section 001: Mondays 9-10am, Room 1000 Fairchild: Andrew
Section 002: Tuesdays 9-10am, Room 1000 Fairchild: Abhishek
Section 003: Wednesdays 9-10am, Room 1000 Fairchild: Bovey
Section 005: Wednesdays 6-7pm, Room 800 Fairchild: James
Section 004: Thursdays 9-10am, Room 1000 Fairchild: Yuhao (Leo)

GR5005 and 6005 students: GR5005 Neurobiology II

Section 001: Fridays 9-10am, Room 1000 Fairchild: Nandhini

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 24th- 28th.

LECTURE PLAN

1. Brain Anatomy — Jan 18th

Yuste: Chapters 1 and 2
Purves: Chapter 1 and Appendix

2. Neurons, and Synapses — Jan 20th

Yuste: Chapter 3
Purves: Chapters 1- 4

3. Neural Circuits Yuste: Chapter 4 Purves: Chapters 5- 8	Jan 25th
4. Neural Networks Yuste: Chapter 5	Jan 27th
5. Early Brain Development Yuste: Chapter 2 Purves: Chapter 22	Feb 1st
6. Construction of Neural Circuits Yuste: Chapter 2 Purves: Chapter 23	Feb 3rd
7. Circuit Differentiation Yuste: Chapter 2 Purves: Chapter 24	Feb 8th
8. Developmental Plasticity Yuste: Chapter 2 Purves: Chapter 25	Feb 10th
9. Repair and Regeneration Purves: Chapter 26	Feb 15th
Test 1	Feb 17th
10. Retina Yuste: Chapter 6 Purves: Chapter 11	Feb 22nd
11. Vision 1 Yuste: Chapter 6 Purves: Chapter 12	Feb 24th
12. Vision 2 Yuste: Chapter 6 Purves: Chapter 12	March 1st
13. Olfaction and Taste Yuste: Chapter 8 Purves: Chapter 15	March 3rd
14. Audition Yuste: Chapter 7 Purves: Chapter 13	March 8th

15. Somatosensation and Proprioception — March 10th
    Yuste: Chapter 9
    Purves: Chapter 9

SPRING BREAK — Mar 14th-18th

16. Pain — March 22nd
    Yuste: Chapter 10
    Purves: Chapter 10

17. Reflexes — March 24th
    Yuste: Chapter 11
    Purves: Chapter 16

Test 2 — March 29th

18. Upper Motor — March 31st
    Yuste: Chapter 12
    Purves: Chapter 18

19. Basal Ganglia & Cerebellum — April 5th
    Yuste: Chapter 13 and 14
    Purves: Chapters 17 and 19

20. Emotions — April 7th
    Yuste: Chapter 15
    Purves: Chapter 31

21. Learning and Memory — April 12th
    Yuste: Chapter 17
    Purves: Chapter 30

22. Speech
    Yuste: Chapter 16 — April 14th
    Purves: Chapter 33

23. Sleep (Dr. Justin Lines, guest lecturer) — April 19st
    Yuste: Chapter 18
    Purves: Chapter 28

24. Attention — April 21st
    Yuste: Chapter 18
    Purves: Chapter 27, 29

25. Thinking — April 26th
    Yuste: Chapter 18

Purves: Chapter 32

Test 3 April 28th

Recitation papers:

January 17th-21st: No recitations

1. Jan 24th-28th:
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. Jan 31st-Feb 4th:
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 7th-11th:
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 14th -18th: No recitations, Test week

4. Feb 21st-25th :
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. Feb 28th-March 4th:
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 7th – 11th
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 14th -18th: No recitations, Spring break

7. March 21st - 25th:
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

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

8. April 4th – 8th :

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/nn0898_304.pdf

9. April 11th-15th:

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 18th – 22nd :

Paper: Xie L et al . (2013). Sleep drives metabolite clearance from the adult brain. Science. 2013 Oct 18;342(6156):373-7.

https://www.science.org/doi/10.1126/science.1241224

https://www.science.org/doi/10.1126/science.1245798

April 25th – 29th: No recitations, Test week