

**Columbia University**  
**BIOLUN3005\_001\_2022\_1 - NEUROBIO II: DEVPT & SYSTEMS**

**Spring 2022**  
*Syllabus 12/7/21*

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

Online Zoom link: TBA

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

Instructor: Rafael Yuste, [rmy5@columbia.edu](mailto: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 study independently chapters 1-8 of the Purves textbook.

**TEXT (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 (Recommended): Neuroscience: Purves et al**, Oxford University Press, 6<sup>th</sup> 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. Several copies are 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](https://oup-arc.com/access/neuroscience-sixth-edition-student-resources#tag_animations)

**TEXT (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. Several copies are 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:

Mondays 9-10am, Room 1000 Fairchild  
Tuesdays 9-10am, Room 1000 Fairchild  
Wednesdays 9-10am, Room 1000 Fairchild  
Thursdays 9-10am, Room 1000 Fairchild

GR5005 and 6005 students:

Fridays 9-10am, Room 1000 Fairchild

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 24<sup>th</sup>- 28<sup>th</sup>.

## LECTURE PLAN

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|---|----------------------|
| 1. Brain Anatomy<br>Yuste: Chapters 1 and 2<br>Purves: Chapter 1 and Appendix | Jan 18 <sup>th</sup> |
| 2. Neurons, and Synapses<br>Yuste: Chapter 3<br>Purves: Chapters 1- 4         | Jan 20 <sup>th</sup> |
| 3. Neural Circuits<br>Yuste: Chapter 4<br>Purves: Chapters 5- 8               | Jan 25 <sup>th</sup> |
| 4. Neural Networks<br>Yuste: Chapter 5  | Jan 27 <sup>th</sup> |

5. Early Brain Development Yuste: Chapter 2 Purves: Chapter 22	Feb 1 <sup>st</sup>
6. Construction of Neural Circuits Yuste: Chapter 2 Purves: Chapter 23	Feb 3 <sup>rd</sup>
7. Circuit Differentiation Yuste: Chapter 2 Purves: Chapter 24	Feb 8 <sup>th</sup>
8. Developmental Plasticity Yuste: Chapter 2 Purves: Chapter 25	Feb 10 <sup>th</sup>
9. Repair and Regeneration Purves: Chapter 26	Feb 15 <sup>th</sup>
<b>Test 1</b>	<b>Feb 17<sup>th</sup></b>
10. Retina Yuste: Chapter 6 Purves: Chapter 11	Feb 22 <sup>nd</sup>
11. Vision 1 Yuste: Chapter 6 Purves: Chapter 12	Feb 24 <sup>th</sup>
12. Vision 2 Yuste: Chapter 6 Purves: Chapter 12	March 1 <sup>st</sup>
13. Olfaction and Taste Yuste: Chapter 8 Purves: Chapter 15	March 3 <sup>rd</sup>
14. Audition Yuste: Chapter 7 Purves: Chapter 13	March 8 <sup>th</sup>
15. Somatosensation and Proprioception Yuste: Chapter 9 Purves: Chapter 9	March 10 <sup>th</sup>

SPRING BREAK

Mar 14<sup>th</sup>-18<sup>th</sup>

16. Pain

Yuste: Chapter 10

Purves: Chapter 10

March 22<sup>nd</sup>

17. Reflexes

Yuste: Chapter 11

Purves: Chapter 16

March 24<sup>th</sup>

Test 2

March 29<sup>th</sup>

18. Upper Motor

Yuste: Chapter 12

Purves: Chapter 18

March 31<sup>st</sup>

19. Basal Ganglia & Cerebellum

Yuste: Chapter 13 and 14

Purves: Chapters 17 and 19

April 5<sup>th</sup>

20. Emotions

Yuste: Chapter 15

Purves: Chapter 31

April 7<sup>th</sup>

21. Learning and Memory

Yuste: Chapter 17

Purves: Chapter 30

April 12<sup>th</sup>

22. Speech

Yuste: Chapter 16

Purves: Chapter 33

April 14<sup>th</sup>

23. Sleep

Yuste: Chapter 18

Purves: Chapter 28

April 19<sup>st</sup>

24. Attention

Yuste: Chapter 18

Purves: Chapter 27, 29

April 21<sup>st</sup>

25. Thinking

Yuste: Chapter 18

Purves: Chapter 32

April 26<sup>th</sup>

Test 3

April 28<sup>th</sup>

## **Recitation papers:**

January 17<sup>th</sup>-21<sup>st</sup>: No recitations

1. Jan 24<sup>th</sup>-28<sup>th</sup>:

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 31<sup>st</sup>-Feb 4<sup>th</sup>:

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 7<sup>th</sup>-11<sup>th</sup>:

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 14<sup>th</sup> -18<sup>th</sup>: No recitations, Test week

4. Feb 21<sup>st</sup>-25<sup>th</sup> :

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 28<sup>th</sup>-March 4<sup>th</sup>:

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 7<sup>th</sup> – 11<sup>th</sup>

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 14<sup>th</sup> -18<sup>th</sup>: No recitations, Spring break

7. March 21<sup>st</sup> - 25<sup>th</sup>:

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 28<sup>th</sup> - April 1<sup>st</sup> : No recitations, Test week

8. April 4<sup>th</sup> – 8<sup>th</sup> :

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](https://www.nature.com/articles/mn0898_304.pdf)

9. April 11<sup>th</sup>-15<sup>th</sup>:

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 18<sup>th</sup> – 22<sup>nd</sup> :

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 25<sup>th</sup> – 29<sup>th</sup>: No recitations, Test week