

BISC 462: Seminar in Synaptic development, plasticity and disease

Spring 2020

This course covers 15 papers on recent advances in our understanding of the molecular mechanisms that underlie synaptic development, synaptic plasticity and how dysregulation of these mechanisms give rise to brain-related disease. Each week one student will present an overview of the paper being discussed, and then another student will present one of the papers listed below. This student presenting the overview will be responsible for first framing the background that led to the publication, an explanation of the questions being addressed and the techniques/approaches being used. The second student will present the paper and lead a discussion on the papers relative merits and importance.

The following topics will be covered, along with the publications:

Topics:

1. Glutamatergic synaptogenesis
2. GABAergic synaptogenesis
3. Synaptic pruning
4. Molecular mechanisms of Long-term potentiation (LTP)
5. Synaptic Metaplasticity
6. LTP nuclear integration
7. LTP and memory
9. Addiction
8. Alzheimer's
10. Depression
11. Autism

Papers:

1. Kwon et al. "Glutamate induces de novo growth of functional spines in developing cortex." *Nature*, 2011. (January 23rd)
2. Oh et al. "De novo synaptogenesis induced by GABA in the developing mouse cortex." *Science*, 2016. (January 23rd)
3. Paolicelli et al. "Synaptic pruning by Microglia is necessary for normal brain development." *Science*, 2011. (January 30th)
4. Granger et al. "LTP requires a reserve pool of glutamate receptors independent of subunit type." *Nature*, 2013. (February 6th)
5. Murakoshi et al. "Local, persistent activation of Rho GTPases during plasticity of single dendritic spines." *Nature*, 2011. (February 13th)
6. Bosch et al. "Structural and molecular remodeling of dendritic spine substructures during Long-term Potentiation." *Neuron*, 2014. (February 20th)
7. Herring et al. "Kalirin and Trio proteins serve critical roles in excitatory synaptic transmission and LTP." *PNAS*, 2016. (February 27th)

8. Sadybekov et al. "An autism spectrum disorder-related de novo mutation hotspot discovered in the GEF1 domain of Trio." *Nature Communications*, 2017. (March 5th)
9. Harvey et al. "The spread of Ras activity triggered by activation of a single spine." *Science*, 2012. (March 12th)
10. Zhai et al. "Long-Distance Integration of Nuclear ERK signaling Triggered by activation of a few dendritic spines." *Nature*, 2013. (March 26th)
11. Yagishita et al. "A critical time window for dopamine actions on structural plasticity of dendritic spines." *Nature*, 2014. (April 2nd)
12. Pastuzyn et al. The neuronal gene Arc encodes a repurposed retrotransposon gag protein that mediates intercellular RNA transfer. *Cell*, 2018. (April 9th)
13. Hayashi-Takagi et al. "Labelling and optical erasure of synaptic memory traces in the motor cortex." *Nature*, 2015. (April 16th)
14. Roy et al. "Memory retrieval by activating engram cells in mouse models of early Alzheimer's disease." *Nature*, 2016. (April 23rd)
15. Ramirez et al. "Activating positive memory engrams suppresses depression-like behaviour." *Nature*, 2015. (April 30th)

Course Coordinator:

Bruce Herring, PhD
Assistant Professor, Neurobiology
bherring@usc.edu
Phone: (213) 740-6328
Office Hours: Wed 4 pm – 5 pm

Textbook: None

Time and Place: Thursday 2 pm – 3:50 pm, HNB 120

Grading: The grades for the course will be determined by the topic overview (30%), paper presentation (40%), class participation (10%), and questions (20%). Every student must bring 2 questions about the paper being presented to be discussed each class. After the class, the questions will be collected and graded.

Students with Disabilities: Students requesting academic accommodations based on a disability are required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP when adequate documentation is filed. Please be sure the letter is delivered to one of the instructors as early in the semester as possible. Disability Services and Programs is located in Student Union 301 and their phone number is (213) 740-0776.

Statement on academic integrity: USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.

Disclaimer: It may be necessary to make some changes in the syllabus during the semester.