

BISC 461- The Cellular Basis of Learning and Memory

Fall 2023

Prerequisite: BISC 421 or equivalent course.

This course covers 20 papers on the cellular basis of learning and memory. Each week a different student will present one of the papers listed below and will be responsible for explaining the technology used in the paper and the experiments that were performed. In addition, the student will lead a discussion on the relative merits of the paper.

The following papers will be presented:

Papers:

1. Kupfermann, I., Castellucci, V., Pinsker, H., and Kandel, E. R. (1970) Neuronal correlates of habituation and dishabituation of the gill-withdrawal reflex in *Aplysia*. *Science* **167**: 1743–1745.

Castellucci, V.F. et al. Cellular analysis of long-term habituation of the gill-withdrawal reflex of *Aplysia californica* (1978) *Science* 202:1306-8.
2. Morris, R.G.M. et al. Place navigation impaired in rats with hippocampal lesions (1982) *Nature* 297:681-683.

Morris, R.G.M et al. Selective impairment of learning and blockade of long-term potentiation by an N-methyl-D-aspartate receptor antagonist, AP5 (1986) *Nature* 319:774-776.
3. Malenka, R.C. et al. Postsynaptic Calcium is Sufficient for Potentiation of Hippocampal transmission (1988) *Science* 242:81-84.

Bayer, K.U. et al. Interaction with the NMDA receptor locks CaMKII in an active conformation (2001) *Nature* 411:801-805
4. Silva, A. J. et al. Deficient Hippocampal Long-Term Potentiation in α -Calcium – Calmodulin Kinase II Mutant Mice (1992) *Science* 257:201-206.

Silva, A. J. et al. Impaired Spatial Learning in α -Calcium-Calmodulin Kinase II Mutant Mice (1992) *Science* 257:206-211.
5. Phillips, R.G. and LeDoux, J.E. Differential Contribution of Amygdala and Hippocampus to Cued and Contextual Fear Conditioning 106:274-285.
6. Rogan, M. T. & LeDoux, J. E. LTP is accompanied by commensurate enhancement of auditory-evoked responses in a fear conditioning circuit. *Neuron* 15:127–136 (1995).

7. Martin, K.C. et al. Synapse-specific, long-term facilitation of alypsia sensory to motor synapses: a function for local protein synthesis in memory storage. (1997) **Cell** 91:927-38.
8. Maletic-Savatic et al. Rapid Dendritic Morphogenesis in CA1 Hippocampal Dendrites Induced by Synaptic Activity **Science** 283:1923-1927.

Engert, F. and Bonhoeffer, T. Dendritic spine changes associated with hippocampal long-term synaptic plasticity (1999) **Nature** 399:66-70.
9. Shi, S-H. et al. Rapid Dendritic Morphogenesis in CA1 Hippocampal Dendrites Induced by Synaptic NMDA receptor activation (1999) **Science** 284:1811-1815.

Matsuzaki, M. et al. Structural basis of long-term potentiation in single dendritic spines (2004) **Nature** 429:761-766.
10. Liu, X. et al. Optogenetic stimulation of a hippocampal engram activates fear memory recall (2012) **Nature** 484:381-385.
11. Ramirez, S. et al. Creating a False Memory in the Hippocampus (2013) **Science** 341:387-391.
12. Nabavi, S. et al. Engineering a memory with LTD and LTP (2014) **Nature** 511:348-351.
13. Grewe, B.F. et al. Neural ensemble dynamics underlying a long-term associative memory (2018) **Nature** 543:670-675.
14. Roy, D.S. Distinct Neural Circuits for the Formation and Retrieval of Episodic Memories.(2017) **Cell** 170:1000-1012.

Course Coordinator: Don Arnold RRI 204b P: 821-1266 F: (213) 821-1818
darnold@usc.edu Office Hours: M 2:00-3:00 PM

Textbook: None

Time and Place: 4:00-5:50 PM, RRI 221.

Grading: The grades for the course will be determined by the presentation (50%), class participation (10%) and questions (40%). Each week, every student must email 3 questions about each paper that is being discussed in that week's class to the instructor prior to the class. These questions will be graded and will constitute 40% of the final grade.

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 Dr. Arnold as early in the semester as possible. DSP is open Monday-Friday, 8:30-5:00. The office is in Student Union 301 and their phone number is (213) 740-0776.

COVID-19. Students are expected to comply with all aspects of USC's COVID-19 policy. Failure to do so may result in removal from the class and referral to SJACs.

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