Approaches to Understanding the Neurobiology of Learning and Memory
Biology 351; Fall, 2010

Instructor: John Kirn
phone: ext. 3494; email:jrkirn@wesleyan.edu

Class room: Shanklin 201

Class times: T,TH: 2:40-4:00 pm

Required readings: Selected reviews and original papers. Note: All readings will be available for downloading from the class “Blackboard”.

The goal of this course is to familiarize you with the many ways scientists have attempted to unravel the mystery of how the brain acquires and stores information. There is no "right" way to study this problem. Each approach has a unique set of advantages and disadvantages, at both conceptual and technical levels. However, the collective results from this field of study point to a remarkable degree of neuroanatomical and neurophysiological plasticity during learning and memory formation. The results suggest conceptual bridges between so called "innate" vs. “learned” behavior, and common threads linking adult brain plasticity, reorganization of the nervous system following brain damage, and brain development. These issues will be among the central themes of the course. One of the earliest readings will be from the work of D. O. Hebb, an early pioneer in the field. Throughout the semester, we will revisit the hypotheses of Hebb to see how well they have withstood the test of time and whether they need revision.

This seminar is a mix of lectures and student presentations. In both cases, the success of this course will be determined in part by the extent of student participation. Discussion will be expected, and is weighted accordingly in the grading. To encourage class participation, I ask that you do 2 things. First, read the assigned papers BEFORE class. Second, for each student presentation, bring in 3 questions you have from the reading assignment for that day. These questions can range from points of clarification to criticisms of the approach under investigation. Think about what is good and what is bad about a given approach, and what kind of experiment you would do next if you were the scientists doing the work.

You will also have the opportunity to present one of the assigned papers. You should prepare a 20-30 minute talk summarizing the key points of the research (see guide in Moodle). The remaining class time will be for discussion. There will be 2 in-class, essay exams. These will be in the form of published abstracts/papers that have had the Discussion Section removed by me. Your job will be to write the Discussion as if you were the experimenters; drawing from and integrating information you have learned from lectures, discussions, and readings.

You are also asked to write a 10-15 page paper (20 pages maximum) on one of the topics we will be examining (see guide in Moodle). The topic can be the same as the one for your presentation if you like, but it need not be. It should, however, be thorough and up to date, with a reference list of no fewer than 10 papers. The paper topic should be approved by me before Fall Break. The paper is due on November 23 by 5PM. No extensions will be granted. You are encouraged to submit a draft of your paper and I will make suggestions on how you might improve it. However, this draft can be submitted no later than November 11.
Grading: in class participation - 10%
class presentation - 20%
exams-20% each
paper-30%

Students with Disabilities:
It is the policy of Wesleyan University to provide reasonable accommodations to students with documented disabilities. Students, however, are responsible for registering with Disabilities Services, in addition to making requests known to me in a timely manner. If you require accommodations in this class, please make an appointment with me as soon as possible [during the nth week of the semester], so that appropriate arrangements can be made. The procedures for registering with Disabilities Services can be found at <http://www.wesleyan.edu/deans/disability-students.html>.

The readings for this course come from book chapters and the primary literature. Full references for texts used are:


Sept. 7 Orientation

A Conceptual framework for the course

Sept. 9 What is learning?

Sept. 14 How to study the neurobiology of learning and memory
Readings: Dudai, “The Neurobiology of memory": CH 3 (Biological universals)

Sept. 16 The Hebbian Synapse
Readings: D. O. Hebb, "The first stage of perception: growth of the assembly"

Systems Approaches: from simple to complex

Sept. 21 Aplysia
Readings: T. Carew, "Behavioral Neurobiology", CH 10 (Learning and memory in simple reflex systems in Aplysia)

Sept. 28  \textbf{Hippocampus--LTP and spatial memory}  
\textbf{Readings}: T. Carew, "Behavioral Neurobiology", CH 12 (Spatial navigation in rats)


Oct. 5  \textbf{Hippocampus-- Does it do more? Multiple forms of memory}  
\textbf{Readings}: H. Eichenbaum, "The cognitive neuroscience of memory" pg. 156-170, and 195-211


Oct. 12  \textbf{Exam 1}

Oct. 14  \textbf{The Cerebellum and skill learning-1}  
\textbf{Readings}: King & Thompson, “Skill Learning: The Role of the Cerebellum”

\textbf{Fall Break (Oct. 15-20)}

Oct. 21  \textbf{The Cerebellum and skill learning-2}  
\textbf{Readings}: King & Thompson, “Skill Learning: The Role of the Cerebellum”


\textbf{Learning and memory explored through studies of the ontogeny of brain/behavior}

Oct. 28  Experience guides sensory/motor development before and after birth.  
\textbf{Readings}: Black & Greenough, "Developmental Approaches to the Memory Process"


Nov. 4  \textbf{Bird Song Development}  
\textbf{Readings}: M. Konishi, "Birdsong: from Behavior to Neuron".

Embryology carried into adulthood

Nov. 11 Adult cortical map plasticity as a function of experience or injury


Nov. 18 Neurogenesis in adulthood


Nov. 23 Term Papers Due

Thanksgiving Break (Nov. 23-29)

Learning “Off-Line”

Nov. 30 Sleep / Dreaming and Learning
Reading: E. Kandel, J. Schwartz & T. Jessel, "Sleep and dreaming" pg. 936-947


Dec. 7 Course Overview

Dec. 9 Exam 2