BIOL 3409 Section 02 Neurobiology of Learning and Memory  
CRN: 37746

Time: M,W,TH 9:15-10:20 AM  
Location: Ryder Hall 296  
Instructor: Jamie G. Bunce, PhD  
Email: j.bunce@northeastern.edu *Email is the best way to reach me.
Phone: 617-373-6327  
Office hours: Tuesday and Friday 9:30-11:30AM  
Office: 382 Nightingale Hall (Please use the black phone at the entrance to the 3rd floor to dial my extension (x6327) and I will escort you to the office.
Prerequisites: BIOL 2301

Course Description:  
We will explore the neurobiology of learning and memory from the level of the synapse up to the neural systems underlying emergent mnemonic function. Topics include the synaptic mechanisms underlying neural plasticity; the molecular basis of mnemonic processes; and the neural circuits serving distinct memory systems. In addition to lecture based material, students will be introduced to the current scientific literature and will become proficient in reading, interpreting and evaluating primary research and review articles via presentations and active discussions in the classroom. The overarching goal of the course is to provide a neurobiological perspective on how information is encoded, consolidated and later retrieved and the significance of dysfunction in these processes associated with neurologic disease.

Learning Outcomes:  
1) Identify and describe key mechanisms, components and functions of memory and mnemonic systems

2) Describe fundamental concepts that apply to advanced topics in the neurobiology of learning and memory.

3) Evaluate, orally, current theories and relevant scientific research on advanced topics in neuroscience.

Class Web Site: Class documents, assignments, grades, and resources will be available on our Blackboard site, which also includes communication tools for the class. Check Blackboard regularly for updates and announcements.

Reading Assignments: There is no required textbook for this course. If you wish to have a resource to reinforce what we cover in class, I recommend the following textbook:

The Neurobiology of Learning and Memory (2nd Ed.) Jerry W. Rudy (2014).
We will read a number of primary research articles and reviews over the course of the semester. You will also have an opportunity to present a scientific article to the class as part of a small group. Please see “group presentations” below.

PDFs of articles will be posted on Blackboard. **Everyone, with the exception of those presenting the article that day, should post a write-up of the assigned article to Blackboard by 9PM the day before class.** Write-ups should include a brief summary of the article describing, in your own words, what the article was about and why it is significant. Additionally, write-ups should include a question that emerged from the article. Questions can include “muddy concepts” or “next steps” that would carry the research further.

**Class Format**

This course will consist of in-class lectures introducing topics and concepts as well as active discussions and activities pertaining to topics covered. Students will be introduced to the current scientific literature and will become proficient in reading, interpreting and evaluating primary research and review articles via in-class presentations and debates.

My lecture slides will be posted on Blackboard before class to help with note taking.

**Grading:**

Exams: 3 @ 60 % of final grade  
Quizzes: 3 @ 20 % of final grade  
Presentations @ 10% of final grade  
Write-ups: 10% of final grade

Exam and quiz format may consist of: Multiple choice (scantron), Short answer, Essay, Fill-in the blank, Matching, Problem Solving, and True/False.

Grades for the course will be on the ABCDF scale with +/- modifiers. It is anticipated that letter grades for this course will be assigned to the scale below.

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Course Policies:

This course follows the College of Science Academic Course Policies, which are viewable at this link:


Exam Policy: Students will only be allowed to use the following materials during an exam: writing utensils, plain white scrap paper, and a basic calculator (if necessary). Students will not be allowed to use text books, notes, cell phones, e-readers, tablets or laptops during the exam period. Students caught with any of these materials with receive and automatic zero for the exam. Students will have the allotted class time to complete exams. Exams will primarily cover material from the current period, though knowledge of fundamental concepts covered earlier in the semester will be assumed. Make up exams can be scheduled should you have an unavoidable health or personal emergency. Only one make up exam per student per semester will be offered. Please contact me as soon as possible if you have a conflict with an exam so we can make the appropriate accommodations for you.

Cell Phone Policy: If there is a problem or emergency please excuse yourself and step outside of the classroom to take or make a phone call. Students who are disruptive during the class period will be warned, and receive a 2% deduction from your final grade for each time the instructor needs to address you after the first warning.

Getting Help: Come to my office hours; make an appointment to see me at another time; email me with questions.

Peer tutoring: Students requiring additional help are advised to come to my office hours (see above) with questions. Peer tutoring is also available through the Peer Tutoring Program via this link: http://www.northeastern.edu/undergraduate/mentoring-advising/

Statement on Academic Integrity:

I adhere to Northeastern’s Policy on academic integrity:

http://www.northeastern.edu/osccr/academic-integrity-policy/

Academic dishonesty is a serious offense and renders the offender liable to disciplinary action. Students caught violating the policy will be penalized according to the severity of the offense. Possible penalties range from grade reduction to failure of the course.

Students with Disabilities: Accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resources Center (DRC), 20 Dodge Hall (x2675).
Class Web Site: Class documents, assignments, grades, and resources will be available on our Blackboard site, which also includes communication tools for the class. Check the site regularly for updates and announcements. Blackboard is also where you will be blogging (see below).
Topical Outline for Neurobiology of Learning and Memory

In the event that class is canceled, all due dates (e.g., exams, quizzes) will be shifted to the next class.

01/09-Lecture 1
Introductions to each other and the course
Four Themes in Research on the Neurobiology of Memory

01/11-Lecture 2  Chapter 1
Theoretical Concepts of Learning and Memory
Historical Influences

01/12-Lecture 3  Chapter 2
Neurons and Memory Circuits

01/16-NO CLASS MLK DAY

01/18-Lecture 4  Chapter 2
Synaptic Transmission

01/19-Lecture 5  Chapter 2
Synaptic Plasticity I

01/23-QUIZ #1

01/25-Lecture 6  Chapter 2 & 3 & 10
Synaptic Plasticity II: LTP/LTD

01/26-Lecture 7  Chapter 4
Generating and Stabilizing the Trace: Post Translational Processes
Signaling Molecules

01/30-Lecture 8  Chapter 5 & 6
Consolidating Synaptic Changes: Translation and Transcription

02/01-Lecture 9  Chapter 7 & 11
Maintaining the Consolidated Trace

02/02-Lecture 10  Chapter 7 & 11
Maintaining the Consolidated Trace II
Presentation 1: Ko et al., 2016; The role of nuclear PKMζ in memory maintenance

02/06-Catch up and Review

02/08-EXAM #1

02/09-Lecture 11  Chapter 12 & 15
Forgetting and Amnesia: What H.M. Taught us about the Hippocampus
02/13-Lecture 12  Chapter 15 & 17
The Medial Temporal Lobe Memory System

02/15-Lecture 13  Chapter 16
Hippocampus Indexing Theory
Pattern Separation and Completion

02/16-Lecture 14
Alzheimer’s Disease I

02/20-NO CLASS PRESIDENTS’ DAY

02/22-Lecture 15
Alzheimer’s Disease II
Presentation 2: Nagakura et al., 2013; Characterization of cognitive deficits in a transgenic mouse model of Alzheimer’s disease and effects of donepezil and memantine

02/23 Lecture 16
Alzheimer’s Disease III
Presentation 3: Kennedy et al., 2016; The BACE1 inhibitor verubecestat (MK-8931) reduces CNS beta-amyloid in animal models and in Alzheimer’s disease patients

02/27-Lecture 17
Alzheimer’s Disease IV
Presentation 4: Lu et al., 2014 REST and stress resistance in ageing and Alzheimer’s

03/01-QUIZ #2

03/02-Lecture 18  Chapter 13
Memory Modulating Systems

03/04-03/12 NO CLASS SPRING BREAK

03/13-Lecture 19  Chapter 19
Emotional Memory I: Fear Learning

03/15-Lecture 20  Chapter 19
Emotional memory II
Presentation 5: Quinones-Laracuente et al., 2015; The effects of repeated ethanol exposure on pre-existing fear memories in rats

03/16- Lecture 21  Chapter 19
Emotional memory III
Presentation 6: Young et al., 2015; 3, 4-Methylenedioxymethamphetamine facilitates fear extinction learning

03/20-Catch up and Review

03/22-EXAM #2
03/23- Lecture 22 Chapter 14
The Fate of Retrieved Memories

03/27- Lecture 23 Chapter 14
The Fate of Retrieved Memories II
Presentation 7: Vanvossen et al., 2016; Newly acquired and reactivated contextual fear memories are more intense and prone to generalize after activation of prefrontal cortex NMDA receptors

03/29- Lecture 24
Sleep and Memory

03/30- Lecture 25
Sleep and Memory II
Presentation 8: van de Ven et al., 2016; Hippocampal offline reactivation consolidates recently formed cell assembly patterns during sharp wave-ripples

04/03- Lecture 26 Chapter 18
The Corticostriatal Circuit: Actions and Habits

04/05- Quiz #3

04/06- Lecture 27 Chapter 18
The Corticostriatal Circuit: Actions and Habits II

04/10- Lecture 28
Hot topics: Physiological dynamics of Memory

04/12- Lecture 29
Hot topics: Physiological dynamics of Memory
Presentation 9: Curstidis & Poirazi, 2015; A computational study on how theta modulated inhibition can account for the long temporal windows in the entorhinal-hippocampal loop

04/13- Lecture 30
Hot topics: Physiological dynamics of Memory
Presentation 10: Yaffe et al., 2014; Reinstatement of distributed cortical oscillations occurs with precise spatiotemporal dynamics during successful memory retrieval

04/17 NO CLASS PATRIOTS’ DAY

04/19- Lecture 31
Wrap up and Review

EXAM #3 – (Held during finals week. Date, time and location TBA)

This syllabus is subject to change with notification.