



CBEN 411
Neuroscience, Memory, and Learning
8-9:15am Tuesday and Thursdays
Alderson 352
Spring 2016

Professor: Dendy Sloan, AH 452/ 303-273-3723/ esloan@mines.edu, Office hours by appointment

Guest Lecturer: Cynthia Norrgran, AH 241/ 303-273-3414/ cnorrgra@mines.edu

Required text: 1) Rudy, J.W., *The Neurobiology of Learning and Memory (2nd Ed)* Sinauer Associates, Sunderland, MA, (2014)

Supplemental texts: 2) Sloan, E.D., Norrgran, C.W., *Neuroscience, Memory, and Learning*, CreateSpace, Charleston, SC (2013)

3) Bourtchouladze, R., *Memories are Made of This*, Columbia University Press, New York, NY, (2002). Pdfs of the chapters are available on Blackboard.

Class Goal: The goal is to learn the neuroscience of memory and learning, and to apply that science to improve the process of learning.

Learning Objectives: At the conclusion of the class the successful student will:

1. State the history of neuroscience and psychology, and how they differ.
2. Define memory types and how they relate to different types of learning.
3. List the biochemistry of memory generation, stabilization, and maintenance.
4. State how brain systems relate to episodic and semantic memory.
5. List neuroscience bases for actions, habits, and fear (as one emotion example)
6. Determine the scientific bases for learning strategies
7. Generate and test hypotheses to improve learning, based on neuroscience.

Required Background

As a minimum, you should have the consent of the instructor (which may be obtained via email to esloan@mines.edu), if you have not studied the following CSM courses in biology, chemistry, and physics: BIOL110, CBEN303, CHGN121, CHGN122, PHGN100, PHGN200 . It will be very helpful to have studied CBEN 311, *Introduction to Neuroscience*. A pre-test will be given on the first day of class, to assess background

in the above science classes. The course may be modified based upon the pre-test outcomes. In some cases, students may be advised to enhance their background.

Learning Philosophy and Homework

To establish neuroscience learning patterns, you need substantial practice to reveal your knowledge gaps and what you need to work on. For each chapter of our text, I have posted homework on Blackboard, due at the start of class each Tuesday. Homework will be graded and returned the following Thursday. For each homework set only answer the open-ended “Study Questions. “You should not answer any of the “Fill-in-the-blanks,” “Short Answer,” “True/False,” or “Multiple Choice,” questions on the posted homework pages; these additional questions are useful for your exam reviews.

Learning Resources

The slides will be posted on Blackboard 24 hours before each class. Before class make notes on the portions you do not understand. You are encouraged to download the slides before each class to enhance your reading, bringing your annotated slides to class in hardcopy and/or on your laptop.

Evaluation

There will be **3 cumulative exams** on the science in our text, but **no final exam**. At the end of the class, you will present a final paper, in which you apply the neuroscience to suggest how to enhance your personal learning.

Tentative Exam & Homework Schedule and Values

| Exams | Material | Date | Value |
|----------------------------|---------------------------------------|--------------|-------|
| Homework | Chapters 1-19 | Each Tuesday | 15% |
| 1 | Chapters 1-8 | Feb 11 | 20% |
| 2 | Chapters 1-14 | Mar 10 | 20% |
| 3 | Chapters 1-19 & other course material | April 28 | 20% |
| Final Project Presentation | Application | May 05 | 20% |
| Reading assignments | See Following Table | Jan 19,21,26 | 5% |

Reading Assignment: Memories are Made of This

Five per cent (5%) of your final grade is based on the summaries of the Bourtchouladze book; *Memories are Made of This*. By 8am on each assigned date in the table below,

please email me a 1-page, single-spaced, typed summary of each assignment. Summaries will be graded pass/fail. Summaries should be sent to my email address, esloan@mines.edu, as a MS Word® file. You should entitle your document file using your last name and assignment number. Thus, for the first assignment if your name is John Doe, your document should be titled *Doe Assignment 1.doc*.

Schedule for Bourtchouladze Reading Assignments

| Assignment | Text Material | Due Date |
|------------|---------------|------------|
| 1 | Chapters 1&2 | January 19 |
| 2 | Chapters 3&4 | January 21 |
| 3 | Chapter 5 | January 26 |

Tentative Course Schedule

| DATE | TOPIC | READING |
|---------|--|----------------------|
| R 01/14 | Introduction to course; Biology pre-test | Chapter 1 |
| T 01/19 | Mechanisms of Synaptic Plasticity | Chpt 2: RB Chpts 1&2 |
| R 01/21 | Modifying Synapses: Central Concepts | Chpt 3: RB Chpts 3&4 |
| T 01/26 | Generating and Stabilizing the Trace: | Chpt 4: RB Chpt 5 |
| R 01/28 | Consolidating Synapse: Xcription & Xlation | Chapter 5 |
| T 02/02 | Consolidating Synapse: Specific Mechanism | Chapter 6 |
| R 02/04 | Maintaining the Consolidated Trace | Chapter 7 |
| T 02/09 | Toward a Synthesis | Chapter 8 |
| R 02/11 | EXAM 1 | |
| T 02/16 | Making Memories: Concepts & Methods | Chapter 9 |
| R 02/18 | Memory Formation: Early Stages | Chapter 10 |
| T 02/23 | Memory Consolidation | Chapter 11 |
| R 02/25 | Memory Maintenance and Forgetting | Chapter 12 |
| T 03/01 | Memory Modulation Systems | Chapter 13 |
| R 03/03 | No Class | |
| T 03/08 | The Fate of Retrieved Memories | Chapter 14 |
| R 03/10 | EXAM 2 | |

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|---------|---|------------------|
| T 03/15 | SPRING BREAK | |
| R 03/17 | SPRING BREAK | |
| T 03/22 | Memory Systems and the Hippocampus | Chapter 15 |
| R 03/24 | Hippocampus Index & Episodic Memory | Chapter 16 |
| T 03/29 | MTH System: Episodic & Semantic Memory | Chapter 17 |
| R 03/31 | Actions, Habits & the Cortico-Striatal System | Chapter 18 |
| T 04/05 | Neurobiology of Fear | Chapter 19 |
| R 04/07 | Your Place at the Neuroscience Table | Chapter 1 S&N |
| T 04/12 | The Biochemistry of Memory | Chapter 3 S&N |
| R 04/14 | Emotion, Fear & the Limbic System | Chapter 4 S&N |
| T 04/19 | Tools of Neuroscience | Chapter 6 S&N |
| R 04/21 | Attention and Consciousness | Chapter 7 S&N |
| T 04/26 | Memory, Models & Problem Solving | Chapters 8&9 S&N |
| R 04/28 | EXAM 3 | |
| T 05/03 | Application | Chapter 10 S&N |
| R 05/05 | Project Presentation | |