Course Description

As a scientific enterprise, the field of learning and memory has existed for a little over 100 years. For about the first 80 years, this field was essentially the sole province of experimental/cognitive psychologists. However, in the last 20 years the methods and concepts of biology and its sub-discipline, neuroscience, have been increasingly applied to the study of learning and memory. Scientists working in this multidiscipline field have produced a staggering amount of information about where and how experience leaves its mark on the brain, and new discoveries are made every week. So, we now have an exciting field that can be called the Neurobiology of Learning and Memory.

I created this course to introduce you to the methods, facts and concepts that are central to this field. This was a challenging task because it requires the integration of psychological methods, facts, and theory with the methods, facts and concept of neuroscience. The primary goal of this field of science is to reduce personal experience to brain products. It is fundamentally about where and how the brain stores the wealth of experiences that make us what we are as individuals.

Course Outline (Follows the Textbook)

1. Introduction: Fundamental Concepts and Historical Foundations

Part One. Synaptic Basis of Memories

3. Modifying Synapses: Central Concepts
4. Generating and Stabilizing the Trace
5. Consolidation of Synaptic Changes: Translation and Transcription
6. Consolidation of Synaptic Changes: Specific Mechanisms
7. Maintaining the Consolidated Trace
8. Toward a Synthesis

Part Two. Molecules and Memories

9. Making Memories: Conceptual Issues and Methods
10. Memory Formation: Early Stages
11. Memory Consolidation and Maintenance
12. Memory Maintenance and Forgetting
13. Memory Modulation Systems
Part Three. Neural Systems and Memory

15. Memory Systems and the Hippocampus
16. The Hippocampus Index and Episodic Memory
17. Hippocampal System: Episodic Memory, Semantic Memory, and Ribot’s Law
18. Actions, Habits and the Cortical-Striatal System
19. Learning about Danger: The Neurobiology of Fear Memories

The Textbook and Lectures

The textbook, *The Neurobiology of Learning and Memory*, is required and is the core of the course. It presents everything you need to know with the exception of a several supplements that cover new material presented in the lectures be The lectures are designed both to cover and amplify the material in the textbook. So the textbook and lectures are tightly coupled. One way in which the lectures amplify the text is by the use of animations that I created to bring to life some of the content presented in the textbook illustrations. Make sure you get the 2nd edition.

I have made PDFs of the PowerPoint lectures available on D2L These can be downloaded onto your computer and printed out. The recorded lectures however cannot be downloaded.

Recorded Lectures and Lecture PDFs

The lectures for this course are recorded and available on D2L. The lectures are in complete synchrony with the textbook and are designed to facilitate your understanding of the material presented in the textbook. Note that these lectures cannot be downloaded so you will need to have access to the Internet to view them. However, I have made PDFs of the PowerPoint lectures.

Glossary and Study Guide

In addition, the Glossary provided in the textbook also provides a convenient way to check on your understanding of the many of the key terms. I have also made a set of study guide questions for each chapter available on D2L.

Learning Philosophy and Self-assessments

I believe that to learn you need to take a lot of tests and practice outputting what you think you know. This will reveal your knowledge gaps and what you need to work on. To facilitate your practice, I have created a large amount of test material in the form self-assessments quizzes. These assessments cover the material presented in each chapter and lecture and are available on D2L. By repeatedly taking these assessments you will become aware of what you know and don’t known.

Success in this course depends on rapidly acquiring the new vocabulary that is needed to understand the concepts and principles that will be discussed. These self-assessments can play an important role in helping you acquire this new vocabulary.
The self-assessment questions are set up so that you can get immediate feedback after each question. To receive immediate feedback click on the hint button after you have entered your answer.

*You will not be graded on the self-assessments.* They are provided to allow you to monitor your progress in understanding the material.

**Advice and A Strong Word of Caution**

I strongly advise that you read each chapter prior to listening to the lecture. This will enable you to more fully benefit from the material presented in the lectures. Some lectures will include new material because this field is extremely dynamic. Where this is the case supplementary material is posted on CU Learn. I encourage you to take full advantage of the self-assessments that are available on CU learn.

This is a **challenging course** and will require a significant effort on your part. This is especially true for the Maymester version because the material is compressed into a very small time frame. We move rapidly through the material. However based on my experience last year it is manageable. However, you will have to become completely immersed in the course during this period. The problem for you is that you have no time to exhale. The good news is that just at the time we all will be running out of gas its over.

If you have signed up for this course just because it fits your schedule and/or you need an elective, you might look for another course. It is an advanced neuroscience course designed primarily for **neuroscience majors**. If you struggled with biology and Biopsychology then this may not be an appropriate course for you. It is quite common for about 15% of the class to drop this course. So, as soon as possible you should read Chapters 2-4 to determine if this course is for you. However, if you are interested in the content of this course and prepared to work I expect that you will have an enjoyable experience and learn a lot.

**COURSE MATERIAL**


**Class WEB Site: Desire to Learn (D2L)**

All course material will be available on the CU Learn Web site. This includes

- Recorded lectures (cannot be downloaded)
- PDFS of the Memories are Made of This Chapters
- PDFS of the lectures (can be downloaded)
- Study Guide (can be downloaded)
- Self assessments that will allow you to test yourself of the course material
- Supplementary material (can be downloaded)
Schedule of Classes, Exams and Reading Assignments

There will be **4 exams** plus a **final exam**. The exams are semi-cumulative (see **Tentative Exam Schedule and Values** table below)

**The final exam is cumulative.** It covers all of the material presented in the text and lectures.

### Table 1: Month of May Dates

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<tr>
<th>Date</th>
<th>Note</th>
<th>Chapters</th>
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**Reading Assignments**

This course is divided into 3 major sections. In the first section you will learn some of the basic principles and mechanisms of synaptic plasticity. In the second section you will learn how this principles and mechanisms have been exploited to reveal the molecular basis of memory. In the third section you will learn how components of the brain are organized to support different types of memories. For each section you will be required to read and write a summary of a basic research paper that is relevant to the general topic. Several papers on D2L that are relevant to each section. The schedule of for these assignments is also provided in Table 1 above.

**Evaluation Method**

### Exam Schedule and Values

<table>
<thead>
<tr>
<th>Date</th>
<th>Exam</th>
<th>Chapters</th>
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<td>May 26</td>
<td>Exam 4</td>
<td>Chapters 9-17</td>
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<td>May 29</td>
<td>Final</td>
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<td>All chapters</td>
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</tbody>
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Grading Scale

A   = 94-100%
A-   = 92-93%
B+  = 88-91%
B    = 83-87%
B-   = 80-82%
C+  = 78-79%
C    = 73-77%
C-   = 69-72%
D    = 58-68%
F    = < 58%

Optional Paper for extra credit. Due no later than June 2

You have the option of writing a paper for extra credit. The details are described below. This paper can be worth up to .5 a letter grade. For example it could change your grade from a B to B+.

Optional Research Paper

For the research paper I want you to pick an interesting question/issue that is directly related to the topic. In your research paper I want you to discuss in detail 3 research reports that you have read related to your topic. These research reports need to be primary reports of scientific empirical studies (reports that include the Methods and Data/Results of a research project) that are published in scientific journals, i.e. you need to read the original reports, not just review papers that discuss the original reports. You should, however, supplement your paper with additional information that you obtain from books and review papers related to your topic (see Bibliography and Citations below). Your paper should be 8-10 double-spaced pages long.

I'd like you to divide your paper into 3 sections.

(20 points) Section 1: Introduction and Background (2-3 pages). Introduce the topic of your paper. Describe the question/issue that you have chosen to research. Why is this question/issue important to study? Does it have theoretical importance? Does it have practical or applied importance? How does this question/issue pertain to our course in which we are studying hormone/behavior interactions? What in general is already known about your topic (i.e. what are the results of research besides the 3 studies that you are reviewing?)? Give the reader any additional background information/education that they will need to be able to fully appreciate your paper. Assume that your audience is a fellow classmate in our Neurobiology of Learning and Memory class. Define any key terms or concepts that we have not covered in class.

(45 points) Section 2: Review of Related Research Reports (3+ pages). In this section review each of the 3 empirical studies that you have read. Importantly, please attach a photocopy of the first page of each article to
the back of your paper if they are different from the ones that you attached with your outline (see below). For each study:

1) describe the purpose/aim of the study. i.e. what was the research question, or what was the study trying to find out?

2) what was the researcher's hypothesis? i.e. what did the authors predict or suggest would be the outcome of their study? Note, some studies may be more "descriptive" in nature, and consequently the authors may not offer a hypothesis. Instead the authors may merely state that they wanted to find out what will happen if they do such and such. If this is the case, state it.

3) what was the rationale for the hypothesis? What reason do the authors give for making the hypothesis that they make? Or, if there is not a hypothesis, what reason do the authors give for why they did what they did?

4) give a brief description of the experimental design/procedure. Important details are who/what were the subjects. How were subjects selected. What was the experimental procedure. **What were the independent variables and what were the dependent variables (I will deduct points if you don’t include this, or don’t state it correctly).** Anything else that you think is important for understanding the particular study.

5) what were the basic results? This doesn't need to be much more detailed than the description of the results that the authors included in the abstract (but use your own words!). So, there is no need to report numbers, etc. Instead describe the basic effects, e.g. "there was a large increase in the number of words that were recalled by individuals treated with snake oil".

6) what conclusions did the authors make from their data?

7) do the data support the conclusions? Can you think of flaws in the experimental design that may lead to confounding effects. Can you think of alternative hypotheses or explanations that fit the data as well as the author's conclusions/interpretations?

(20 points) **Section 3: Conclusion (2-4 pages).** In this section make an attempt to be especially sophisticated and insightful! Essentially all you have to do to accomplish this is to thoughtfully discuss the impact that the 3 studies you have chosen have made on the research question/issue that is the focus of your paper. Have these studies led to new information? Have these studies led to a better model for thinking about the question/issue? Are the studies consistent with each other? Perhaps by integrating/synthesizing the results of these studies you can propose a new model not discussed in any of the papers that you have read on the topic.

Finally, what do you recommend that future studies on this topic should examine? What remains unresolved?

(5 points) **Bibliography and Citations:** Your bibliography (reference list) should include the 3 articles that you have reviewed as well as any other articles/books that you have read and refer to within your paper. Within the text cite only articles/books that you have read (or at least skimmed). So, every article/book in your bibliography should be cited somewhere in the text, and conversely, every cited article/book in your text should also appear in your bibliography. **I expect that you will need to use 8-15 sources for your paper.**

(10 points) **Overall mechanics of the paper:** Make sure that your paper is well formatted, that all words are properly spelled, and that you have used good grammar. Take pride in your work!
Finally, **don't use quotations**. You should always be able to adequately paraphrase what someone else writes.

**Disabilities:** I encourage students with disabilities, including non-visible disabilities such as chronic diseases, learning disabilities, head injury and attention deficit/hyperactive disorder, psychiatric disabilities, to discuss with me, after class or during my office hours, appropriate accommodations.

**Honor Code:** Please note that I believe that a person’s integrity is one of their most important attributes. Consequently, I fully support the University’s Honor Code: if I find that someone has cheated on an exam (e.g. looking at someone else’s exam) or on the research paper (e.g. plagiarism) I will give that person an “F” for the course and file a report of academic dishonesty with the Dean’s office.