

PSY492H1 S

Neurobiology of Learning and Memory

Winter 2025 Syllabus

Course Meetings

PSY492H1 S

Section	Day & Time	Delivery Mode & Location
LEC0101	Thursday, 2:00 PM - 5:00 PM	In Person: SS 1085

Refer to ACORN for the most up-to-date information about the location of the course meetings.

Course Contacts

Instructor: Professor Kaori Takehara-Nishiuchi

Email: kaori.nishiuchi@utoronto.ca

Office Hours and Location: Virtual, by appointment only

Additional Notes: You can ask questions during the lectures, post them on “Discussions” in Quercus, or email me via Quercus. If you need to discuss any other issues and concerns, please make an appointment for a virtual individual meeting via email via Quercus. I will try my best to reply to emails within three business days.

Course Overview

Understanding the complexities of how the mammalian nervous system acquires and stores information and how it transforms this information into appropriate behavior is fundamentally important to our understanding of both animal and human behavior. This lecture course explores empirical and theoretical contributions to our understanding of the neural basis of learning and memory.

This course will review the present understanding of genetic and physiological changes in the brain when animals acquire new information and form stable memory traces. It will cover the basic physiology and molecular biology of neurons and explain how neurons change gene expression, structures, and activity patterns as animals form, stabilize, and recall different types of memory.

Course Learning Outcomes

By the end of this course, you will be able to understand the present views on the biological mechanisms underlying learning and memory and use this knowledge to evaluate new findings critically.

Prerequisites: PSY201H1/ ECO220Y1/ EEB225H1/ GGR270H1/ IRW220H1/ POL222H1/ SOC202H1/ STA220H1/ STA238H1/ STA248H1/ STA288H1/ ECO220Y5/ PSY201H5/

STA215H5/ STA220H5/ PSYB07H3/ STAB22H3/ STAB23H3/ STAB57H3, **and one of** PSY260H1/ PSYB38H3 **or** PSY290H1/ PSY290H5/ PSYB64H3/ HMB200H1/ PSL300H1

Corequisites: None

Exclusions: None

Recommended Preparation: None

Credit Value: 0.5

Course Materials

Textbook: *The Neurobiology of Learning and Memory 3rd edition*, Jerry W Rudy (2020)
Sinauer (I do not recommend using the 1st or 2nd edition.)

Marking Scheme

Assessment	Percent	Details	Due Date
Term Test 1	20%		2025-02-06
Term Test 2	20%		2025-03-13
Term Test 3	25%		2025-04-03
In-class thought paper 1	3%		2025-01-30
In-class thought paper 2	2%		2025-03-06
Research proposal	30%		2025-03-20

Term tests: The tests will cover any topics that were explained during the lecture. Tests 1 and 2 are not cumulative; however, Test 3 will contain questions on the topics covered in any lectures during the semester.

In-class thought paper: This paper is designed to improve your ability to identify flaws in experimental designs. It will serve as practice before the tests and submission of the research proposal. During the class on January 30th and March 6th, I will present a case study in which a flaw exists in the experimental design or interpretation of the results. Subsequently, you are required to write a 1-page paper that describes the flaw and proposes a new experiment to address it. The paper will receive 2.5% as far as it includes the required information.

Research proposal: This assignment provides you with an opportunity to conduct independent research on one of the major topics in learning and memory research. You will propose an experiment (or a series of experiments) to address a remaining question in one of the following topics:

- Memory engrams

Memory engrams: Recalling the past and imagining the future, Josselyn SA, Tonegawa S, Science, 2020; 367(6473):eaaw4325

- Memory consolidation during sleep

Sleep — A brain-state serving systems memory consolidation, Brodt S, Inostroza M, Miethard N, Born J, Neuron, 2023; 111(7), 1050-1075

- Epigenetics in memory

How the epigenome integrates information and reshapes the synapse, Campbell RR, Wood MA, Nature Reviews Neuroscience, 2019; 20(3), 133-147

To complete this assignment, you must follow the following steps:

Step 1: You need to choose one from the three topics shown above and read the review paper assigned to the topic of your choice.

Step 2: You need to choose one primary research article among those cited in the review paper and read it thoroughly.

Step 3: You then summarize 1) how previous findings led to the hypothesis in the chosen primary research article, 2) what the chosen primary research article showed, and 3) what it did not show (i.e., the remaining question).

Step 4: You need to formulate a hypothesis to address the remaining question.

Step 5: By modifying the design of the experiments in the chosen primary research article, you design a new experiment to address the remaining question and think of the expected outcome and its implication for your hypothesis.

The research proposal should be organized in the following format:

- Introduction (~3 pages)

This section summarizes the background and main findings of the chosen primary research article. It should also describe what the chosen article showed and what it did not show. It then ends with a clear statement showing the remaining question that your experiments will address.

- Methods (~3-4 pages)

This section describes detailed procedures of the proposed experiments, including participants/subjects, behavioural paradigms, control and experimental groups, and outcome measures. You need to clearly indicate which parts were modified from the original experiment in the chosen primary research article and why.

- Results (~3-4 pages)

This section describes what kind of results you are expecting to observe. You are encouraged to include figures that depict the expected results.

- Discussion (~1 page)

In this final section, you interpret the expected results and discuss their meaning for the original question.

The proposal will be evaluated based on the following criteria:

Importance of the main hypothesis --- The introduction summarizes sufficient background information to demonstrate why your main hypothesis is important.

Effectiveness of experiment(s) --- Sufficient justifications are provided to evaluate whether the proposed experiment is the best way to address the hypothesis.

Logic of expected outcome --- Expected results are logical and are thoroughly explained.

Novelty of research --- No previous publication uses the same methodologies and approaches for addressing the same hypothesis.

Your papers should be a minimum of 10 pages and a maximum of 12 pages (double-spaced pages excluding a cover page and list of references). Please use 12-point font and 1-inch margins. Include a cover page (with your name and student number) and an APA-style reference for cited articles. You must submit your proposal via Quercus by **1 pm on March 20th**.

Missed tests

You will lose all the marks assigned to a test if you miss it. If you have legitimate excuses, such as a documented family emergency and documented illness, the documents need to be submitted within one week of the missed test. In this case, the score for the other tests will be used to substitute for the score for the missed test. The mark for the written assignment cannot be used as a substitute for the mark for the missed test. Therefore, if you miss all three tests, you will receive a mark of zero for the test component. There will be no make-up test.

Penalties for Lateness

The research proposal is due at 1 pm on March 20th. The request for the deadline extension for the writing assignment must be submitted at least three business days before the deadline. It should be accompanied by legitimate excuses, such as family emergencies, illness, and religious holidays. The penalty for late submission without a pre-approved extension is a reduction of 10% of the maximum mark for each business day the assignment is late. The clock starts at 1:01 pm on March 20th. Therefore, an assignment submitted more than ten business days after the deadline will have a mark of zero recorded for that assignment. The test component of the mark cannot be used as a substitute for the mark for the research proposal.

Late Assessment Submissions Policy

The research proposal is due at 1 pm on March 20th. The penalty for late submission without a pre-approved extension is a reduction of 10% of the maximum mark for each business day the assignment is late.

Course Schedule

Week	Description
Week 1 January 9th	Overview of the course, concepts, and history of the neurobiology of learning and memory (Chapter 1)
Week 2 January 16th	Review of basic molecular biology and physiology, modifiable synapses underlying simple memory (Chapters 2, 3, 8)
Week 3 January 23rd	Episodic memory1 – Acquisition: Brain systems (Chapters 9, 10, 16, 17)
Week 4 January 30th	Episodic memory2 – Acquisition: Physiological process (Chapters 3, 9, 10, 14) In-class thought paper 1
Week 5 February 6th	Midterm test 1
Week 6 February 13th	Episodic memory 3 – Acquisition: Molecular process (Chapters 3, 4, 9, 10, 14)
Week 7 February 27th	Episodic memory 4 – Consolidation and maintenance: Brain systems (Chapters 17, 18)
Week 8 March 6th	Episodic memory 5 – Consolidation and maintenance: Molecular process (Chapters 5, 6, 7, 8, 11, 13) In-class thought paper 2
Week 9 March 13th	Midterm test 2
Week 10 March 20th	Associative memory (Chapters 15, 20) Research proposal due

Week 11 March 27th	Memory modulation and skill learning (Chapters 12, 19)
Week 12 April 3rd	Midterm test 3 (cumulative)

Policies & Statements

Re-marking Policy - Timeline and Protocol

The grade will be posted in Quercus within two weeks of the test. TA will have an office hour to view marked tests on the week the grade has been posted. Any questions about the grading should be asked by sending an email via Quercus within two weeks of receiving the grade. In the email, please explain your concerns logically. If your concern sounds reasonable, I will schedule an individual meeting to re-evaluate your mark. Please note that the re-evaluation potentially lowers your mark.

Religious Accommodations

As a student at the University of Toronto, you are part of a diverse community that welcomes and includes students and faculty from a wide range of cultural and religious traditions. For my part, I will make every reasonable effort to avoid scheduling tests, examinations, or other compulsory activities on religious holy days not captured by statutory holidays. Further to University Policy, if you anticipate being absent from class or missing a major course activity (such as a test or in-class assignment) due to a religious observance, please let me know as early in the course as possible, and with sufficient notice (at least two to three weeks), so that we can work together to make alternate arrangements.

Students with Disabilities or Accommodation Requirements

Students with diverse learning styles and needs are welcome in this course. If you have an acute or ongoing disability issue or accommodation need, you should register with Accessibility Services (AS) at the beginning of the academic year by visiting <https://studentlife.utoronto.ca/departments/accessibility-services/>. Without registration, you will not be able to verify your situation with your instructors, and instructors will not be advised about your accommodation needs. AS will assess your situation, develop an accommodation plan with you, and support you in requesting accommodation for your course work. Remember that the process of accommodation is private: AS will not share details of your needs or condition with any instructor, and your instructors will not reveal that you are registered with AS.

Specific Medical Circumstances

If you become ill and it affects your ability to do your academic work, consult me right away. Normally, I will ask you for documentation in support of your specific medical circumstances. This documentation can be an Absence Declaration (via ACORN) or the University's Verification of Student Illness or Injury (VOI) form. The VOI indicates the impact and severity of the illness, while protecting your privacy about the details of the nature of the illness. If you cannot submit a VOI due to limits on terms of use, you can submit a different form (like a letter from a doctor), as long as it is an original document, and it contains the same information as the VOI (including dates, academic impact, practitioner's signature, phone and registration number). For more information on the VOI, please see <http://www.illnessverification.utoronto.ca>. For information on Absence Declaration Tool for A&S students, please see <https://www.artsci.utoronto.ca/absence>. If you get a concussion, break your hand, or suffer some other acute injury, you should register with Accessibility Services as soon as possible.

Academic Integrity

All suspected cases of academic dishonesty will be investigated following procedures outlined in the [Code of Behaviour on Academic Matters](https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) (<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019>). If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to me. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources. For example, to learn more about how to cite and use source material appropriately and for other writing support, see the U of T writing support website at <http://www.writing.utoronto.ca>. Consult the Code of Behaviour on Academic Matters for a complete outline of the University's policy and expectations. For more information, please see [A&S Student Academic Integrity](https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity) (<https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity>) and the [University of Toronto Website on Academic Integrity](https://www.academicintegrity.utoronto.ca) (<https://www.academicintegrity.utoronto.ca>).

Generative artificial intelligence tools

The use of generative artificial intelligence (AI) tools, including ChatGPT and other AI writing assistants, for the completion of or to support the completion of any assignments in this course is prohibited. Representing an idea that was AI-generated as one's own idea may be considered an academic offense in this course.

Equity, Diversity and Inclusion

The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

Departmental Guidance for Undergraduate Students in Psychology

The Department of Psychology recognizes that, as a student, you may experience disruptions to your learning that are out of your control, and that there may be circumstances when you need

extra support. Accordingly, the department has provided a [helpful guide](#) to clarify your and your instructor's responsibilities when navigating these situations. This guide consolidates Arts & Science Policies for undergraduate students in one place for your convenience. As an instructor in the department, I will frequently consult with these recommendations when providing you with support, and I recommend that you also consult it to learn more about your rights and responsibilities before reaching out to me.

Quercus Info

This Course uses the University's learning management system, Quercus, to post information about the course. This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. New information and resources will be posted regularly as we move through the term. To access the course website, go to the U of T Quercus log-in page at <https://q.utoronto.ca>. SPECIAL NOTE ABOUT GRADES POSTED ONLINE: Please also note that any grades posted are for your information only, so you can view and track your progress through the course. No grades are considered official, including any posted in Quercus at any point in the term, until they have been formally approved and posted on ACORN at the end of the course. Please contact me as soon as possible if you think there is an error in any grade posted on Quercus.

Course Materials, including lecture notes

Course materials are provided for the exclusive use of enrolled students. These materials should not be reposted, shared, put in the public domain, or otherwise distributed without the explicit permission of the instructor. These materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Students violating these policies will be subject to disciplinary actions under the Code of Student Conduct.