

Course: Neurobiology of Learning, BIOL 506

Instructor/coordinator: Aparna Suvrathan

Date and time: TBD, 2 classes/week during the Fall semester, each for 1.5 hours.

Context:

Advanced neuroscience course for undergraduate students in their final year and graduate students. Prerequisites BIOL 306 or NEUR 310 or NSCI 200 and NSCI 201 or PHGY 311 or PHGY 314 or permission of instructor. Limited to 18 students, including both undergraduate and graduate students.

Description:

This course explores the neurobiological basis of learning, from molecules to circuits. The focus of this course is the synaptic, cellular and circuit-level processes that support learning, in the context of different brain regions and forms of learning. The course is divided in three sections. The first section will be lecture based, providing a framework of the current state of knowledge in the field. A perspective on current research at McGill is provided by five guest lecturers who discuss their own findings. The second section will involve critical analysis and presentation of recent literature by students, with students choosing from a list of papers that is provided. In the third section, students will identify gaps in current knowledge and propose research to address them. 3-credit course.

Learning outcomes:

1. Understand key concepts in the field of learning, ranging from a historical perspective to recent discoveries and current theories.
2. Know how different circuits within the brain implement learning.
3. Think about learning with a broad perspective that includes findings at molecular, cellular and circuit levels.
4. Critically evaluate current literature on the topic.
5. Identify gaps in current knowledge and propose future research to address them.

Course material:

No required textbook. Reading materials will be uploaded by instructor.

Assessment:

1. One mid-term exam after the lecture section of the class (20%)
2. Research paper presentation/discussion (30%)
3. Research proposal (15% presentation, 25% written proposal)
4. Participation (10%)

Mid-term exam (20%)

On the lecture materials covered in class, after the first section. This will be an in-person exam. The exam will be designed to be completed in 1.5 hours.

Research paper presentation/discussion (30%)

The goal of the **second module** is to read, discuss, and critically evaluate current literature in the field of learning and memory. Students, in teams of 2, will select a primary research paper from a list provided by the instructor, introduce the topic and lead the discussion in class. All students are expected to have read the paper and to be ready to participate in the discussion. The presentations will be followed by a discussion of the merits, limitations, and future potential of each research paper.

The presentations should include the following sections:

- (1) A general introduction to the subject, why it is important, and a clear statement of the open questions addressed by the paper.
- (2) Presentation of the results and the key methods used to obtain them.
- (3) Discussion of the conclusions and implications, as well as of the merits, potential shortcomings and future directions of the paper.

The presentation + discussion should take a maximum of 1 hour 20 min. Evaluation will be based on a grading rubric that will be provided.

Research proposal (15% oral presentation, 25% written)

During the **third module**, students will design research addressing an open question in the field of learning. Working in groups of 3, they will develop a research proposal, under the close guidance of the instructor. The proposal should be limited to 4 pages (not including figures and references), and include the following sections:

- (1) An up to 250-word abstract.
- (2) A brief literature review justifying the proposed project.
- (3) The specific aims of the research/hypothesis.
- (4) Significance of the research in a broader context.
- (5) A research plan, with details how the specific aims will be achieved and what the expected outcomes are.

Students will present their proposals in presentations in class, the written proposal will be due one week after the end of class. The written proposal will be graded according to the provided rubric. The team will receive the same grade for the written section. This section is designed to give the additional benefit of training in peer review (both giving and receiving it) and developing skills for team-work. Working in teams towards a common goal is a core feature of interdisciplinary scientific research today.

Participation (10%).

Students are expected to actively participate in class, to have read the papers that are being discussed, to be ready to present figure panels during primary research article presentations.

Asking questions and contributing to discussions is important (during class, and/or on online discussion board).