DALHOUSIE UNIVERSITY

COURSE SYLLABUS

NESC 4185 & PHYL 4000
Synaptic Function & Plasticity
Department of Physiology & Biophysics
Fall 2026

Dalhousie University operates in the unceded territories of the Mi'kmaw, Wolastoqey, and Peskotomuhkati Peoples. These sovereign nations hold inherent rights as the original peoples of these lands, and we each carry collective obligations under the Peace and Friendship Treaties. Section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights in Canada.

We recognize that African Nova Scotians are a distinct people whose histories, legacies, and contributions have enriched that part of Mi'kma'ki known as Nova Scotia for over 400 years.

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Course Information

Course Description: In this course we analyze and discuss research publications in cellular and systems neurophysiology. Specific topics covered are mechanisms of neurotransmission, Hebbian and homeostatic plasticity, modulation of excitability, dendritic integration of synaptic input, and neural circuits. Emphasis is placed on current research questions in these areas and methodologies used to address them.

Prerequisites: Either NESC/PSYO/PHYL 2570 or PHYL 2041 or permission of course instructor.



Credit Value:
3



Learning Modality:
In-person



Format:
Seminars; discussion-focused

Template last updated: 2026.09.14

Time: Mondays 2:35 pm – 17:25 pm

Location: Carleton Dentistry, Room 1206

Course Learning Outcomes

Comprehension of cellular neurophysiology

After completing this course, you will be able to:

- Describe instances in which regulation of neurotransmitter receptor transcription, posttranslational modification, trafficking and protein interactions affect synaptic transmission.
- Characterize regulatory mechanisms altering neurotransmitter release.
- Specify mechanisms and consequences of Hebbian plasticity (LTP, LTD, STDP).
- Outline instances and potential mechanisms of homeostatic plasticity.
- Discuss how the morphological plasticity of synapses contributes to the experience-dependent adaptation of cortical circuits.
- Explain how the excitability of neurons is dynamically regulated.
- Dissect how dendritic integration of synaptic input is modulated.
- Illustrate methodologies allowing the classification of neurons and the identification of their afferent and efferent connections.
- Discuss the function of place cells and grid cells in hippocampus and entorhinal cortex, respectively.

Analytical and communication skills

When given a research publication in cellular neurophysiology, you will be able to:

- Recognize and independently investigate unfamiliar concepts and methods.
- Determine appropriate experimental approaches to address a research question in cellular neurophysiology and identify the limitations of and alternatives to the chosen methodologies.
- Critically evaluate the scientific results and assess the validity of their interpretation.
- Place the study's findings in the context of previous work to assess their novelty and significance.
- Identify unresolved gaps in knowledge or new research questions uncovered by the study and devise experimental approaches to confront them.
- Communicate the context, rationale, and outcome of scientific studies in oral presentations.

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Instructor Information



Instructor: Stefan Krueger
Email: stefan.krueger@dal.ca
Office: Tupper Building, Lab 5F

Student Drop-in Hours: ADD days, times, and format (e.g., in-person, virtual/Teams). If virtual, include the hyperlink.

Communications

For effective email communications, please use your Dalhousie email address. I will respond to your questions within 24 hours on weekdays and 48 hours on weekends.

Course Resources & Tools

To successfully complete this course, you should have access to a computer with a reliable internet connection and Microsoft Office for Windows/Mac.

Brightspace Course Site

The course site on Brightspace serves as platform for resources and communication. Links to discussed publications are posted on this site. Students use a collaborative online notebook to collect potential learning issues and post their learning issue responses. Suggestions on how to efficiently perform a literature search on a specific topic, compose learning issue responses and structure paper presentations are also available on Brightspace. In addition to the Brightspace site, students can use a number of different resources. Textbooks such as *Neuroscience* from Dale Purves et al. (Sinauer) or *Neuroscience. Exploring the Brain* from Mark Bear and collaborators (Lippincott) are great for background readings and general information. Copies of both books are available at the Killam Library. For learning issues, students will study research publications and reviews available electronically via the university library system.

Please note that only students registered in the course are permitted to view, download, upload, comment, or otherwise participate in the course site. **You do not have permission to upload course materials to external/third-party websites.**

While you may be able to access the course from your phone, a desktop computer or laptop is recommended. **Brightspace functions best when using Google Chrome.**

If you need assistance with Brightspace or other online learning technologies, submit an online ticket at https://service.portal.dal.ca or call 902-494-4357 (toll-free 1-800-869-3931).

Course Assessments

In-class Assignments

-- One or two presentations of research publications[*,#] (weight 12% for each presentation)
-- One or two responses to an extensive learning issue[**,#] (12% for each response)
-- 4 regular learning issue responses[**] (6% for each response, 24% total)
-- Participation: Leading the discussion for three presentations of other students (6% for each), as well as participation in other discussions (4%; for a total participation grade of 10%)

[#] Students presenting only one paper will be assigned two extensive learning issues.
* Presentations of research publications will be scheduled during the first class.
** Learning issue responses will be assigned on Saturday before each seminar.
Please refer to Brightspace for information on how to complete the various assignments.

Final exam

The final exam is held during exam time and has a weight of 30%. The exam will be held in-person and is "open-book". Hardcopies of course material, notes, cheat sheets etc. are allowed. No electronic equipment (computers, tablets, phones) can be used unless stipulated by your personal accommodation plan.

If an assessment may result in a barrier or does not align with your formal academic accommodations, reach out to me to collaboratively find a solution that meets your needs.

Numerical grades will be converted to final letter grades following Dalhousie's undergraduate grading scale:

A+ (89.50 – 100)	A (84.50 - 89.49)	A- (79.50 - 84.49)	B+ (76.50 - 79.49)
B (72.50 - 76.49)	B- (69.50 - 72.49)	C+ (64.50 - 69.49)	C (59.50 - 64.49)
C- (54.50 - 59.49)	D (49.50 - 54.49)	F (0 - 49.49)	

Participation and Attendance Requirements/Expectations: The seminars in this course crucially depend on student participation through paper presentations and learning issue responses. Students should generally attend all seminars, regardless of whether they present an assignment or not. If you know well ahead of time that you will be unable to attend a certain seminar, inform me so that you do not receive an assignment for that date. If you miss a seminar due to a sudden illness or other unforeseen circumstances, contact me ahead of the seminar if possible.

Use of Generative AI: You are welcome to use AI tools in this course, **except during the in-person final exam**. If you do use an AI assistant for an assignment like a learning issue, use it for your initial research, not to generate your response. **Disclose which AI tool has been used in the research** and ideally list the prompts that you have used. Please be aware that current AI assistants do actually NOT know everything, although they certainly will pretend to do so. Large Language Models are trained on material that is available to the general public and may miss knowledge that is not, like research publications in

academic journals that have paywalls. For this reason, you will **have to verify all AI-generated information**. You are responsible for the accuracy of the information. When referencing information, you cannot refer to an AI tool. Rather, you **need to reference the original source of this information**.

Accessibility: Refer to the Student Accommodation Policy for information on how Dalhousie instructors and staff work collaboratively with students to create an accessible educational environment.

- **If there are aspects of this course, including but not limited to its design, teaching approaches, learning activities, and assessments, that result in barriers to your learning or do not align with your formal academic accommodations, reach out to me to collaboratively find a solution that meets your needs.**
- You are eligible for accommodations based on protected characteristics such as religion. If you have religious, cultural, or community-significant observances that conflict with course requirements, reach out to me to collaboratively find alternatives for completing the course requirements.
- To begin the process of requesting a formal academic accommodation, contact the Student Accessibility Centre (or the Student Success Centre for Faculty of Agriculture courses).
- Your classroom may contain accessible furniture and equipment. It is important that these items remain in the classroom, undisturbed and unused, so that classmates who require their use will be able to fully participate in the course.

Academic Integrity: Dalhousie expects all students to be responsible learners, demonstrating the values of intellectual honesty, trust, fairness, and respect in your work. Key aspects of academic integrity include, but are not limited to: Avoiding plagiarism, not engaging in cheating, submitting original work, and acknowledging sources of information and ideas when they are not your own. Refer to the Statement on Intellectual Honesty for definitions of various academic offences. Failure to meet Dalhousie's academic integrity standards will result in appropriate disciplinary and/or corrective measures.

Missed and Late Assessments: Seminars crucially depend on in-person presentations of assigned paper presentations and learning issue responses. **Avoid late assignments by planning ahead**. If you know that you will be absent for a particular seminar or will be having a high workload during a particular week, ask me not to assign a presentation or learning issue to you. If you miss a seminar due to a sudden illness or other unforeseen circumstances, the following policies apply:

- Learning issue responses, if completed before the missed seminar, can be submitted online ahead of the seminar and will then be discussed in class in your absence. You will be graded on the assignment without penalty.
- If the learning issue response is not completed, you may submit the response late. The grade obtained will be reduced by 20%.
- Presentations of research publications **CANNOT** be postponed or merely submitted as video or Powerpoint presentation. If you are unable to deliver your presentation in-person during the seminar, you will not receive a grade for this assignment, and the final exam will be weighted more heavily in the calculation of the overall grade to compensate for the missed presentation.

Tentative Course Schedule

Refer to Dalhousie's Important Dates for holidays and academic dates such as course add, drop, and withdrawal dates.

Week #	Class Date	Topics
1	Sep 14	*Course Orientation*
2	Sep 21	Regulation of neurotransmitter release
3	Sep 28	Neurotransmitter receptors
4	Oct 5	Synaptic cell adhesion and scaffolding proteins
	Oct 12	*No class (Thanksgiving)*
5	Oct 19	Synapse-specific plasticity: LTP, LTD and spike-timing dependent plasticity
6	Oct 26	Homeostatic plasticity
7	Nov 2	Structural synaptic plasticity
	Nov 9	*No class (Fall break)*
8	Nov 16	Regulation and plasticity of neuronal excitability
9	Nov 23	Dendritic integration of synaptic input
10	Nov 30	Neural circuits (I): Methods to probe neuronal diversity and connectivity
11	Dec 7	Neural circuits (II): Hippocampus
12	Dec 8	*Review*

*Current as of Sep 4, 2026. Schedule subject to change.
Final Exam Period: Final Exam date and time TBA.

Syllabus Appendix: Student Supports & University Statements, Policies, and Guidelines

Information on student supports available to all Dalhousie students, and University-wide statements, policies, and guidelines applicable to your academic studies can be found here.