

## **NROB61: Neurophysiology**

University of Toronto Scarborough  
Summer 2022

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## Key Information

### Course Instructors:



Jennifer Wilkin, MA  
jennifer.wilkin@mail.utoronto.ca



Hanista Premachandran, MA  
hanista.premachandran@mail.utoronto.ca

**Course email:** nrob61.summer22@gmail.com

**Office hours:** Thursdays 3-4pm (drop-in; Zoom)

**Course site:** Quercus

### Course delivery:

Lecture – Online, asynchronous

Practical – Online, synchronous; some in-person components may be possible during weeks 8 and 9

### Practical Sections and Course TA:

PRA-001, **Wed 9-11am TBD** | Nisma Khan

PRA-002, **Wed 7-9pm TBD** | Nisma Khan  
nisma.khan@mail.utoronto.ca

## I. Course Overview

### Instructors

Hanista Premachandran and Jennifer Wilkin are your course instructors for the summer 2022 term. *All lectures were recorded by Dr. Marie Gadziola and will be made available through Quercus, while Hanista and Jennifer will be administering the course.*

**Hanista Premachandran** is a PhD student at UTSC in the Department of Psychology. She received her Master of Arts in Psychology (in the Behavioural Neuroscience stream) at UTSC and is continuing her PhD studies in the same program. Her research and teaching interests include principles of behavioural neuroscience, learning and memory, and the neural pathways underlying emotional learning.

**Jennifer Wilkin** is a PhD student at UTSC in the Department of Psychology. She received her Master of Psychology in Dr. Arruda Carvalho's lab in 2020. Her research lies in developmental changes in affective memory and focuses on investigating the underlying circuitries that mature to produce and sustain behaviour.

### Course description

Neurons in the brain receive thousands of complex inputs that provide information derived from our internal states and the external world. We will explore the diverse mechanisms that neurons employ to receive, integrate and process this complex array of inputs, with an emphasis on how electrical signals underlie neuronal communication. Topics include principles of bioelectricity, the ionic basis of the resting potential and action potential, synaptic transmission and integration, and neural coding schemes. The content of this course will provide a critical foundation for further studies in neuroscience and understanding of higher-order functions in the brain. Across all modules, we will highlight the classic experimental methods used to identify these fundamental principles, as well as modern techniques used in current research. Students will participate in mix of virtual tutorials and in-person labs to enhance mastery of content and promote skill development.

### Pre-requisites

[NROB60H3](#)

### Learning Outcomes

By the end of this course, a successful learner will be able to:

1. Explain how the properties of ion channels, transporters and receptors contribute to synaptic function and neural communication in neurons
2. Apply their understanding of neurotransmission and biophysical properties to predict what will happen to an excitable cell with a change in electrochemical gradient or synaptic input
3. Understand the core principles of how transmitted signals are integrated within and across neurons to encode and decode sensory information
4. Describe several classic and modern experimental techniques used in neurophysiology and explain how they can be used to address different types of research questions
5. Exercise scientific inquiry by formulating hypothesis-driven questions, considering appropriate experimental approaches, and analyzing neurophysiological data to illustrate results
6. Demonstrate the foundational skills necessary for locating, comprehending, and referencing primary literature relevant to neuroscience

- Develop strategies for effective scientific communication through written laboratory reports and summarizing primary research articles

## II. Course Schedule

As the semester progresses, we may make adjustments to our pacing or content coverage as necessary, and you will be notified on Quercus.

### Tentative Schedule

WEEK	DATE	TOPIC	ASSIGNED READINGS
1	May 9	LEC: Course Introduction & Review of Fundamentals PRA: No meeting	Quercus – <i>Start Here</i> resources
2	May 16	LEC: Ion channels & signaling PRA: Introductions & constructing effective arguments	FNTB (Chapter 4) JoVE: Patch-clamp electrophysiology
3	May 23	LEC: Ionic basis of resting potential PRA: Lab 1 - RC Circuit Lab	FNTB (Chapter 6) Background & Protocol
4	May 30	LEC: Ionic basis of the action potential PRA: Finding, referencing & paraphrasing academic literature	FNTB (Chapter 7)
5	Jun 6	LEC: Passive electrical spread in neurons PRA: Lab 2 - Virtual Leech Lab	FNTB (Chapter 8) Background & Protocol JoVE: Intracellular Recording in the Leech
6	Jun 13	LEC: Sensory coding & measuring extracellular activity PRA: Professional Development & Building Community	Kandel (Chapter 21)
<b>READING WEEK</b> <i>June 20-24</i>			
7	TBD	<b>MIDTERM*</b> PRA: No meeting	
8	Jul 4	LEC: Postsynaptic mechanisms of synaptic transmission PRA: Lab 3 - Extracellular Analysis Lab	FNTB (Chapter 11) Background & Protocol

WEEK	DATE	TOPIC	ASSIGNED READINGS
9	Jul 11	LEC: Targeted approaches for controlling neuronal activity	
		PRA: Individual work with Spike Recorder <i>(Optional drop-in for extra help)</i>	
10	Jul 18	LEC: Presynaptic mechanisms of synaptic transmission	FNTB (Chapter 13) JoVE: FM dyes in vesicle recycling JoVE: Calcium imaging in neurons
		PRA: Article Deconstruction (Part 1)	Demo Article (Yang et al., 2018)
11	Jul 25	LEC: Synaptic integration	FNTB (Chapter 8)
		PRA: Article Deconstruction (Part 2)	Demo Article (Yang et al., 2018)
12	Aug 1	LEC: Synaptic plasticity	FNTB (Chapter 16)
		PRA: <i>Optional drop-in for extra help</i>	
	Aug 10	<b>Final Lab Report Due</b>	
	<b>TBD*</b>	<b>FINAL EXAM</b>	

*\*The midterm will be scheduled by the Registrar. We have requested for it to occur in Week 7.*

*\*The final exam will be scheduled by the Registrar during the exam period (Apr 13-29).*

### III. Assigned Readings

You are responsible for reading all lecture notes and any assigned readings, including textbook chapters, posted videos, and assigned empirical articles.

#### Required Course Textbook (FNTB):

Martin et al. *From Neuron to Brain* (6<sup>th</sup> ed.). New York, NY: Oxford University Press.

Our course is working with the University's bookstore to pilot a new way for you to access online course textbooks directly from Quercus. Click on the "Course Textbook" button from our homepage, then click on the "eBook: From Neurons to Brain" link. All students are provided with a free 2-week trial access to the eBook, along with the option of purchasing through the bookstore.

A print copy of the textbook has also been placed in the Library's Course Reserves. Please note that the 5<sup>th</sup> edition is also a suitable alternative.

### IV. Assessments

This course will offer you multiple opportunities for assessment and feedback, especially during laboratory/tutorial assessments. Course assessments have been broken down into 3 major categories:

## 1. Examinations

Exams will consist of both multiple-choice and short-answer questions. Multiple-choice questions may come in various formats, including (but not limited to) questions with diagrams and “all of the above” or “none of the above” options. Short-answer responses may require several sentences to address the question complexity; they may also require a mathematical calculation and/or the creation or analysis of a visual (e.g., diagram). The points assigned will be weighted based on the relative importance, as opposed to how many things you need to say (i.e., we will not employ a system of three points requiring three “things” to say).

Success on the exams will require you to develop a clear understanding of both the lecture content and assigned readings. Rote memorization of lectures and readings will not guarantee you a high mark; rather, I expect you to not only learn key concepts, but also to explain why each is relevant and to demonstrate how you can apply your knowledge in new and creative ways.

### **a) Midterm Exam (27%)**

The midterm exam will be scheduled by the Registrar. The exam will include all lecture content covered in Weeks 1-5, including any assigned readings or videos.

### **b) Final Exam (35%)**

The final exam will be scheduled by the Registrar during the final exam period. The final exam is considered cumulative. While the priority will be on the material covered Weeks 6-12, keep in mind that much of that material assumes an understanding of concepts that were introduced earlier in the course.

## 2. Practical Assignments

Practicals will provide you with an opportunity for peer-to-peer learning, collaborative teamwork, and group discussion. Your participation is mandatory, and you must only attend the practical section you are registered in. You will be randomly assigned to a small group (~4 students) to collaborate on exercises together and through shared documents. When required, students will be responsible for their own submissions of work, and final answers must be in your own words. Both tutorial and laboratory exercises will be due within 48-hrs of when your practical section ends.

### **a) Tutorial Exercises (1% each, or 6% of final grade)**

There will be 6 weeks of tutorial where we will focus on essential skills, such as information literacy, critical analysis and scientific communication. Your TAs will help you get started with an overview on a given topic, and your group will work together on an exercise and contribute to tutorial discussion.

### **b) Laboratory Exercises (3% each, or 9% of final grade)**

There will be 3 laboratory weeks where you will follow a provided protocol and take a more “hands-on” approach to demonstrating our understanding of the course material, exercise critical thinking, generate hypotheses and communicate your findings. These exercises may require additional time to complete outside of the designated practical session.

**c) Final Lab Report (20% of final grade)**

For this assignment you will work independently to complete a formal laboratory report based on an analysis similar to one you will do as part of the extracellular data analysis lab. You will demonstrate essential skills relating to information literacy, experimental approach, data analysis, and scientific communication, which we will work on building in labs and tutorial. Detailed assignment guidelines will be posted on Quercus later in the term.

**3. Reflection/Self-Assessments**

**a) Pre-post course reflections (2% of final grade)**

You will be asked to complete two self-assessments via Quercus – one at the beginning of the semester and one towards the end. The purpose of these reflections is to allow us to understand where your skills are at coming into this class and encourage you to actively reflect on your skill development and learning process across the course. There are no “correct answers”, but you must provide full responses for full marks.

**Pre-course Survey** Due Date: May 24<sup>th</sup>, 11:59PM

**Post-course Survey** Due Date: Aug 8<sup>th</sup>, 11:59PM

**b) Academic Integrity Quiz (1% of final grade)**

Due Date: May 24<sup>th</sup>, 11:59PM

**Course Grading Rubric**

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-
90%+	85-89	80-84	77-79	73-76	70-72	67-69	63-66	60-62	57-59	53-56	50-52

**V. Communication**

**Quercus messaging or discussion board?** Please do not contact your instructor or TAs using the Quercus messaging system. Decide if your question is most appropriate for the Quercus discussion board or course email (see below).

**Quercus discussion board.** Please use the discussion board on Quercus for all general course inquiries and content-related discussions. The discussion board is highly catered to getting you help fast and efficiently from classmates, the TAs, and instructors. Rather than emailing questions to the teaching staff, we encourage you to post your questions on the discussion board.

**Email policy.** Email should be reserved for correspondence that requires privacy (e.g., accommodations, grading concerns), and should be sent to the course email ([nrob61.summer22@gmail.com](mailto:nrob61.summer22@gmail.com)). Emails must be sent from your university email account. In most cases, e-mails will be answered within 48 hours of receipt (excluding weekends and holidays).

Emails should have an informative subject title that includes some detail related to your question. Please keep your emails professional, concise, and clear. Your email should include your full name and student ID number so that we know who you are. A short email based around a single question, with some level of effort to explain the issue, will likely be most effective. If you are not familiar with writing professional emails, you may find this resource helpful: <https://tinyurl.com/kysxwtx>.

**Office hours.** Office hours will be hosted using Zoom (meeting link and passcode found on the Quercus homepage), unless notified otherwise. Office hours will be an open, drop-in format. More than one student may be in the room at the same time, and students are welcome to ask questions and/or stay to listen to peer questions. Individual appointments can be requested by email if the questions/concerns are more appropriate to be addressed privately.

Office hours are a valuable resource for you to learn more about the class and/or other important things related to (but outside of) the class. You should consider attending our office hours if you would like to (1) discuss course content, (2) if you have an issue with course performance or progress, or (3) you would like to discuss the field of psychology/neuroscience and how to get more involved.

## VI. Course Policies

**Equity, Diversity, and Inclusion.** The University of Toronto welcomes and includes students, staff, and faculty from a wide range of backgrounds, cultural traditions, and spiritual beliefs. The NROB61 teaching team proudly supports U of T's commitment to equity, human rights and respect for diversity, and we aspire to uphold these values as priorities in this course. 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. We stand with U of T against discrimination or harassment against any persons or communities.

**Land Acknowledgement.** We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit. Scarborough is also located on the traditional lands of the Anishnabeg, the Chippewa, and the Haudenosaunee peoples. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

**Classroom etiquette.** Whether we are together in a physical or virtual classroom, our learning environment is a place where you should always feel safe and respected. It is also a place that is conducive to learning and intellectual curiosity. To help create this learning environment, we ask that you always use respectful language and strive to create an atmosphere of mutual respect. We should all recognize and respect diversity of opinions; it's okay to disagree and engage in scientific discourse, but inappropriate to disrespect or be offensive to others. It is expected that you also respect the privacy of your classmates, by never copying or distributing the contents of an online discussion thread or course videos that may include their participation.

**In-person opportunities.** In the event of a return to in-person instruction, which may be during the week 8 or 9, we will ensure that your participation in practicals can continue to be possible through remote Zoom meetings and digital-based group work. Any in-person opportunities will be optional and on a sign-up basis. Under no circumstance should you participate in any in-person opportunities if you are sick or have been exposed to a close contact that is sick or under isolation. You will be expected to wear a well-fitted mask at all times, covering your nose, mouth and chin without gaping, and you will need to pass the University's uCheck and show your green screen to the TA.

**Slides and pre-recorded videos.** For your convenience, lecture/practical slides will be posted on Quercus, along with recorded videos, where available. Slides on their own are not considered a suitable substitute for attendance or listening to the full recorded video; slides are not exhaustive and we may cover important material that extends beyond them during recorded videos or synchronous meetings.

**Copyright notice.** All of the course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation, and are protected by copyright. In this course, you are permitted to download materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit written permission of the instructor.

**Notice of video recording (download permissible; re-use prohibited).** Portions of the practicals, including your participation, may be recorded on video and will be available to students in the course for viewing asynchronously, if needed. Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor.

**Contesting a grade.** All requests for a re-grade must be submitted in writing to the course email within two weeks of the day the grade is received. Only requests that include adequate written justification of an error in the original grading will be considered. Where possible, a legitimate request will result in the entire assignment being re-graded. Your overall grade may be raised, lowered, or stay the same.

**Late submissions.** Assignments submitted after the deadline, and without being granted missed term work accommodations, will receive a -10% penalty per day late. All deadlines are set according to Toronto time.

**Changes to the syllabus.** There may be minor changes to the syllabus during the term. You will be notified of these changes ASAP and no changes will be instituted that dramatically affect your ability to reasonably prepare for a class or assessment.

## VII. AccessAbility

Students with diverse learning styles and needs are welcome in this course! In particular, if you have a disability/health consideration that may require accommodations, please approach your course instructors (nrob61.summer22@gmail.com) and/or the AccessAbility Services Office as soon as possible.

AccessAbility Services staff (located in Rm SW302, Science Wing) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations 416-287-7560 or email [ability@utsc.utoronto.ca](mailto:ability@utsc.utoronto.ca). The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

## VIII. Academic Integrity

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters ([http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppju\\_n011995.pdf](http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppju_n011995.pdf)) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

- Using someone else's ideas or words without appropriate acknowledgement;
- Submitting your own work in more than one course without the permission of the instructor;



- Making up sources or facts;
- Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

- Using or possessing unauthorized aids;
- Looking at someone else's answers during an exam or test;
- Misrepresenting your identity; and
- When you knew or ought to have known you were doing it.

In academic work:

- Falsifying institutional documents or grades;
- Falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes; and
- When you knew or ought to have known you were doing so.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If students have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, they are expected to seek out additional information on academic integrity from their instructors or from other institutional resources.

Note: You may see advertisements for services offering grammar help, essay editing and proof-reading. Be very careful. If these services take a draft of your work and significantly change the content and/or language, you may be committing an academic offence (unauthorized assistance) under the *Code of Behaviour on Academic Matters*.

It is much better and safer to take your draft to the Writing Centre as early as you can. They will give you guidance you can trust. Students for whom English is not their first language should go to the English Language Development Centre.

If you decide to use these services in spite of this caution, you must keep a draft of your work and any notes you made before you got help and be prepared to give it to your instructor on request.

**Plagiarism detection.** Normally, students will be required to submit their course essays/assignments to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (<https://uoft.me/pdt-faq>).

This class may be important to you, but not so important as to gamble with your academic career by cheating. If you find yourself wondering if something constitutes academic misconduct, I encourage you to investigate the subject more thoroughly before acting – not knowing that something is considered academic misconduct does not protect you from trouble! Knowing is half the battle! Consider visiting <http://uoft.me/academicdishonesty>.

## IX. Department of Psychology Missed Term Work Policy, SUMMER 2022

For missed term work (assignments and term tests) due to illness, emergency, or other mitigating circumstances, please follow the procedures outlined below.

Note:

- The following reasons are not considered sufficient for missed term work: travel for leisure, weddings, personal commitments, work commitments, human error.
- [Missed Final Exams](#) are handled by the Registrar's Office and should be declared on eService.
- Instructors cannot accept term work any later than five business days after the last day of class. Beyond this date, accommodations are only possible via the Registrar's Office [petition process](#).

The email address to submit missed term work accommodation requests in **NROB61** is:  
**nrob61.summer22@gmail.com**

### ILLNESS OR EMERGENCY accommodations:

For missed work due to ILLNESS OR EMERGENCY, complete the following process:

1. Complete the [Request for Missed Term Work Accommodations Form](#).
2. Declare your absence on [ACORN](#) (Profile & Settings > Absence Declaration)
3. Email **both** of the following items to the course email **WITHIN 2 BUSINESS DAYS** of the missed work:
  - the [Request for Missed Term Work Accommodations Form](#)
  - \*AND\***
  - a screenshot of your Self-Declared Absence on ACORN

Note:

- *If you are unable to submit your request within 2 business days, you must still email your instructor within the 2 business day window to explain the nature of the delay. Exceptions to the 2 business day deadline will only be made under exceptional circumstances.*
- *If your absence is declared on ACORN, we do not require any additional supporting documentation (e.g. medical notes) to support your missed term work accommodation request.*

### ACADEMIC CONFLICT accommodations:

For missed term work due to an ACADEMIC CONFLICT (e.g. two midterms at the same time):

1. Complete the [Request for Missed Term Work Accommodations Form](#).
2. Take screenshots of your course Quercus pages that demonstrate the conflict.
3. Email the form and screenshots to the course email **at least two weeks (10 business days) before the date of the activity**, or as soon as possible if it was not possible to identify the conflict earlier. Requests sent after the activity deadline may not be accommodated.

Note:

- *Multiple assignments due on the same day are not considered conflicts. Students are expected to manage their time effectively to meet assignment deadlines.*
- *Back-to-back tests/quizzes are not considered conflicts. Only overlapping activities are conflicts.*

- *Students are responsible for keeping their course timetables conflict-free. Students who register in two courses with overlapping lecture/tutorial/lab schedules will not be accommodated.*

### **RELIGIOUS CONFLICT accommodations:**

For missed term work due to a RELIGIOUS CONFLICT:

1. Complete the [Request for Missed Term Work Accommodations Form](#).
2. Email the form to the course **email at least two weeks (10 business days) before the date of the activity**, or as soon as possible if it was not possible to identify the conflict earlier. Requests sent after the activity deadline may not be accommodated.

### **ACCESSABILITY SERVICES accommodations:**

For missed **TERM TESTS** due to ACCESSABILITY REASONS:

- **Contact your AccessAbility consultant** and have them email the course email detailing accommodations required.

For missed **ASSIGNMENTS** due to ACCESSABILITY REASONS:

- If your desired accommodation is **within the scope** of your Accommodation Letter (e.g. your letter includes “extensions of up to 7 days” and you need 3 days):
  1. Complete the [Request for Missed Term Work Accommodations Form](#).
  2. Email the form **\*AND\*** your **Accommodation Letter** to the course email specifying how many days extension you are requesting.
- If your desired accommodation is **outside the scope** of your Accommodation Letter (e.g. your letter includes “extensions of up to 7 days” but you need more time than that):
  1. **Contact your AccessAbility consultant** and have them email the course email detailing the accommodations required.

### **Accommodation Procedure:**

After submitting your documentation, you will receive a response from your instructor or TA. This form does not guarantee that you will be accommodated. The course instructor reserves the right to decide what accommodations (if any) will be made. Failure to adhere to any aspect of this policy may result in a denial of your request. **You are responsible for checking your official U of T email and Quercus course announcements daily**, as accommodations may be time-critical.

For missed assignments, **do not wait for the instructor’s response to resume work on your assignment**. Extensions may be as short as one business day, depending on the nature of the illness/emergency. Complete your assignment as soon as you’re able, and email it to your instructor.

For an **anticipated absence** (e.g. a scheduled surgery or an illness with a prolonged recovery period), if you would like to request accommodations in advance, submit a [Verification of Illness Form](#) completed by your doctor AND the [Request for Missed Term Work Accommodations Form](#) to the course email. Absences can be declared up to 14 days into the future on ACORN.

### **Missed Accommodations**

If an accommodation is granted but a continued illness/emergency prevents you from meeting its requirements, you must repeat the missed term work procedure to request additional accommodations. **Please make it clear in your subject line that you are requesting a second accommodation.** E.g. If you are given an extension but are still sick and need more time, or if you miss a make-up term test, you must submit *another* [Request for Missed Term Work Accommodations Form](#) and declare your extended absence on ACORN. \*Note: In the case of a missed make-up test, an opportunity to write a second make-up test may not necessarily be provided.

### **Questions?**

If you have any questions about this Missed Term Work policy, please contact the course email **well before** the date of the test / assignment deadline to describe your circumstances and inquire about procedures.

### **X. Course-specific Accommodation Policies for Missed Term Work**

Missed term work not granted accommodations will receive a 0% grade. Always submit your missed work to the Quercus assignment link as soon as you are able to; do not wait for an instructor response first to resume your work.

***Final lab reports.*** The final lab report is due on the last day of the term, which means that the maximum possible extension we can accommodate is 5 business days. Any accommodations that require more time than this will need to be petitioned through the Registrar's Office.

***Missed midterm.*** There will be only one makeup midterm opportunity, specific date and time TBD. If you are unable to attend the make-up midterm and granted accommodations, your final exam will then be cumulative and worth 62% of your final grade.