NROB61: Neurophysiology

University of Toronto Scarborough
Winter 2021

Key Information

Course Instructor:
Marie Gadziola, PhD (*she/her*)
Pronounced: gad-zee-oh-la
marie.gadziola@utoronto.ca

Course email: nrob61.gadziola@gmail.com

Course site: Quercus

Course delivery:

Lecture – Online, asynchronous

Practical – Online, synchronous

Wed 9-11am (PRA001 & PRA002)

Wed 1-3pm (PRA003 & PRA004)

Wed 8-10pm (PRA005 & PRA006)

Office hours: Fridays 2-3pm (drop-in; Bb Collaborate)

Course TAs:

Ahmad Israwi

Jeffrey Kates

Hanista Premachandran

Sylvia Romanowska

Natalia Sandoval

Jennifer Wilkin

I. Course Overview

Instructor

Dr. Gadziola is a Lecturer in the Department of Psychology. She received her PhD in Neuroscience from Kent State University, followed by postdoctoral research at Case Western Reserve University. Her research and teaching interests are in sensory systems, and the neural mechanisms that underlie the detection and evaluation of salient stimuli influencing motivated behaviours.

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 virtual labs and tutorials 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
7. Develop strategies for effective scientific communication through written laboratory reports and summarizing primary research articles

II. Course Schedule

As this is the first offering of the course, there will likely need to be revisions to our course schedule from time to time. As the semester progresses, I 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	**Jan 11**	**LEC:** Course Introduction & Review of Fundamentals	Video: Virtual Tour Allen Institute FNTB (Appendix A)
	Jan 13	**PRA:** *No meeting*	Quercus – *Start Here* resources
2	**Jan 18**	**LEC:** Ion channels and signaling	FNTB (Chapter 4) Video: Patch-clamp electrophysiology
	Jan 20	**PRA:** Introductions & Constructing effective arguments	
3	**Jan 25**	**LEC:** Ionic basis of resting potential	FNTB (Chapter 6)
	Jan 27	**PRA:** Lab 1 - RC Circuit Lab	Background & Protocol
4	**Feb 1**	**LEC:** Ionic basis of the action potential	FNTB (Chapter 7)
	Feb 3	**PRA:** Finding, referencing & paraphrasing academic literature	
5	**Feb 8**	**LEC:** Electrical signaling and spread in neurons	FNTB (Chapter 8)
	Feb 10	**PRA:** Lab 2 - Virtual Leech Lab	Background & Protocol
	Feb 13-19	***READING WEEK***	
6	**Feb 22**	***MIDTERM****	
	Feb 24	**PRA:** *No meeting*	
7	**Mar 1**	**LEC:** Sensory transduction and neural coding schemes	FNTB (Chapter 19)
	Mar 3	**PRA:** Article Deconstruction (Part 1)	Demo Article
8	**Mar 8**	**LEC:** Targeted approaches for controlling neuronal activity	TBD
	Mar 10	**PRA:** Lab 3 - Extracellular Data Analysis Lab	Background & Protocol
9	**Mar 15**	**LEC:** Direct synaptic transmission & Release of neurotransmitters	FNTB (Chapter 11) FNTB (Chapter 13)

WEEK	DATE	TOPIC	ASSIGNED READINGS
	Mar 17	**PRA:** Article Deconstruction (Part 2)	Demo Article
10	**Mar 22**	**LEC:** Synaptic integration	TBD
	Mar 24	**PRA:** TBD	
11	**Mar 29**	**LEC:** Synaptic plasticity	FNTB (Chapter 16)
	Mar 31	**PRA:** TBD	
12	**Apr 5**	**LEC:** TBD	TBD
	Apr 7	**PRA:** *No meeting*	Turn in Final Paper **April 9th**
	TBD	***FINAL EXAM****	

**The midterm exam will be scheduled by the Registrar. I have requested for it to occur Week 6.*
***The final exam will be scheduled by the Registrar during the exam period.*

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):

Nicholls et al. (5th ed.). *From Neuron to Brain*. New York, NY: Oxford University Press.

E-book purchases and rentals are available for the course textbooks at reduced prices.

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

   All examinations will be considered "open book, non-collaborative", meaning you are allowed to refer to the textbook, course materials and any of your own personal notes, but you may NOT collaborate with others (see *authorized aids* policy details below). You will be tested on lecture material and any assigned readings.

   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 (30%)

The midterm exam will be scheduled by the Registrar, likely to take place at some point in Week 6. The exam will include all lecture content covered prior to the midterm, as well as any assigned readings.

b) Final Exam (37%)

The final exam will be scheduled by the Registrar during the final exam period. The final exam is cumulative. While the priority will be on the material covered after the midterm, much of that material assumes an understanding of concepts that were introduced earlier in the course.

2. Practical Assignments

Our synchronous online meetings 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 in breakout rooms 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.

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

There will be 6 weeks of tutorial where we will focus on essential skills related to 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. You or your group may be asked to submit a file by the end of tutorial and/or your TAs will assign a score based on your participation that week. Tutorial exercises will be graded on a 3-category scale that assesses a reasonable degree of effort: Insufficient (0%), Needs Improvement (70%), Meets Expectations (100%).

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

There will be 3 virtual laboratory weeks where you will take a more "virtual 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. Laboratory exercises will be due within 48-hrs of when your lab session ends.

c) ***Final Paper (15% of final grade)***

For this assignment you will work independently to complete a laboratory report based on an analysis you did as part of the extracellular data 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: Jan 18th, 11:59PM
Post-course Survey Due Date: April 12th, 11:59PM

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

Due Date: Jan 18th, 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. Please do not contact your Instructor or TAs using the Quercus messaging system. Decide if your question is most appropriate for the Piazza discussion board or course email (see below).

Piazza Discussion. This term we will be using Piazza for all of our general course inquiries and content-related discussions. Piazza is highly catered to getting you help fast and efficiently from classmates, the TAs, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza.

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.gadziola@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.

VI. Course Policies

Netiquette. The University of Toronto is committed to equity, human rights and respect for diversity. Our online 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 where all members of this course can express themselves, engage with each other, and respect one another's differences.

Please adhere to the following guidelines when communicating online:

- Remember the human on the other side of the computer. Avoid doing anything online that would offend or frustrate other people.
- 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.
- Be considerate of others' time. Read prior replies and threads to see if your topic has already been discussed at length. Write concisely and stay on topic. Use a meaningful subject line about what your post contains.
- Be mindful when using sarcasm and humor. Without face-to-face communication, your joke may be misinterpreted.
- Respect the privacy of your classmates. Never copy or distribute the contents of a discussion thread.

***Office hours*.** 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 Dr. Gadziola's 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.

Office hours will be hosted using Bb Collaborate, unless notified otherwise. General 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 handled privately.

Slides and pre-recorded videos. For your convenience, lecture/practical slides will be posted on Quercus, along with pre-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 within 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.

***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 Eastern 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.

Authorized aids. Exams will be considered "open-book, non-collaborative". This means that you are welcome to refer to the textbooks, course materials and any of your own personal notes, but you may NOT collaborate with others. To avoid potential allegations of academic misconduct, you must adhere to the following:

- **You are the only person allowed to access, interact with, and submit your exams.** Allowing someone else to access the questions, content, and/or answers from your assessments (other than members of the NROB61 teaching team) will be considered a direct violation of *the Code*. This includes comparing answers with other students after the deadline has passed.
- **You are NOT allowed to collaborate with anyone else by sharing your work, working together, or using someone else's work to gain an unfair advantage.** Paying for, using, or contributing to any shared material or efforts to collaborate is a direct violation of *the Code*.
- **You are NOT allowed to access unauthorized material pertaining to your assessments.** It is a direct violation of *the Code* to access any source in which someone has solicited, discussed, and/or posted assessment content, questions, or answers. This includes group chats, shared Google docs, email threads, Discord, Chegg, and any other source that meets this description. Being a member of a group in which test materials were shared may also constitute an academic integrity offense.
- **If you see it, report it.** If you find yourself in a situation where you have stumbled upon unauthorized content accidentally, protect yourself by reporting it to the teaching team ASAP. You may be considered complicit in the offence if your digital fingerprint is there, but you failed to report it.

VII. Access*Ability*

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 me and/or the Access*Ability* Services Office as soon as possible.

Access*Ability* 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. 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/ppjun011995.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.

TurnItIn: Normally, students will be required to submit their course essays/assignments to Turnitin.com 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 Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

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. Psychology Department Missed Term Work Policy, WINTER 2021

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

Notes:

- 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: http://www.utsc.utoronto.ca/registrar/missing-examination
- Instructors cannot accept term work any later than five business days after the last day of class**.** Beyond this date, you would need to file a petition with the Registrar's Office: https://www.utsc.utoronto.ca/registrar/term-work

Accommodations for Illness or Emergency:

For missed work due to ILLNESS OR EMERGENCY, please complete the following **two-step** process:

1. Complete the **Request for Missed Term Work Accommodations Form** (http://uoft.me/PSY-MTW) and email it to Keely Hicks at keely.hicks@utoronto.ca ,

   and

2. **Declare your absence** on ACORN (Profile & Settings > Absence Declaration)

Deadline: You must complete the above steps **within 3 business days** of the missed work.

Note: For this semester, we do not require any additional supporting documentation (ex. medical notes) to support your missed term work accommodation request.

Accommodations for Academic Conflicts:

For missed term work due to an ACADEMIC CONFLICT (i.e. two quizzes or tests scheduled at the same time), please complete the following process:

1. Complete the **Request for Missed Term Work Accommodations Form** (http://uoft.me/PSY-MTW), choosing "Other" as your reason for missed work and explaining the conflict in the space provided.
2. Take screenshots of your course homepages that demonstrate the conflict.
3. Email the form and screenshots to Keely Hicks (keely.hicks@utoronto.ca).

Deadline: You should report the conflict to Keely Hicks (keely.hicks@utoronto.ca) **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.

Note: Multiple assignments due on the same day are not considered conflicts. Accommodations may only be possible in the case of quizzes and tests that are both scheduled during the same discrete period. Back-to-back tests/quizzes are not considered conflicts.

Note: Students are responsible for keeping their course timetables conflict-free. Students who choose to register in two synchronous courses with overlapping lecture/tutorial/lab schedules may not necessarily be accommodated.

Accommodations for Religious Conflicts:

For missed term work due to a RELIGIOUS CONFLICT, please complete the following process:

1. Complete the **Request for Missed Term Work Accommodations Form** (http://uoft.me/PSY-MTW), choosing "Other" as your reason for missed work and noting "Religious conflict" in the space provided.
2. Email the form to Keely Hicks (keely.hicks@utoronto.ca).

Deadline: You should report the conflict to Keely Hicks (keely.hicks@utoronto.ca) **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.

Accommodations for Time Zone Conflicts:

If you are physically in a different time zone and a quiz or midterm is scheduled outside of 7:00am to midnight in your local time, please complete the following process:

1. Complete the **Time Zone Conflict Form** (https://uoft.me/PSY-TimeZone), and
2. Email the form to Keely Hicks (keely.hicks@utoronto.ca)

Deadline: You should report the conflict to Keely Hicks (keely.hicks@utoronto.ca) **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.

Accommodations for Students Registered with AccessAbility Services:

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

- **Contact your AccessAbility consultant** and have them email Keely (keely.hicks@utoronto.ca) detailing accommodations required.

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

- If your desired accommodation is **within the scope** of your Accommodation Letter (ex. your letter includes "extensions of up to 7 days" and you need 3 days):
    1. Complete the **Request for Missed Term Work Accommodations Form** (http://uoft.me/PSY-MTW).
    2. Email the form and your **Accommodation Letter** to Keely Hicks (keely.hicks@utoronto.ca).
- If your desired accommodation is **outside the scope** of your Accommodation Letter (ex. 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 Keely Hicks (keely.hicks@utoronto.ca) detailing the accommodations required.

After submitting your documentation:

Within approximately one to five business days, you will receive a response from your instructor detailing the accommodations to be made (if any).

You are responsible for checking your official U of T email and Quercus course announcements daily, as accommodations may be time-critical.

You should continue to work on your assignments to the best of your ability, as extension accommodations may be as short as one business day, depending on the nature of the illness/emergency.

If an accommodation has been granted but you are unable to meet the conditions of the accommodation (ex. you need a longer extension, or you missed a make-up test), you will need to repeat the missed term work procedure and submit additional forms to request further accommodation. Note that in the case of a missed make-up test, an opportunity to write a second make-up test may not be provided.

Completion of this form does not guarantee that accommodations will be made. 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 for accommodation.

Missed Accommodations

If an accommodation is granted but a continued illness/emergency prevents you from meeting the requirements of your accommodation, you must repeat the missed term work procedure to request additional accommodations.

(E.g.) If you miss a make-up midterm, you would need to submit another Request for Missed Term Work Accommodations form and declare your extended absence on ACORN.

Importance of Three Business Day window:

If you are unable to submit your documents within the three business day window, **you must email Keely (keely.hicks@utoronto.ca) within the three business day window** to explain the nature of the delay, and when you will be able to provide your documents. Exceptions to the documentation deadline will only be made under **exceptional circumstances.**

Questions?

If you have any questions about this Missed Term Work policy, please contact Keely Hicks (keely.hicks@utoronto.ca) **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

In addition to the Missed Term Work policy, you should also notify the NROB61 teaching team via the course email that you are in the process of requesting accommodations. Missed term work not granted accommodations will receive a 0% grade.

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 67% of your final grade. The format of the makeup midterm may be modified to take place as an oral examination.