

THE SYNAPTIC ORGANIZATION AND PHYSIOLOGY OF THE BRAIN

NROC69

UNIVERSITY OF TORONTO SCARBOROUGH
FALL 2019

Tuesday 1-3pm, MW160

Instructor: Rutsuko Ito - Office hours: **Friday 1-3pm, SW627**

TAs:

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***Website:** Quercus

***E-mail:** nroc69.uts@gmail.com

** Please post course/content related questions to relevant blackboard discussion forum for the benefit of other students. All other questions must be sent to nroc69.uts@gmail.com. Please note that emails pertaining to*

COURSE OVERVIEW

Synaptic organization is the study of principles underlying the organization of synapses and neurons into circuits that mediate the functional operations of different brain regions. It is a multidisciplinary and multi-level subject that integrates experimental findings from a vast number of disciplines including molecular neurobiology, neuroanatomy, neurochemistry, neurophysiology, neuropharmacology and behavioural neuroscience. We start with a focus on the property of the synapse as a basic unit of neural circuit organization, moving up to the property of whole neurons and multi-neuronal local circuits characteristic of a given brain region, then explore the interactions between various circuits forming a neural system, right up to system-system interactions that occur in a normal and abnormal brain. We will also explore some exciting new developments in the field such as the use of receptor knockouts in rodents to establish causal functions of specific receptors, optogenetic techniques in the investigation of neural circuitries in brain function, and the approach of looking at network oscillations in the brain as underlying certain functions.

COURSE OBJECTIVES

By the end of the course:

- You will understand the core principles of how the brain is organised at the systems, circuit, and synaptic level to achieve complex information processing.
- You will understand how electrical signals are generated, and transmitted throughout the brain.
- You will understand how synaptic organization in a particular brain area is related to its function.
- You will understand the methodologies (some of which are very current!) used in the field of cellular neurobiology.
- You will be able to read critically, and appreciate at a fairly sophisticated level, articles written in the field of cellular neurobiology.

COURSE READING

The lecture series will be loosely based on a book entitled Synaptic Organization of the Brain, (Gordon M Shepherd, 5th Ed). However, there will be no assigned readings from this book. Instead, assigned readings will consist of a lecture handout and original empirical articles pertaining to the lecture topic. You will be assessed on the content of the handouts/papers.

TENTATIVE COURSE OUTLINE

This outline may be subject to minor revisions with advance notice from the instructor.

Date	Topic
Sep 3	Organizational principles of the mammalian brain
Sep 10	Pre-synaptic and post-synaptic mechanisms of neurotransmission
Sep 17	Synaptic integration and neuromodulation
Sep 24	Basic and cutting edge techniques in cellular neuroscience
Oct 1	Midterm test on lectures 1-4 (1hr 50min)
Oct 8	Synaptic organization of the thalamus
Oct 15	<i>Reading Week – no class!</i>
Oct 22	Synaptic organization of the basal ganglia Critical analysis paper assignment due 27th Oct
Oct 29	Synaptic organization of the hippocampus
Nov 5	Synaptic plasticity and learning
Nov 12	Midterm test on lectures 5-8 (1hr50min)
Nov 19	Synaptic organization of the neocortex
Nov 26	Synapses in networks: network oscillations
Final exam	Date TBA by Registrar (2.5hrs)

Resources: Lectures slides and PDFs of papers for assigned reading will be posted on the course website (in the “Content” section) ***by midnight at the latest*** the night before the lecture. Other resources (such as videolinks, revision notes) will become available throughout the course to supplement the lecture slides.

Scheduling conflict: A web option will not be offered for this course, so it would be your responsibility to ensure that you are able to attend all the lectures. Given the nature of the material and course, attendance is critical to your success. If you have an ongoing conflict with lecture time, you should strongly consider dropping the course or adjusting your schedule to allow you to attend. Accommodations are not possible for scheduling conflicts. We will not answer emails concerning scheduling conflict.

EVALUATION

The tests will be based on the materials covered in the lectures, the handouts and empirical papers.

Midterm Tests 1 & 2 (50% overall grade- 20% Midterm 1, 30% midterm 2)

Each test will consist of multiple-choice (MC) questions and short answer questions (SAQ) of equal weighting on the material covered in the preceding 4 lectures.

MC 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. MC questions will be drawn predominantly from the lecture slides and lecture handout.

SA questions may require a several sentence response, and may also require the creation or analysis of a visual (e.g., diagram), or for you to solve a mathematical equation. SA questions will be drawn predominantly from the lecture slides and lecture handout.

Acceptable calculators are permitted on midterm exams. Guidelines will be provided for what is considered an “acceptable calculator”.

Critical analysis assignment (15% overall grade):

You will be provided with an empirical article, and you will be required to write a critique on the assigned paper. The article will be assigned the week of September 30th and will be due **Oct 27th (Sunday)**. This will give you practice in developing your analytical and scientific writing skills for the final exam and give you the opportunity to get feedback on areas that require improvement.

The paper must be a maximum of 4 pages, excluding references, double spaced, in Times New Roman font, with 1” margins. References must be cited using Journal of Science format. Details of the content of the assignment will be posted.

Final exam (30% overall grade)

This exam will have 3 sections:

- 1) **Multiple-choice questions (5% overall grade)** on lectures 9 and 10.
- 2) **Critical analysis of empirical paper (25% overall grade):** You will be provided with an empirical paper to read two weeks before the final exam date. In the exam, you will be required to answer questions that are designed to test your understanding of the paper, as well as the research topic.

The best strategy for the final exam is for you to learn the material for lectures 9 and 10, and then select three or four of the earlier lectures that most interest you to revise in detail. ***It is also essential that you read the assigned papers from each lecture and become familiar with the format of scientific writing.***

Self-Assessment & Feedback (5% overall grade)

After each lecture, you will have the opportunity to participate in a self-assessment and feedback (SAF) exercise. SAFs consist of a few practice questions related to content covered in lecture or text that week. These questions will help you assess your comprehension of the lecture material and prepare you for the types of questions you might see on the exams. SAFs also incentivize class attendance and staying on pace with readings and prep.

Each SAF also has an open textbox to provide feedback on lecture content and highlight any areas of confusion. This will help you evaluate your own areas of weakness, and help me assess whether there are common concerns that should be addressed on BB or in class.

This learning strategy is most effective if you make a genuine attempt at answering the questions on your own, and keep up to date with the lecture material (i.e. don’t just cram the week before the midterm). You will be graded for participation and accuracy of the answers (2.5% each).

There will be 10 SAF opportunities throughout the term. At the end of each lecture, an SAF “quiz” will become available on Quercus (in the left-side navigation pane). You must submit your answers by the

end of the week (no later than Sunday 11:59PM), at which time the SAF link will become unavailable. You will only receive correct answers and feedback (on Monday) if you submit the SAF on time.

COURSE POLICIES

Classroom conduct.

Our classroom 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 I ask that you always use respectful language, minimize potential distractions during lectures (e.g., off-topic chatting, Facebook), show up to class on time and support your peers.

Email policy.

All course-related correspondence should be sent to nroc69.utscc@gmail.com. Emails should not be sent to our personal email addresses.

In most cases, e-mails will be answered within 48 hours of receipt (not including weekends and holidays). Please keep your emails professional, concise, and clear: start with an informative subject title that includes the course name, and some detail on your query. Please note that we strongly encourage you to post content-related questions on the Quercus Discussion forums for the benefit of your peers.

Office hours.

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

Your TAs will hold office hours in the weeks before midterm tests and finals to support students as they prepare for the tests. Midterms will be viewable in an TA-led exam review sessions only, and will not be released outside of these hours. You are NOT allowed to take notes or photographs of the exams and violation of this policy will be treated as academic misconduct.

Video and Auditory Recording

For reasons of privacy as well as protection of copyright, unauthorized video or audio recording in classrooms is prohibited. This is outlined in the Provost's guidelines on *Appropriate Use of Information and Communication Technology*. Note, however, that these guidelines include the provision that students may obtain consent to record lectures and, "in the case of private use by students with disabilities, the instructor's consent must not be unreasonably withheld."

Copyright of lecture material

Instructional materials (lecture slides, handouts, articles) are to be used only for the purpose of learning in this course and must not be distributed or used for any other reason. **As protection of copyright, unauthorized copying, use, or uploading on www of any of the lecture slides, lecture handouts produced by Professor Ito is strictly prohibited.**

Accessibility

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 feel free to approach me and/or the AccessAbility Services Office as soon as possible. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff (located in S302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca.

Missed exams

You are expected to make every effort to take required mid-terms/final exam. Absence from a mid-term/exam will only be granted for genuine, legitimate reasons, including a documented family emergency, or a documented severe illness ***that is formerly approved by the Undergraduate Course Coordinator (NOTE the new policy explained below).*** If you miss the first midterm, **your second midterm will be a cumulative exam (based on lecture materials 1-8).** If you miss the second midterm, **there will be one make up exam in the week of Nov 22nd.** However, please note that this exam will be very close to your final exam, and will take away from important time that you could be revising for the final exam. ***Mid-terms/exams that are missed without a genuine, legitimate reason will receive a 0% mark.***

Missed Term Work due to Medical Illness or Other Emergency:

All students citing a documented reason for missed term work must submit their request for accommodations **within three (3) business days** of the deadline for the missed work.

Students must submit **BOTH** of the following:

- (1.) A completed **Request for Missed Term Work Accommodations form** (<http://uoft.me/PSY-MTW>), and
- (2.) **Appropriate documentation** to verify your illness or emergency, as described below.

Appropriate documentation:

For missed **TERM TESTS** due to **ILLNESS**:

- Submit the Request for Missed Term Work Accommodations form (<http://uoft.me/PSY-MTW>), along with an **original** copy of the official UTSC Verification of Illness Form (uoft.me/UTSC-Verification-Of-Illness-Form) or an **original** copy of the record of visitation to a hospital emergency room. Forms are to be completed in full, clearly indicating the start date, anticipated end date, and severity of illness. The physician's registration number and business stamp are required.
- Note: If an end date of "ongoing" is specified, the medical note will be assumed to cover a period of two weeks. If no end date / an "unknown" end date is specified, the note will be assumed to cover a period of three business days (starting from illness start date.)

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

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

For missed **ASSIGNMENTS** due to **ILLNESS**:

- Submit the Request for Missed Term Work Accommodations form (<http://uoft.me/PSY-MTW>), along with a **hardcopy** of the Self-Declaration of Student Illness Form (uoft.me/PSY-self-declare-form).

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), submit the Request for Missed Term Work Accommodations form (<http://uoft.me/PSY-MTW>) and attach a copy of your letter. **Specify how many days extension you are requesting** on the request form.
- 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) you will need to meet with your **AccessAbility consultant** and have them email Keely (keely.hicks@utoronto.ca) detailing the accommodations required.

For missed term tests or assignments in **OTHER CIRCUMSTANCES**:

Submit the Request for Missed Term Work Accommodations form (<http://uoft.me/PSY-MTW>), along with:

- In the case of a **death of a family member or friend**, please provide a copy of a death certificate.

- For U of T varsity-level or professional **athletic commitments**, an email from your coach or varsity administrator should be sent directly to Keely Hicks (keely.hicks@utoronto.ca) **well in advance** of the missed work, detailing the dates and nature of the commitment.
- For **religious accommodations**, please email (keely.hicks@utoronto.ca) **well in advance** of the missed work.
- For circumstances **outside of these guidelines**, please email Keely (keely.hicks@utoronto.ca) on or before the date of the test / assignment deadline to describe your circumstances and ask what documentation would be appropriate

Documents covering the following situations are NOT acceptable: medical prescriptions, personal travel, weddings/personal/work commitments.

Procedure:

Submit your (1.) [request form](#) and (2.) [medical/self-declaration](#)/other documents in person **WITHIN 3 BUSINESS DAYS** of the missed term test or assignment.

Submit to: Keely Hicks, Room SW420B, Monday – Friday, 9 AM – 4 PM. (Slide forms under door if out of office.)

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. If your original medical note / documentation included the date of the make-up midterm, then only the Request form is required. If the date of the make-up midterm fell outside of the dates indicated on your original medical note/other documentation, then a new medical note/other appropriate documentation must also be submitted.

Importance of Three Business Day window:

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

prepared to bring your documents to Keely in-person as soon as you are well. Late documents may not be accepted.

NOTE: Assignments due at end of term

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.utoronto.ca/registrar/term-work>).

NOTE: Final Exams

This policy applies only to missed assignments and term tests. Missed final exams are handled by the Registrar's Office (<http://www.utoronto.ca/registrar/missing-examination>).

Grading

Scale

NUMERICAL MARKS	LETTER GRADE	GRADE POINT VALUE
90 - 100%	A+	4.0
85 - 89%	A	4.0
80 - 84%	A-	3.7
77 - 79%	B+	3.3
73 - 76%	B	3.0
70 - 72%	B-	2.7
67 - 69%	C+	2.3
63 - 66%	C	2.0
60 - 62%	C-	1.7
57 - 59%	D+	1.3
53 - 56%	D	1.0
50 - 52%	D-	0.7
0 - 49%	F	0.0

Guidelines (<http://www.writing.utoronto.ca/advice/general/grading-policy>):

A+ Outstanding performance, exceeding even the A described below.

A Exceptional performance: strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter with sound critical evaluations; evidence of extensive knowledge base.

B Good performance: evidence of grasp of subject matter; some evidence of critical capacity and analytic ability; reasonable understanding of relevant issues; evidence of familiarity with the literature.

C Intellectually adequate performance: student who is profiting from her or his university experience; understanding of the subject matter and ability to develop solutions to simple problems in the material.

D Minimally acceptable performance: some evidence of familiarity with subject matter and some evidence that critical and analytic skills have been developed.

F Inadequate performance: little evidence of even superficial understanding of the subject matter; weakness in critical and analytic skills; with limited or irrelevant use of literature.

Note: for all written work, consistently poor spelling/grammar will be penalised. Please make use of the UTSC writing centre if you feel you need additional help with writing or want to develop your writing skills further: <http://ctl.utoronto.ca/twc/>.

Contesting a grade

All requests for a re-grade must be submitted **in writing** 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. *A legitimate request will result in the entire exam or assignment being re-graded. Your overall grade may be raised, lowered, or it may stay the same.* If there has been an error in our arithmetic, please let us know and we will immediately recalculate your grade (no written request necessary). **Arbitrary requests for grade increases will not be entertained (e.g., “I need to get into grad school, so could you please give me a higher grade?”).**

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/policies/behaveac.htm>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

On tests and exams:

- Using or possessing unauthorized aids.
- Looking at someone else's answers during an exam or test.
- Misrepresenting your identity.

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.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see <http://www.utoronto.ca/academicintegrity/>).

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>.