Molecular Neuroscience
NROC36H3S

University of Toronto Scarborough
Winter 2020
Tue 1-3pm: MW140

***Instructor*: Maithe Arruda Carvalho**

Office hours: Wed 10am-12pm, SW533

T.A.s: **Hanista Premachandran** *E-mail*:* hanista.premachandran@mail.utoronto.ca

Mudi Zhao *E-mail*:* mudi.zhao@mail.utoronto.ca

**Any questions referring to this course must be first addressed to the TAs.*

This course will provide students with a thorough background in the molecular and cellular mechanisms underlying neuronal communication in the central nervous system. We will explore concrete examples of that communication within the physiological (e.g. learning and memory) and pathological (e.g. neurodegenerative disorders) realms. We will start with the building blocks of synaptic communication, by learning about intracellular signalling, modulation of neuronal DNA and protein expression, and neurotransmitter systems. We will then use this knowledge to understand the specific molecular and cellular steps necessary for enabling neuronal communication. This will serve as a base to our understanding of how these mechanisms can be used in the brain to encode information in the form of synaptic plasticity in learning and memory. We will close by examining how these same mechanisms can be co-opted in pathological instances to impair cognitive and emotional function.

Course Learning Objectives

By the end of this course, students will:

- Understand the core principles underlying synaptic communication in the central nervous system, and how these mechanisms contribute to synaptic plasticity and learning
- Be provided with an overview of some of the main contemporary concepts and applications of molecular and cellular neuroscience
- Understand how molecular and cellular methods can be applied in research to address the latest challenges within the field
- Practice reading and analysing scientific articles relevant to the area
- Think critically and express themselves about unresolved questions in the field
- Gain the necessary background to critically evaluate the design, analysis, and conclusions of molecular neuroscience research

- Improve their oral and written communication skills through in-class discussions and feedback on written assignments and short-answer questions on exams

Course Materials

Students will be provided with complementary readings for each lecture, which will include textbook chapters and papers (see timetable). Mostly, this course will use selected chapters from two textbooks available online through the UTSC library website:

- **From molecules to networks: an introduction to cellular and molecular neuroscience = (MtN)**
  Edited by John H. Byrne, James L. Roberts.
  https://www-sciencedirect-com/book/9780123971791/from-molecules-to-networks

- **Principles of neural science = (PoN)**
  Edited by Eric R. Kandel et al.
  https://search.library.utoronto.ca/details?9548509&uuid=55d35fed-dbbe-4682-9afb-d8169f98181b

Additional material (including assigned papers) will be available through the e-reserves module of Course Reserves: https://cr.library.utoronto.ca/

Although not all content of textbook chapters will be covered in the lectures, it is **highly recommended** you read the accompanying chapter for each lecture. It will help your *understanding* of the topic and will *improve your performance* on the exams. You can also find any additional papers featured in the lectures (if they are not already available on course reserves) through a pubmed search - all references are on the lecture slides. Handouts of lecture slides will be posted on Quercus by midnight at the latest the night before the lecture.

Course Evaluation

Summary of Evaluation:

	Percent of final grade	Date
Writing assignment	15%	Mar 3rd
Term tests 1 and 2 (in class)	25% each	Feb 4th, Mar 17th
Final Exam	35%	Exam Period

Description of evaluation components:

1. Writing Assignment (15%)

This assignment will consist of a critical review of an empirical research paper. You will be given a choice between two assigned papers. Papers will be assigned on February 4th through an announcement on Quercus. Both the assigned papers have been submitted to Biorxiv without prior peer-review, which means you will be doing exactly what the reviewers of this manuscript will be doing when it is submitted to a neuroscience journal such as Journal of Neuroscience, etc – this is the real deal!

You will write a critique of the paper of your choice, which will be broken down in three sections:

1. Brief summary of results – In this 2-4 paragraph section you will briefly summarize the main rationale (what is the main goal of this paper? Which gap in knowledge are they trying to fill?), results and conclusions of the paper

2. Critical review – In this section you will evaluate this article in detail focusing on two parts: (i) its main strengths and (ii) its main weaknesses. This exercise is supposed to emulate the reviewing of a paper by a scientific journal. So think about the paper in terms of its conclusions and interpretations - Does the data support the conclusions? Are the experiments well designed and controlled? Are the techniques appropriate? Does this paper fill an important gap in knowledge? Does it answer the questions it set out to answer? Are you satisfied with the way they chose to answer those questions?

   You can explore the weaknesses of the manuscript in any way you prefer, but one suggestion is to frame your concerns relating to what you think the authors should do to improve the manuscript. This will strengthen your decision to recommend accepting or rejecting the manuscript (next section).

   Example (here in bullet points solely for illustration purposes):

   - Given that (i) estrous cycle blocks the behavioral deficits reported in this manuscript, (ii) TMX is an estrogen modulator and (iii) the known effects of estrogen on memory performance, estrogen seems a likely candidate to mediate the reported effects. Nevertheless, this possibility is not really discussed in the manuscript. Instead, the authors insist on comparing their data to ….
   - Several controls should be included to strengthen the conclusion that ….. Training data, anxiety and motor tests are the minimum necessary controls for these types of experiments, and are not present in this study.
   - It would be helpful for the reader if the authors described the drugs used in this study in the main text. As it stands no explanation or description is offered of their targets or function and of how they serve the described experiments.

3. Recommendation – In a few sentences, you will justify whether you would accept or reject this paper based on your critical evaluation in the last section. The options for the majority of journals include *accept, minor revisions, major revisions* or *reject*. State your recommendation and justify your choice!

This assignment will develop your critical and scientific writing skills. It will also give you a glimpse into the editorial process of any submitted manuscript to a journal. Importantly, you will receive feedback on your assignment identifying areas that require improvement.

The paper must be a <u>maximum of 5 pages, excluding references, double spaced, in Calibri font 11, with 1" margins</u>. In-text citations must follow the Journal of Neuroscience citation style. List all the references cited in the text in alphabetical order by first author's last name following Journal of Neuroscience citation style. Here is one example of Journal of Neuroscience citation style:

Drew MR, Denny CA, Hen R (2010) Arrest of adult hippocampal neurogenesis in mice impairs single- but not multiple-trial contextual fear conditioning. Behav Neurosci 124:446–454.

This assignment will be submitted through Quercus and Turnitin. Submissions are due **by 11:59PM on March 3rd**. Late submissions will be accepted with a **penalty of 50% for every day late**. To submit your assignment, click on Assignments: Writing assignment

2. Term Tests 1 and 2 (25% each) – February 4th and March 17th, in class, 1h50m each

Tests will be based on the material covered on the lectures (Lectures 1-4 for term test 1, and lectures 5-8 for term test 2). Each term test will consist of multiple-choice and short answer questions. I will provide sample questions for the first term test, as well as for the other lectures. Term tests will take place in class, and will last 1h50m each.

3. Final Exam (35%) – Exam period

The final exam will be scheduled during the exam period and will be comprised of two sections:

Section 1 (12.5%)
Short answer and multiple choice questions spanning lectures 9 and 10

Section 2 (22.5%) – Research paper analysis
An empirical research paper will be posted 2 weeks prior to the final exam. Students should carefully read the paper in preparation for the exam. You will be required to answer questions assessing your understanding of the paper, its research topic, as well as providing a critical analysis of its content. Your experience with the writing assignment will help with this process.

Overview of Course Schedule:
The following table presents the schedule of lectures and term tests as they will occur over the course of the term, and the due dates for the assignment.

Lecture	DATE	CONTENT	LOCATION	Recommended Reading	TO DO
1	Jan 7	Course Introduction and Recap of intracellular signaling	MW140	Excerpt from Molecular Biology of the cell (on course reserves)	
2	Jan 14	Regulation of Neuronal Gene Expression and Protein Synthesis	MW140	MtN chapter 5	
3	Jan 21	Neurotransmitter synthesis and removal	MW140	MtN chapter 7	
4	Jan 28	Neurotransmitter release	MW140	MtN chapter 15	
	Feb 4	Term test 1	MW140	MtN chapter 10	Papers assigned

5	Feb 11	Neurotransmitter receptors I: Ionotropic Receptors	MW140		
	Feb 18	Reading Week – No Class			
6	Feb 25	Neurotransmitter receptors II: Metabotropic Receptors	MW140	PoN chapter 11	
7	Mar 3	Molecular basis of implicit memory	MW140	PoN chapter 66	Writing assignment due
8	Mar 10	Molecular basis of synaptic plasticity I	MW140	PoN chapter 67; Collingridge et al., Nat Rev Neuro 2004 and 2010; Henley and Wilkinson Nat Rev Neuro 2016	
	Mar 17	Term test 2	MW140		
9	Mar 24	Molecular basis of synaptic plasticity II	MW140	MtN chapter 18; Lisman, Nat Rev Neuro 2002	
10	Mar 31	Molecular mechanisms of disease	MW140	MtN chapter 21	

Course Grading Scheme:

Following the University Assessment and Grading Practices Policy: (http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/grading.pdf; http://www.artsci.utoronto.ca/newstudents/transition/academic/grading):

Letter Grade	*Grade point value*	*Numerical Mark*	*Grade Definition*
A+	*4.0*	*90 - 100%*	Excellent: Strong evidence of original thinking; good organization; capacity to analyze and synthesize; superior grasp of subject matter with sound critical evaluations; evidence of extensive knowledge base.
A	*4.0*	*85 - 89%*	Excellent
A-	*3.7*	*80 - 84%*	Excellent
B+	*3.3*	*77 - 79%*	Good: Evidence of grasp of subject matter; some evidence of critical capacity and analytic ability; reasonable understanding of relevant issues; evidence of familiarity with literature.
B	*3.0*	*73 - 76%*	Good
B-	*2.7*	*70 - 72%*	Good
C+	*2.3*	*67 - 69%*	Adequate: Student who is profiting from

			his/her university experience; understanding of the subject matter; ability to develop solutions to simple problems in the material.
C	*2*	*63 - 66%*	Adequate
C-	*1.7*	*60 - 62%*	Adequate
D+	*1.3*	*57 - 59%*	Marginal: Some evidence of familiarity with subject matter and some evidence that critical and analytic skills have been developed.
D	*1.0*	*53 - 56%*	Marginal
D-	*0.7*	*50 - 52%*	Marginal
F	*0*	*0 - 49%*	Inadequate: Little evidence of even superficial understanding of subject matter; weakness in critical and analytic skills; with limited or irrelevant use of literature.

Note: Consistently poor spelling/grammar will be penalized. Please make use of the resources available at the UTSC writing centre for additional help with writing: http://ctl.utsc.utoronto.ca/twc/.

Course Policies:

Missed Term Work due to Medical Illness or Other Emergency:

All students citing a documented reason for missed term work must bring their documentation to the Psychology Course Coordinator in SW427C **within three (3) business days** of the assignment due date. You must bring the following:

(1.) A completed Request for Missed Term Work 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 an **original** copy of the official UTSC Verification of Illness Form (http://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.

For missed **ASSIGNMENTS** due to ILLNESS:

- Submit **both** (1.) a **hardcopy** of the Self-Declaration of Student Illness Form (http://uoft.me/PSY-self-declare-form), **and** (2.) the **web-based** departmental declaration form (http://uoft.me/PSY-self-declare-web).

For missed term tests or assignments in OTHER CIRCUMSTANCES:

- In the case of a **death of a family member**, a copy of a death certificate should be provided.

- In the case of a **disability-related concern**, an email from your Disability Consultant at AccessAbility Services should be sent directly to both the Course Coordinator (psychology-undergraduate@utsc.utoronto.ca) and your instructor, detailing the accommodations required.
- For U of T Varsity **athletic commitments**, an email from your coach or varsity administrator should be sent directly to the Course Coordinator (psychology-undergraduate@utsc.utoronto.ca), detailing the dates and nature of the commitment. The email should be sent **well in advance** of the missed work.

Documents covering the following situations are **NOT acceptable**: medical prescriptions, personal travel, weddings, or 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: Course Coordinator, Room SW427C, Monday – Friday, 9 AM – 4 PM

If you are unable to meet this deadline for some reason, you must contact the Course Coordinator via email (psychology-undergraduate@utsc.utoronto.ca) within the three business day window. Exceptions to the documentation deadline will only be made under exceptional circumstances.

Within approximately one week, you will receive an email response from the Course Instructor / Course Coordinator 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.

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.**

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

Mid-terms/exams that are missed without approved justification (see above) will receive a 0% mark.

If accommodation is granted:

- If you miss the first term test, your second term test will be a cumulative exam (based on lectures 1-8)
- If you miss the second term test, there will be one make up exam on the week of December 3rd. However, as this exam will be very close to the final exam, please note that this may take away from important preparation for the final exam.

Contesting a grade

Re-grade requests will only be considered within two weeks of the grade being received. These will only be considered if adequate written justification is provided by the student. If granted, re-grading will consist of re-evaluation of the complete assignment, potentially leading to a change in the grade in either direction, i.e. a grade increase, no change, or decrease. Requests without a solid rationale will not be considered (e.g. higher grade needed for entering grad school, etc.).

Video and Auditory Recording

For reasons of privacy and copyright, unauthorized video or audio recording in classrooms is prohibited. This is in accordance with the Provost's guidelines on Appropriate Use of Information and Communication Technology. Please note 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

As protection of copyright, unauthorized copying, use, or uploading on www of any of the lecture slides, lecture handouts or course materials produced by Professor Arruda-Carvalho is **strictly prohibited**.

AccessAbility statement:

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 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. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

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 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