

ACKNOWLEDGEMENT

UBC’s Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəyəm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

COURSE INFORMATION

Course Title	Course Code Number	Location	Credit Value
Behavioral Neuroscience 1	PSYC 370	AERL 120	3 credits

PREREQUISITES

One of PSYC 260, PSYC 270 and one of PSYC 217, PSYC 277 and one of PSYC 218, PSYC 278.

COREQUISITES

None

CONTACTS

Course Instructor(s)	Contact Details	Office Location	Office Hours
Jason Snyder	jasonsnyder@psych.ubc.ca --put “370” in the subject line to escape spam filters (especially yahoo users) --no email for course content questions (Piazza) --anonymous feedback: https://forms.gle/oWXyzyjCttpVjz8N7	UBC Hospital: Koerner Pavilion F128	--Q&A will primarily occur asynchronously on Piazza. --live Q&A will occur in class as time permits --if additional live Q&A is needed, reach out on Piazza and we will schedule something --catch me after class

COURSE INSTRUCTOR BIOGRAPHICAL STATEMENT

Hi. My name is Jason and you can call me that. You can call me Dr/Prof Snyder too, or J-Dawg, or any of my old nicknames (respect if you can find them). I still am a student of neuroscience because there will be tons to learn about the brain until the day I die. But I also was a student in a classroom, just like you, once upon a time. I did an undergraduate degree in Physiology at the University of Toronto, focusing on neuroscience in my upper years. I stayed in that department for my PhD, and studied the electrophysiological properties of newborn neurons in the hippocampus. In particular I studied long-term plasticity since I was (and still am) interested in the biological basis of memory. However, at some point I wanted to study more than just biology and wanted to link my findings more directly to behavior (since this is more relatable and is also the ultimate function of the brain). So, for the latter portion of my PhD I collaborated with psychologists and studied memory (impairments) in rats that lacked adult neurogenesis. After finishing my PhD I went to the National Institutes of Health in Bethesda, Maryland where I continued to study the function of adult-born neurons in memory, anxiety and depression-like behaviors in transgenic mice and rats. I did a bit more of this in Toronto at

SickKids Hospital before starting a lab and teaching at UBC in 2013. I draw on my background in physiology when teaching since modern approaches for studying the brain rely on an understanding of how neurons work, individually and cooperatively, so that they can be manipulated with precision. Also, behaviors can increasingly be understood in terms of their underlying physiological patterns of neuronal activity.

OTHER INSTRUCTIONAL STAFF

Teaching Assistant: Alyssa Ash, alyssa.ash@alumni.ubc.ca

COURSE STRUCTURE

This is my first time teaching in person since prior to covid, since last year I was on study leave. I hope to combine the fun and social aspects of in person teaching with some of the newer digital and asynchronous tools that have recently proved useful. Classes will be conducted in person, and will consist of lectures and group discussion/exercise sessions where we review concepts together and perform various exercises (pushups, situps etc) that reinforce what we have learned. Lecture slides will be provided on Canvas in advance and I aim to have classes will be recorded so that you can review them later if needed. Recorded classes are not meant as a substitute for attended class, since you will only be able to benefit from in-person activities if you are actually present in class and can engage directly. I will only post videos as a means to review since I know that sometimes it can be difficult to process content and write notes at the same time. Recordings are not to be shared outside of PSYC 370, since class content is only meant to be viewed in the context of the class itself. I encourage your attendance at live lectures so you can ask questions in real time, benefit from discussions and exercises, and enjoy my full wardrobe. We will use Piazza for online asynchronous discussion and Q&A; this will be where all course content questions should go, so that student peers can help answer questions and so that all can benefit from the questions that are asked. I look forward to seeing you in person, sharing what I know, and learning from you!

SCHEDULE OF TOPICS

Sept. 8	Lecture 1: Course intro and warmup
Sept. 13	Lecture 2: Neurons – anatomy and methods pt1
Sept. 15	Lecture 3: Neurons – anatomy and methods pt2
Sept. 20	Lecture 4: Membrane potential, action potential
Sept. 22	Lecture 5: Synaptic transmission
Sept. 27	Lecture 6: Synaptic transmission & circuits
Sept. 29	Lecture 7: Review, practice test
Oct. 4	Test 1 (Lectures 2-7)
Oct. 6	Lecture 8: Visual System (retina)
Oct. 11	Lecture 9: Visual System (pathways & circuits)
Oct. 13	Lecture 10: Visual System (cortex)
Oct. 18	Lecture 11: Auditory System
Oct. 20	Lecture 12: Somatosensory, Olfactory & Gustatory systems
Oct. 25	Test 2 (Lectures 8-12)

Oct. 27	Lecture 13: Ventral Stream, Association Cortex
Nov. 1	Lecture 14: Dorsal Stream, Association Cortex
Nov. 3	Lecture 15: Entorhinal cortex, hippocampus & place cells pt1
Nov. 8	Lecture 16: Entorhinal cortex, hippocampus & place cells pt2
Nov. 10	<i>midterm break</i>
Nov. 15	Lecture 17: Synaptic plasticity & memory encoding pt1
Nov. 17	Lecture 18: Synaptic plasticity & memory encoding pt2
Nov. 22	Test 3 (Lectures 13-17)
Nov. 24	Lecture 19: Memory consolidation and reconsolidation
Nov. 29	Lecture 20: Semantic memory and habit memory
Dec. 1	Lecture 21: Memory and Disorders pt1
Dec. 6	Lecture 22: Memory and Disorders pt2
Dec. 11-22	Exam Period - Test 4 (Lectures 18-22)

LEARNING OUTCOMES

The overarching goal is that by the end of 370 you will have a holistic picture of how sensory information enters the brain, is represented and remembered as a meaningful experience, and used to guide behavior. You will also understand the neurobiological basis of many of your everyday experiences (which will totally impress your friends at parties).

Here are specific learning outcomes and study topics:

- 1) You will appreciate that neurons and circuits are the foundational units of brain function, and you will understand the relative (dis)advantages of classic and state of the art methods for studying them. You be shocked to learn that, for many types of neurons, we do not even know exactly where they “wire up”, and therefore which exact circuits they are a part of. Despite the complexity and uncertainty, you will gain confidence that what we know about neurons in some (perhaps simpler) circuits can help us understand how they work in throughout the brain.
 - a. Visualizing neurons as anatomical building blocks
 - i. Methods including Golgi, dye injection, genetically-encoded fluorescent proteins, immunohistochemistry, electron microscopy, brain clearing, rabies virus
 - b. Neurons as physiologically functional building blocks
 - i. Action potentials conduct signals within neurons
 - ii. Synaptic transmission sends signals between neurons
 - c. Neurons cooperate to form circuits
 - i. Synaptic convergence/divergence, feedforward and feedback inhibition
 - ii. The stretch reflex: a simple circuit that regulates behavior

- 2) You will be able to identify shared and unique mechanisms by which various sensory stimuli are detected, converted to electrical signals and represented in the brain. Although photons, chemicals and force are very different types of physical stimuli they all need to be transformed into a common neural code.
 - a. Basic sensory anatomy and physiology explains many psychophysical phenomena
 - b. Visual, auditory/vestibular, somatosensory, chemical sensory systems

- i. Specialized sensory organs convert external stimuli into action potentials (sensory transduction)
 - ii. Neurons have receptive fields that relate to their function
 - iii. The spectrum of sensory stimuli is organized according to neuroanatomical maps
 - iv. Simple sensory neural representations are processed to form complex representations
- 3) You will appreciate that different memory systems learn about complementary aspects of experience. You will be able to draw on personal experience to recognize the advantages of episodic, semantic and habit types of memory (and also identify where they can lead you astray).
 - a. Sensory information pathways merge in the hippocampus to form episodic memories of specific experiences
 - i. Lateral and medial entorhinal cortex neurons represent object and spatial information, respectively
 - ii. Hippocampal neurons represent details of experiences and, together, they form memories that can be used flexibly
 - b. Synapses undergo plasticity to store memories in circuits
 - i. LTP as a synaptic model of memory
 - ii. Early LTP, late LTP and linking memories
 - c. Hippocampal memories transform and are consolidated into semantic/gist/factual memories in the neocortex
 - i. Standard model vs Multiple Trace model of memory consolidation
 - ii. Reconsolidation enables the continual updating of memories
 - d. The striatum forms habit-based memories (that can support or compete with hippocampal memories)
- 4) You will appreciate that memory guides future behaviors and is disrupted in many psychiatric conditions
 - a. Memories allow for imagination of future experiences
 - b. Memory generalization contributes to anxiety disorders
 - c. Aging and Alzheimer's disease impacts specific aspects of episodic memory

LEARNING ACTIVITIES

We will use a variety of different types of activities to learn the course content:

Lectures: Admittedly, this is not the most active type of activity, but I include it here for the sake of being complete.

Breakout discussion: We will regularly break from traditional lecturing by forming small groups during class time where you will discuss content, perform exercises and solve problems with one another. The instructor will hop around as best they can to try to provide some guidance in a more intimate fashion than can be achieved in the standard class format. After these breakout sessions, we will regroup as a full class and share what we have learned.

Piazza Asynchronous Discussion: Inevitably, questions will arise outside of class time. We will therefore use Piazza for asynchronous discussion. All course content questions should be posted in Piazza in the relevant forum and students are encouraged to provide answers, which will be

moderated, endorsed or elaborated upon by the instructor and the TA. In order to post a question, one first has to explain their understanding of the problem (i.e. don't just say "I don't understand X can someone explain it to me?"). This helps us identify where the confusion lies. Also, many times we answer our own questions when we think carefully about a problem and try to articulate it. To encourage participation, posting can be anonymous (to the class but not the instructor) and extra marks will be given to the top participants. Here is the signup link for the class Piazza forum: piazza.com/ubc.ca/winterterm12022/psyc370. Note that you can also get the app for your phone.

Other: This course has transformed as a result of the pandemic and the ease of online tools is making it much easier to try methods for teaching, learning and giving feedback. We may therefore explore other types of learning activities throughout the term (let me know if you have any suggestions!).

LEARNING MATERIALS

We will use Canvas as our online learning management system. Selected readings will be provided (for free) from the following textbook: Kandel, E.R. et al. (2012), Principles of Neural Science, 5th Edition. **The textbook readings are not mandatory but they are highly recommended;** they complement and expand upon the class material. If you are looking for a good general neuroscience textbook I would recommend you buy this one. Also, Neurobiology: A Functional Approach by George F. Striedter is very good, and we will draw upon portions of this one for PSYC 371 (again, relevant portions provided for free, but the book is worth purchasing as a reference).

Other notes and learning materials will be compiled and provided as lecture slides and associated content (eg videos). **All of the material covered in lectures, and present in the lecture slides, is testable.**

ASSESSMENTS OF LEARNING

Tests: There will be 4 closed-book tests, spaced approximately equally throughout the term. Each test will be worth 25% of the final grade (100% of total course grade) and will consist of short answer, multiple choice, fill in the blank and interpretive dance questions. If you miss or cannot write a test let us know within 24 hours and we will schedule an alternate date. The TA will set aside time to review tests with you after you get your grades.

Bonus participation marks: an extra 2% for the top 3 people, and an extra 1% to the next 2 people, who contribute to the richest discussion and learning environment on Piazza (participate frequently, provide good questions, insightful observations, useful answers and the like).

Regrading: In cases where there is regrading of an assignment or exam, the entire question or assignment will be regraded and the new grade will replace the old grade.

A NOTE ON CHEATING

I never had this section in my syllabus until online teaching came about and everyone got nervous about how to assess learning in a fair way. Of course, now we are in person and so many of those

concerns are no longer with us. But cheating will always be around, no matter where you are in life, and so it is worth thinking about. Personally, I believe people are honest and good at the core. But stuff happens that can make it hard for us all to be the way we are supposed to be. When you look around the classroom at your peers, do agree? Do you see good people people that need to be cared for and supported? Would you hurt them physically? Probably not. Would you hurt them emotionally or want them to suffer academically? Probably not! But this is what happens when someone cheats; it affects everyone else because you are all being ranked with respect to one another. This is to say nothing of the fact that the personal consequences of cheating / lying / misconduct can be tremendous, and difficult to live down if you are ever caught. So, with that said, let's make this a collaborative, supportive and fair learning environment

DEPARTMENT OF PSYCHOLOGY POSITION ON ACADEMIC MISCONDUCT

Cheating, plagiarism, and other forms of academic misconduct are very serious concerns of the University, and the Department of Psychology has taken steps to alleviate them. In the first place, the Department has implemented software that can reliably detect cheating on multiple-choice exams by analyzing the patterns of students' responses. In addition, the Department subscribes to TurnItIn – a service designed to detect and deter plagiarism. All materials (term papers, lab reports, etc.) that students submit for grading will be scanned and compared to over 4.5 billion pages of content located on the Internet or in TurnItIn's own proprietary databases. The results of these comparisons are compiled into customized "Originality Reports" containing several sensitive measures of plagiarism; instructors receive copies of these reports for every student in their class. In all cases of suspected academic misconduct the parties involved will be pursued to the fullest extent dictated by the guidelines of the University. Strong evidence of cheating or plagiarism may result in a zero credit for the work in question. According to the University Act (section 61), the President of UBC has the right to impose harsher penalties including (but not limited to) a failing grade for the course, suspension from the University, cancellation of scholarships, or a notation added to a student's transcript. All graded work in this course, unless otherwise specified, is to be original work done independently by individuals. If you have any questions as to whether or not what you are doing is even a borderline case of academic misconduct, please consult your instructor. For details on pertinent University policies and procedures, please see Chapter 5 in the UBC Calendar (<http://students.ubc.ca/calendar>) and read the University's Policy 69 (available at <http://www.universitycounsel.ubc.ca/policies/policy69.html>).

COVID SAFETY

For our in-person meetings in this class, it is important that all of us feel as comfortable as possible engaging in class activities while sharing an indoor space. Non-medical masks that cover our noses and mouths are a primary tool to make it harder for COVID-19 to find a new host. Please wear a non-medical mask during our class meetings, for your own protection, and the safety and comfort of everyone else in the class. If you have not yet had a chance to get vaccinated against COVID-19, vaccines are available to you, free (see <https://covid19.ubc.ca/> for more information). The higher the rate of vaccination in our community overall, the lower the chance of spreading this virus. You are an important part of the UBC community. Please arrange to get vaccinated if you have not already done so.

If you're sick, it's important that you stay home – no matter what you think you may be sick with (e.g., cold, flu, other). If you think you might have COVID symptoms and/or have tested positive for COVID and/or are required to quarantine: You can do a self-assessment for COVID symptoms here: <https://bc.thrive.health/covid19/en>

Do not come to class if you are sick, have COVID symptoms, have recently tested positive for COVID, or are required to quarantine. This precaution will help reduce risk and keep everyone safer.

If you do miss class because of illness:

- Make a connection early in the term to another student or a group of students in the class. You can help each other by sharing notes. If you don't yet know anyone in the class, post on the discussion forum to connect with other students.
- Consult the class resources on Canvas. We will post all the slides, readings, and recordings for each class day
- Use the Piazza discussion forum for help

If you are sick on a midterm exam day, please email the instructor as soon as you are confident you should not come to the scheduled exam. We would strongly prefer that you contact us to make an alternate arrangement than for you to come to the exam while you are ill. If you do show up for an exam and you are clearly ill, we will make alternate arrangements with you. It is much better for you to email ahead of time and not attend.

If you are sick on a final exam day, do not attend the exam. You must apply for deferred standing (an academic concession) through Science Advising no later than 48 hours after the missed final exam. Students who are granted deferred standing write the final exam/assignment at a later date. Learn more and find the application online: <https://science.ubc.ca/students/advising/concession>

If I (the instructor) am sick: I will do my best to stay well, but if I am ill, develop COVID symptoms, or test positive for COVID, then I will not come to class. If that happens, here's what you can expect:

- If I am well enough to teach we may have an online session or two. If this happens, you will receive an emailed announcement via Canvas telling you how to join the class. You can anticipate that this would very likely be a last minute email. Our classroom will still be available for you to sit and attend an online session, in this (hopefully rare) instance.
- Possibly our TA, Alyssa Ash, will substitute teach
- If I am not well enough to teach then class will be cancelled and I will post a video of the lecture for later viewing/study

UNIVERSITY POLICIES

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members

of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on [the UBC Senate website](#).

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