

Neuroanatomy and Neurophysiology (PNB 2XB3)

Term 1, 2017

Course Description

Following an introduction to the organization of the nervous system, this course describes the electrical and chemical properties of the fundamental unit of the nervous system, the neuron, and how neurons communicate with one another. It then surveys the physiology and functional anatomy of touch, vision, audition, vestibular sensation, movement, and memory. Both the normal functioning and particular pathologies of these systems are discussed. The course also surveys important neuroscience investigative techniques. Students complete online lecture prep quizzes, in-class critical thinking brain teasers, weekly homework assignments, a midterm test, and a comprehensive final exam.

Class Meetings

7:00 - 10:00 PM, ITB 137

Instructor

Dr. Daniel Goldreich, goldrd@mcmaster.ca
Office hour: Wednesday, 4:30 - 6:00 PM (PC 413).

Objectives

Upon successful completion of this course, students will understand the:

- structure and subdivisions of the nervous system.
- organizing principles of functional neuroanatomy, such as contralaterality, topography, and bilateral symmetry.
- scales of the nervous system, such as the numbers and sizes of neurons, and the density of sensory receptors.
- electrochemical properties of the fundamental unit of the nervous system, the neuron.
- mechanisms underlying electrical impulse (action potential) formation and conduction.
- electrochemical events that occur at the site of inter-neuronal communication, the synapse.
- fundamental neurophysiological processes of the sensory systems, such as transduction and adaptation.
- pathways for touch and pain/temperature sensation, from the skin to the somatosensory cortex.
- biochemistry of phototransduction and adaptation in photoreceptors, and neural retinal circuitry.
- central visual pathways, including the retino-geniculo-cortical pathway, and how these contribute to visual perception.
- anatomy of audition, and mechanisms of acousto-electric transduction and sound localization.
- mechanisms of vestibular transduction, central vestibular pathways, and the etiology of common vestibular disorders.
- lower and upper motor control circuits, and the etiology of common motor pathologies.
- brain areas involved in memory acquisition and storage, and associated memory pathologies.
- mechanisms of synaptic plasticity thought to underlie several forms of learning and memory.
- important histological, electrophysiological, and imaging techniques used to study the nervous system.

Required Materials

- Textbook: Purves, D. et al. (2012) *Neuroscience, 5th Ed.* Sunderland, MA: Sinauer
- Calculator: McMaster standard calculator (Casio FX-991). This is available at the McMaster University Store. Students should bring their McMaster standard calculator to each class, to the midterm test, and to

the final exam. No other calculator is permitted.

Evaluation

The student's course percentage score is a weighted average of the following five items:

Item	Weight
Online Prep Quizzes	2%
Brain Teasers	3%
Homework Assignments	15%
Midterm Test	30%
Comprehensive Final Exam	50%

These item weightings are nonnegotiable and will not be modified at the request of the student.

Online Prep Quizzes

- The prep quizzes are online quizzes designed to encourage students to study the slides and readings relevant to the upcoming lecture.
- Students must complete the prep quiz online, without collaboration, prior to the lecture.
- The student's prep quiz percentage score, entered into the course grade calculation, is the average of their prep quiz scores throughout the semester.

Brain Teasers

- The brain teasers are in-class exercises designed to encourage critical thinking about neuroscience.
- Unless otherwise specified by the instructor, students are forbidden from using any material whatsoever (e.g., textbook, notes) or any electronic device during the brain teaser exercise. They may have on their desk only a blank piece of paper and a pen or pencil.
- Some of the brain teasers require a calculator; the student should bring the McMaster Standard calculator (Casio FX-991) to class. The instructor will announce whether a calculator is permitted for the brain teaser exercise.
- At least one brain teaser will be given in each class period.
- Unless otherwise announced, each brain teaser exercise is worth 2 points.
- Each answer will typically receive either zero, half, or full-credit (0, 1, or 2 points), though in some cases partial marks (0.5 or 1.5) are also given.
- The student's brain teaser percentage score, entered into the course grade calculation, is the number of brain teaser points earned divided by the total number of points possible, multiplied by 100%. For example, if the course had 10 brain teasers worth a total of 20 points, and the student earned 15 points, then the student's brain teaser percentage score would be $(15/20)(100\%) = 75\%$.

Homework Assignments

- Each homework assignment is due at the beginning of the corresponding class period. Late homework returns will not be accepted.
- Students are encouraged to type their answers whenever possible.

- Students are encouraged to study with a partner or in a group when attempting to answer the assignment questions. However, students must write their own assignment answers and must submit their assignments individually. Copying part or all of another student's assignment is strictly prohibited and will result in a failing grade on the assignment.
- Points will be deducted for correct but irrelevant statements in students' answers.
- The relative point value of each question will be indicated on the homework assignment. The score for the entire homework assignment will always be reported on a 0-to-100% scale. For example, suppose an assignment has three questions, worth 10, 10, and 20 points. If a student earns half credit on the first question, full credit on the second, and half credit on the third, then the student's score will be $5 + 10 + 10 = 25$, and the score will be reported as 62.5% (i.e., $25 / 40$).
- At the end of the term, the student's lowest homework assignment score will be dropped. The average of the student's remaining homework assignment scores will then be calculated. This is the student's course homework score.
- You may review your marked homework assignments during Dr. Goldreich's office hours. You may also take away any of your marked homework assignments with you to study. If you do choose to take your assignment, you are not allowed later to ask for a reconsideration of the marking.

Midterm Test and Final Exam

- The midterm test and final exam contain some questions that require a calculator. Only the McMaster standard calculator is allowed.
- Any material covered in class (lectures and brain teasers) and in homework assignments may appear on the test or exam; questions based on this material will account for at least 90% of the points. In addition, some questions may be drawn from material in the assigned textbook chapters that is not covered in class or homework. These questions will be worth no more than 10% of the exam's points.
- Points will be deducted for correct but irrelevant statements in students' answers.
- The test and exam are given a mark on a scale from 0 - 100%.
- The midterm test includes material from all course topics covered prior to the test.
- The final exam is comprehensive; it includes material from all course topics.

Course Percentage Score Calculation Formula

- Students' course percentage scores will be calculated according to the formula: Course percentage score = (course prep quiz score)(0.02) + (course brain teaser score)(0.03) + (course homework score)(0.15) + (midterm test score)(0.30) + (final exam score)(0.50)
- Students' letter grades will be determined from their course percentage scores, as follows: A+ (90-100), A (85-89), A- (80-84), B+ (77-79), B (73-76), B- (70-72), C+ (67-69), C (63-66), C- (60-62), D+ (57-59), D (53-56), D- (50-52), F (0-49).

Homework and Lecture Slides

This table shows weekly lecture topics, corresponding textbook readings, and homework assignments. Students are encouraged to read the assigned material prior to each class period. Prior to each class, the instructor will post the majority of the slides to be shown in lecture. For your convenience, the slides will be posted in three PDF formats: Small (four slides per page), Lined (three slides per page, with lines on the right for taking notes), and Large (one full-size slide per page).

Week	Date	Topic	Work Due	Reading

1	Sep. 7	The Nervous System and the Resting Neuron	--	Chs. 1, 2, Appendix (p. 717-728)
2	Sep. 14	The Action Potential	Assignment 1 Prep Quiz 1	Chs. 2, 3
3	Sep. 21	Action Potential Conduction and Synaptic Transmission	Assignment 2 Prep Quiz 2	Chs. 4, 5, 6
4	Sep. 28	Somatosensory System	Assignment 3 Prep Quiz 3	Chs. 9, 10
5	Oct. 5	Eye and Retina	Assignment 4 Prep Quiz 4	Ch. 11, Ch. 12 (p. 257-259)
6	Oct. 19	Midterm Test (2 hours)	--	
7	Oct. 26	Central Vision	Prep Quiz 5	Chs. 12, 24 (p. 543-549)
8	Nov. 2	Auditory System	Assignment 5 Prep Quiz 6	Ch. 13
9	Nov. 9	Vestibular and Motor Systems	Assignment 6 Prep Quiz 7	Chs. 14, 16, 17
10	Nov. 16	Synaptic Plasticity and Memory	Assignment 7 Prep Quiz 8	Chs. 8, 31
11	Nov. 23	Special Guest Lecture: Dr. Deda Gillespie	Assignment 8 Prep Quiz 9	Kauer (2005), Gillespie et al. (2005)
12	Nov. 30	Course review session: Neuroscience Cup competition	--	
	TBA	Final Exam (2.5 hours; comprehensive)	--	

Note: The course schedule may be modified during the semester, at the discretion of the instructor. Any modifications will be made directly to the table above and announced in class.

Study Sessions

To do well in this course, as in any challenging course, you must work diligently and intelligently outside of the classroom as well as inside. You must take ownership of your learning in order to deepen and consolidate your understanding of the fascinating field of neuroscience. Paying careful attention during lectures is only the first step. To learn neuroscience, you will need to continue studying hard outside of class - reviewing your lecture notes, completing the homework assignments, reading the textbook, and interacting with other students to exchange ideas. How much you get out of this course depends on how much time, energy and enthusiasm you put into it! How well and how much you learn is up to you!

We expect you to work hard, and we are also here to help you and to facilitate your learning. We encourage you to work with other students, to post questions and exchange ideas with your fellow students on the synapse discussion forum, and to take advantage of the help offered by our teaching team. We have a talented team of

individuals to help you! Some are graduate students (teaching assistants - TAs) and others are undergraduates (neuroscience consultants - NCs). All are highly qualified individuals and a great resource for you!

Drop-In Study Sessions (No Appointment Needed)

In addition to the prof's office hour, the teaching team offers weekly drop-in study sessions. Come to any study session to ask an NC or TA your questions about the course content or for guidance as you work through the homework assignment, or just come by to meet and interact with your fellow students as you study. For your convenience, we have five drop-in sessions each week (no appointment needed):

Day	Time	Place	Get help from
Monday	4:30 - 5:20 PM	PC 316	Alisha, Jhanahan
Tuesday	2:30 - 3:20 PM	PC 316	Farah, Mina, Nel
Wednesday	2:30 - 3:20 PM 4:30 - 6:00 PM	PC 316 PC 413	Akash, Sebastian Dr. Goldreich
Thursday	10:30 - 11:20 AM	PC 316	Alicia, Omer

If you're curious to learn more about the drop-in teaching team, click on their names in the table.

Individual Help (By Appointment Only)

If what you're looking for is individual help, we have team members on-call for individual office hour appointments. You may contact any of the TAs listed below to make an individual appointment (click on the TA's name to read about them and to find their email address). Each TA is committed to up to 5 hours per semester of individual appointments; once they reach that time, their name will be removed from the list:

Keon
Daniel
Zeeshan
Sabrina
Michael

Policies

Recording

Photographs and video recordings are strictly prohibited. Students may make audio recordings of the lectures, for personal use only and not to be posted online, emailed, distributed or otherwise shared. Students should inform the instructor in advance if they wish to make an audio recording.

Cell Phone Use

Cell phone use, including texting, is prohibited in the classroom. Students who need to use their cell phones should leave the classroom and return when they have finished. Cell phone use in the classroom is distracting to the professor and to nearby students, and studies have shown that students who use their phones in class learn less and obtain lower grades. For more information, see:

Kuznekoff JH, Titsworth S (2012) The impact of mobile phone usage on student learning. *Communication Education* 62(3): 233-252.

Brenner T (2015) The use of mobile devices in the college classroom. *Derek Bok Center for Teaching and Learning, Harvard University*.

Weimer M (2012) Students think they can multitask. Here's proof they can't. *Faculty Focus*.

Laptop Computer Use

Students who use laptop computers are expected to do so for valid classroom purposes only (i.e., taking notes and displaying the posted lecture slides). Studies have shown that students who use laptops to engage in activities that are irrelevant to the course (such as social media or internet browsing) distract both themselves and their fellow students, and suffer from diminished understanding of the course material. For more information, see:

Sana F, Weston T, Cepeda N (2013) Laptop multitasking hinders classroom learning for both users and nearby peers. *Computers & Education* 62: 24-31.

Brenner T (2015) The use of mobile devices in the college classroom. *Derek Bok Center for Teaching and Learning, Harvard University*.

Weimer M (2012) Students think they can multitask. Here's proof they can't. *Faculty Focus*.

Email

In any email you send to the instructor or any teaching team member, please write "PNB 2XB3" in the subject line. Your email should concern logistical course issues only (e.g., to request an appointment, to ask for clarification regarding the due date of an assignment, etc.). Please do not email us with neuroscience questions; we will not answer such questions by email. Instead, specific neuroscience questions should be asked in the work/help sessions or in class. In addition, you are strongly encouraged to ask questions on the Synapse discussion forum, where other students can help to answer them.

Assignment Submission

Homework assignments are to be submitted at the front of the classroom before the start of lecture. You are encouraged to type your assignment answers, but legible handwritten answers are also acceptable. Late submissions will not be accepted. If a student is unable to attend class because of illness or transportation problems, but has completed the homework assignment, then the student should submit the homework assignment by email, prior to the start of the class period, to the instructor (goldrd@mcmaster.ca). Late email submissions will not be accepted.

Assignment Pickup

You may pick up your graded homework assignments each week in Dr. Goldreich's office hour. Be sure to look over your assignment before you leave the office; re-marking requests are not permitted after you leave the office.

Missed Work

Please see the university policy statement concerning missed work. Students who are absent for no more than three days may report their absence, once per term, without documentation, using the McMaster Student Absence Form (MSAF). Please note that the MSAF may not be used for term work worth 25% or more of the course grade, nor can it be used for the final examination. This means that the MSAF cannot be used for the midterm test or the final exam in this course. Absences of more than three days must be reported to the student's Faculty/Program office, with documentation, and relief from course work may not necessarily be granted. A mark of zero will automatically be entered for all missed work until the instructor receives notification from the MSAF system or the student's Faculty Office, and is contacted by the student to discuss how to remedy the missed work situation. It is the student's responsibility to learn all material that the student has missed for any reason. This can be done by reading the posted lecture notes and assigned textbook chapters, by consulting with classmates, and by attending office hours.

Test Review

Specific office hours will be announced for test review. Bring your McMaster ID card to review your test.

Academic Integrity

As a student, you are expected to behave honestly and ethically at all times. According to McMaster University's Academic Integrity Policy, you are engaging in academic dishonesty if you "knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage" (Academic Integrity Policy, p. 6). This behaviour can result in serious consequences, such as a grade of zero on an assignment, loss of credit with a

notation on the transcript that reads "Grade of F assigned for academic dishonesty," and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. The following are just three forms of academic dishonesty:

1. Plagiarism.
2. Improper collaboration.
3. Copying or using unauthorized aids in tests and examinations.

For more information on academic dishonesty and academic integrity, please read the Academic Integrity Policy: <http://www.mcmaster.ca/academicintegrity>

Please also read Dr. Goldreich's tutorial Write ethically: avoid plagiarism. You must print and return the signed acknowledgement of understanding along with your first homework assignment.

Note Regarding Course Dates and Deadlines

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If such modification becomes necessary, reasonable notice will be given. It is the responsibility of the students to check their McMaster email and course websites weekly during the term and to note any changes.