

# Neuroanatomy & Neurophysiology (PNB 2XB3)

Term 1, 2016 (Tuesdays, 7:00 - 10:00 PM, MDCL 1105)

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## 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 in-class critical thinking activities called Brain Teasers (worth 5% of the course grade), weekly homework assignments (15%), a midterm exam (30%), and a comprehensive final exam (50%).

Instructor:

[Dr. Daniel Goldreich](#)

goldrd@mcmaster.ca

Office hour: Mondays, 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

Required Textbook: Purves, D. et al. (2012) *Neuroscience, 5th Ed.* Sunderland, MA: Sinauer

Required Calculator: McMaster standard calculator (Casio FX-991). This calculator is available at the McMaster University Store. Students should bring their McMaster standard calculator to each class, to the midterm exam,

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:

<b>Item</b>	<b>Weight</b>
Brain Teasers	5%
Homework Assignments	15%
Midterm Exam	30%
Comprehensive Final Exam	50%

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

In addition to the above graded components, there are three ways for students to earn optional extra credit points in this course.

### **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 score is reported online in the Check Marks system, and updated weekly.
- 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**

- Homework assignments will be linked from the schedule table (below).
- 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.
- 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.,  $25 / 40$ ).

- The student's homework assignment scores are reported online in the Check Marks system.
- 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 Exam and Final Exam

- The midterm exam 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 exams; questions based on this material will account for at least 90% of the exam's points. In addition, each exam will include some questions 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.
- Each exam is given a mark on a scale from 0 - 100%.
- The midterm exam includes material from all course topics covered prior to the exam.
- The final exam is comprehensive; it includes material from all course topics.

### Extra Credit

- There are three ways for students to earn extra credit points in this course: Stump the Prof, Create a Question, and Delve Deeper:

#### Stump the Prof (2 extra credit points)

If, in class, you raise an excellent question that the professor cannot answer, the professor may nominate you for a Stump-the-Prof opportunity. If you are able to find the answer to the question in a reputable source article, and email the answer to the professor, summarizing the finding of the source article entirely in your own words, in a written statement of no more than 500 words length, and properly referencing the article, then you will earn two extra credit points. Popular press articles, news sites, and blogs are not acceptable sources; the source must be a published scholarly article (i.e., a research or clinical neuroscience article published in a peer-reviewed journal) that you have carefully read and understood). You may be awarded a maximum of two Stump-the-Prof opportunities per semester.

#### Create a Question (2 extra credit points)

As an optional exercise, students are encouraged to try to generate an excellent midterm or final exam question of their own. Questions that are carefully and articulately worded, and that probe student understanding of important concepts, will be considered for inclusion. You must email the professor your proposed question and its answer at least one week prior to the exam date. If your question is used on an exam, you will earn two extra credit percentage points on that exam. The professor will not inform you in advance of the exam whether your question will be used, and will not provide feedback as to whether your answer is correct. If your question is used, your name will not be attached to the question, but a note will indicate that the question was student-generated. If it is used, your question may be edited and/or otherwise modified by the professor. You may submit only one Create-a-Question per exam.

#### Delve Deeper (up to 6 extra credit points)

This is a challenging group term paper and presentation project. Groups of 4 or 5 students select a neuroscience topic of their choosing from among a list of posted categories. If their

topic is approved by the instructor, they will find, read, analyze, and synthesize original scientific research articles on the topic, and write a term paper. Groups that produce top term papers will be invited to give slide presentations to the class. Information presented in the groups' slide presentations will be testable on the final exam. For further information about this challenging project, including important deadlines, see the Delve Deeper information page.

- The student's extra credit points, if any, are reported online in the Check Marks system. Extra credit points earned before the midterm exam are applied to the student's midterm exam score. For example, a student with 2 extra credit points who scores 80% on the midterm exam will receive a mark of 82%. Extra credit points are added to the midterm exam score up to a maximum of 100%. Any remaining points are then held over to the final exam. For example, if a student with 4 extra credit points scores 98% on the midterm exam, then the student's midterm exam score will be recorded as 100%, and the student's remaining 2 extra credit points (as well as any newly earned points) will be applied to the final exam. Because the Delve Deeper paper is due after the midterm, any Delve Deeper extra credit points will be applied to the final exam.

### Course Percentage Score Calculation Formula

- Students' course percentage scores will be calculated according to the formula: Course percentage score = (course brain teaser score)(0.05) + (course homework score)(0.15) + (midterm exam 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).

### Schedule

The table below 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). Note: if you click the link to the lecture slides, your browser may display the PDF in a window; to save the PDF to your computer, you can right-click the link and select to save the file.

<b>Week</b>	<b>Date</b>	<b>Topic</b>	<b>Homework Due</b>	<b>Reading</b>
1	Sep. 6	The Nervous System and the Resting Neuron	--	Chs. 1, 2, Appendix (p. 717-728)
2	Sep. 13	The Action Potential	Assignment 1	Chs. 2, 3
3	Sep. 20	Action Potential Conduction and Synaptic Transmission	Assignment 2	Chs. 4, 5, 6

4	Sep. 27	Somatosensory System	Assignment 3	Chs. 9, 10
5	Oct. 4	Eye and Retina	Assignment 4	Ch. 11, Ch. 12 (p. 257-259)
6	Oct. 18	<b>Midterm Exam</b> (2-hours long, 7:00 PM)		
7	Oct. 25	Central Vision	--	Chs. 12, 24 (p. 543-549)
8	Nov. 1	Auditory System	Assignment 5	Ch. 13
9	Nov. 8	Vestibular and Motor Systems	Assignment 6	Chs. 14, 16, 17
10	Nov. 15	Synaptic Plasticity and Memory	Assignment 7	Chs. 8, 31
11	Nov. 22	Special Guest Lecture	Assignment 8	TBA
12	Nov. 29	Group presentations	--	--
13	Dec. 6	Course review session	--	--
	TBA	<b>Final Exam</b> (comprehensive, 2.5-hours long)		

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.

### **How to do well in this course**

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!

### **Help Outside of Class**

An important part of taking responsibility for your learning is to seek help when you're confused and can't figure things out on your own. We expect you to work hard, and we are also here to help you. There are many ways to seek help: we encourage you to study in a group with other students, to post questions and exchange ideas with your fellow students on the synapse discussion forum, and to take advantage of our many weekly help sessions. 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! In addition, we can offer you an individual office hour by appointment. If you are unable to make any of the drop-in hours, or if you simply prefer some individual tutoring, you may make an appointment to meet with one of our on-call teaching assistants (TAs). Just email the TA to set up a time and place to meet. Each TA is available for an hour per week.

## **Policies**

### **Email Policy**

In any email you send to the instructor, a TA, or an NC, please write "PNB 2XB3" in the subject line. Any email you send to us should be about logistical course issues only (e.g., to set up an appointment with an on-call team member, to ask for clarification concerning the due date of an assignment, etc.). Please do not email the instructor, the TAs, or the NCs with neuroscience questions; we will not answer such questions by email (we will also not answer such questions on the discussion forum). Instead, specific neuroscience questions should be asked in office hours or in class. In addition, students are strongly encouraged to ask questions on the course online discussion forum, where other students can help to answer them.

### **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 Phones**

Cell phone use, including texting, is prohibited in the classroom. Students who need to use their cell phones are expected to 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.\*](#)

### **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.

If a student is unable to attend a class, but has been able to complete the homework assignment, then the student should submit the homework assignment by email, prior to the start of the class period, to the instructor. Late email submissions will not be accepted.

### **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.

### **Online Privacy**

This course makes use of an online grade check system. This system is designed to keep private the information you provide to register for and access this system, and to prevent others from accessing your grades. However, you should be aware that the transmission of information on this or any other web site always carries some risk that the information will become public (for example, if the web site is "hacked"). Your use of the grade check system will be interpreted to indicate that you accept this risk. If you have any questions or concerns about the privacy of your information, please discuss these with the instructor.

### **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.