

# Neuroanatomy & Neurophysiology (PNB 2XB3)

Term 1, 2013

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## 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 will be discussed. The course also surveys important neuroscience investigative techniques. Lectures are interspersed with critical thinking activities called Brain Teasers, which collectively account for 10% of the course grade. In addition, students will complete weekly homework assignments (10%), a midterm test (30%), and a comprehensive final exam (50%).

Meetings:

Class: Thursdays, 7:00 - 10:00 PM, MDCL/1105.

Tutorial: Mondays, 9:30 - 10:20 AM, ITB/AB102.

Course website:

<http://psych.mcmaster.ca/2XB3/>

The website password will be announced in the first lecture, Thursday Sept. 5.

## Instructor

Dr. Daniel Goldreich

Psychology Bldg. room 413

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## 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 acoustoelectric 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 test, and to the final exam. No other calculator is permitted.

### **Schedule**

The course meets once per week: Thursdays, 7:00 - 10:00 PM, in MDCL/1105. An optional tutorial is held Mondays, 9:30 - 10:20 AM in ITB/AB102. The table below shows weekly lecture topics, assigned readings, and homework assignments. Students are encouraged to read the assigned textbook chapters prior to each class period. The day before each class, the instructor will post the majority of the slides to be shown in lecture. Postings will be in three formats: PDF Large (a PDF file with each slide on its own page), PDF Small (4 slides per page), and JPG (a self-extracting archive of jpg files, convenient for loading into applications such as Keynote and Powerpoint).

<b>Week</b>	<b>Date</b>	<b>Topic</b>	<b>Homework</b>	<b>Reading</b>
1	Sep. 5	Neurons & Nervous Systems	--	Chs. 1, 2, Appendix (p. 717-728)
2	Sep. 12	Resting Potential & Action Potential	Assignment 1 (Due Sept. 12)	Chs. 2, 3
3	Sep. 19	Action Potential Conduction & Synaptic Transmission	Assignment 2 (Due Sept. 19)	Chs. 4, 5, 6

4	Sep. 26	Somatosensory Systems	Assignment 3 (Due Sept. 26)	Chs. 9, 10
5	Oct. 3	Eye & Retina	Assignment 4 (Due Oct. 3)	Ch. 11
6	Oct. 7	Midterm review session 9:30 - 10:20 AM		
	Oct. 10	<b>Midterm Test</b> (2-hours long)	--	--
7	Oct. 17	Central Vision	--	Chs. 12, 24 (p. 543-549)
8	Oct. 24	Auditory System	Assignment 5 (Due Oct. 24)	Ch. 13
9	Nov. 7	Vestibular and Motor Systems	Assignment 6 (Due Nov. 7)	Chs. 14, 16, 17
10	Nov. 14	Synaptic Plasticity & Memory	Assignment 7 (Due Nov. 14)	Chs. 8, 31
11	Nov. 21	Neuroscience Techniques	Assignment 8 (Due Nov. 21)	Boxes 3A, 4A, 28A, 28C
12	Nov. 28	Course review session	Assignment 9 (Due Nov. 28)	
		<b>Final Exam</b> (comprehensive, 3-hours long) TBA	---	

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.

### **Evaluation**

Any material covered in class (lectures and brain teasers) and in homework assignments may appear on tests. Questions based on this material will account for at least 90% of each test's points. In addition, each test will include several 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 test's points.

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

Item	Weight
Homework Assignments	10%
Brain Teaser Exercises	10%
Midterm Test	30%
Comprehensive Final Exam	50%

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

### Homework

- Homework assignments will be linked from the schedule table (above).
- 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 may collaborate on homework assignments, if they wish, and collaborating students may choose to submit a single, group answer (maximum group size: three students). If this is done, then the name and student number of each contributing student must appear on the homework submission. Each student in the group will receive the same mark on that homework assignment. Students may change groups throughout the semester, or choose to submit their assignments individually.
- 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 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.

### 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 receive either zero, half, or full-credit (0, 1, or 2 points).
- 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  $(15/20)(100\%) = 75\%$ .

### Midterm Test and Final Exam

- The midterm test and final exam (referred to here collectively as "exams") 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.
- Each exam is 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 covers material from all course topics.

### Extra Credit

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

#### Help-a-Peer (1 extra credit point)

Students who provide an excellent, original answer on the Heads-Together forum, in response to another student's question regarding the course material, will earn an extra credit percentage point. An excellent answer is one that correctly and articulately explains a conceptually challenging topic. The answer is original if no similar answer has yet been posted by another student. A student may earn a maximum of two Help-a-Peer extra credit percentage points per week.

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

If, in class, a student raises an excellent question that the professor cannot answer, the professor may nominate the question for a Stump-The-Prof exercise. If the student who asked the question is able to find a documented (original source, such as a research article) answer to the question, and email the answer to the professor, the student will earn two extra credit percentage points. A student may earn a maximum of two Stump-The-Prof extra credit points per week.

### Create-a-Question (3 extra credit points)

As an optional exercise, students are encouraged to try to generate an excellent test or 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. Please email the instructor your proposed question and its answer. If your question is used on the test/exam, you will earn three extra credit percentage points on that test/exam. The instructor will not inform you in advance of the test/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 instructor.

- The student's extra credit points, if any, are reported online in the Check Marks system. Extra credit points earned before the midterm test are applied to the student's midterm test score. For example, a student with 3 extra credit points who scores 80% on the midterm test will receive a test mark of 83%. Extra credit points are added to the test score up to a maximum of 100%. Any remaining points are then held over to the final exam. For example, if a student with 3 extra credit points scores 98% on the midterm test, then the test score will be recorded as 100%, and the student's remaining extra credit point (as well as any newly earned points) will be applied to the final exam.

### Course Percentage Score Calculation Formula

Each student's course percentage score will be calculated according to the formula:

Course percentage score = (course homework score)(0.10) + (course brain teaser score)(0.10) + (midterm test score)(0.30) + (final exam score)(0.50).

Students' letter grades will then be determined from their course percentage scores, as follows:

Course Letter Grade	Course Percentage Score
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

### **Missed Work**

If a student misses a class period, homework assignment, or test due to illness, personal circumstances, or for any other reason, it is the student's responsibility to notify the instructor and to follow all universities rules that apply to such circumstances. If you are absent from the university for a minor medical reason, lasting fewer than 5 days, you may report your absence, once per term, without documentation, using the McMaster Student Absence Form (MSAF). Absences for a longer duration or for other reasons must be reported to your Faculty/Program office, with documentation, and relief from term work may not necessarily be granted. When using the MSAF, report your absence to Dr. Goldreich: goldrd@mcmaster.ca. You must contact Dr. Goldreich as soon as possible (normally within 2 working days) by email at goldrd@mcmaster.ca to learn what relief may be granted for the work you have missed, and relevant details such as time and location of a make-up exam. Please note that, as specified in the university policy regarding missed academic work, the MSAF may not be used for term work worth 30% or more, nor can it be used for the final examination. This means that you cannot use the MSAF for the midterm test or final exam in this course.

If a student is absent for more than 5 days, or has more than one absence in the semester, then the student must go to the Associate Dean's Office to discuss their situation. A mark of zero will automatically be entered for all missed brain teaser exercises, homework assignments, and tests until the instructor receives notification from the MSAF system or the Associate Dean's office, and is contacted by the student to discuss how to remedy the missed work situation.

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 (goldrd@mcmaster.ca). Late email submissions will not be accepted.

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 and tutorial.

Tests missed due to illness or exceptional personal circumstances may be made up, or the course grade may be redistributed such that more weight is applied to the final exam, at the discretion of the instructor. Make-up tests may differ in format and specific content from the original.

### **Recording**

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 that they wish to make an audio recording. Photographs and video recordings are strictly prohibited.

### **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>.

### **Online Privacy**

This course makes use of an online discussion forum. You should be aware that your chosen forum user name will be apparent to all other students in the course. The technology used in the course web pages is designed to keep private all additional information you provide (your name, email address, password, etc.). However, you should be aware that submission of such 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" unlawfully). Your continuation in this course will be interpreted to indicate that you consent to the disclosure of your chosen user name in the online forum, and that you accept the risk of submitting the additional requested information. 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 student to check their McMaster email and course websites weekly during the term and to note any changes.