

# Fundamentals of Neuroscience (PSYCH 2F03)

Term 1, 2007

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## **Instructor**

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## **Teaching Assistants**

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(Office hours: TBA)

Note: Please do not email the teaching assistants or instructor with specific neuroscience questions. Instead, all such course content questions should be asked in office hours, in the tutorial sessions, or in class. Students are strongly encouraged as well to post such questions on the Heads-Together forum, where other students can help to answer them.

## **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, language and memory. Both the normal functioning and particular pathologies of these systems will be discussed. The course concludes with a survey of important neuroscience investigative techniques.

This course meets once per week in the evenings (Thursdays, 7:00 - 10:00 PM, in TSH / B128). An optional tutorial precedes each lecture period (Thursdays, 5:30 - 6:30 PM, in CNH / 104). Students who have unanswered questions about any of the course material, or who want to review the material, are encouraged to attend the tutorials.

Lectures will be interspersed with critical thinking activities called Brain Teasers, which collectively account for 15% of the course grade. In addition, students will be graded on weekly homework exercises, two midterm exams, and one comprehensive final exam (see below for grading details).

The course web site (<http://psych.mcmaster.ca/2f03/>) plays an important role in this course. The web site contains this syllabus, as well as links to neuroscience information on the web, a form for anonymous feedback to the instructor, and a password-protected system for students to check their marks. The web site also contains "Heads-Together," an online forum in which students may discuss their questions regarding the course material.

## **Objectives**

Upon completion of this course, the student will understand the:

- structure and subdivisions of the nervous system, and fundamental organizing principles of functional neuroanatomy, such as contralaterality, topography, and bilateral symmetry.
- anatomical and functional scales of the nervous system, such as the numbers and sizes of neurons, the density of sensory receptors, etc., and how to generate order-of-magnitude estimates using back-of-the-envelope calculation to explore these scales.
- special electrical properties of the fundamental unit of the nervous system, the neuron, and how these properties result in electrical impulse formation and conduction
- electrochemical events that occur at the site of inter-neuronal communication, the synapse.
- the modification of the synaptic strength (synaptic plasticity) by the processes of habituation, sensitization, and long-term potentiation
- fundamental neurophysiological processes of the sensory systems, such as transduction and adaptation, and the relevance of these processes to perception.
- functional neuroanatomy of the somatosensory system, including pathways for light touch and pain/temperature sensation.
- functional neuroanatomy and neurophysiology of the retina, including the biochemistry of phototransduction and adaptation in the rod and cone systems, and how these contribute to various attributes of human vision.
- functional neuroanatomy of the central visual pathways, how these pathways are thought to contribute to the perception of form, color, and motion, and the functional deficits that arise from injuries to and abnormal development of these pathways.
- functional neuroanatomy of the auditory system, including mechanisms of acoustoelectric transduction and azimuthal sound localization.
- functional neuroanatomy of the vestibular system and the etiology of common vestibular disorders
- functional neuroanatomy of lower and upper motor control circuits, and the etiology of common motor pathologies.
- neuroanatomy of language comprehension and production, evidence for language lateralization revealed by split-brain and other patients, and common language deficits (aphasias) that result from stroke.
- brain areas involved in memory acquisition and storage, and mechanisms of synaptic plasticity suspected to underlie learning and memory.
- most important histological, electrophysiological, and imaging techniques used to reveal the anatomy and functioning of the nervous system.

## Materials

Required Textbook: Purves, D. et al. (2007) *Neuroscience, 4th Ed.* Sunderland, MA: Sinauer

Required Calculator: The McMaster Standard Calculator (Casio FX-991) is permitted in exams and for in-class Brain Teaser exercises. This calculator is available at the McMaster Bookstore. No other calculator is permitted.

Textbooks for optional reading on course reserve (Mills and Health Science Libraries):

Neuroscience : Exploring the Brain / Mark F. Bear, Barry W. Connors, Michael A. Paradiso.

Principles of Neural Science / edited by Eric R. Kandel, James H. Schwartz, Thomas M. Jessell.

## Schedule

The table below shows weekly topics and assigned readings. Students are encouraged to read the assigned material prior to each lecture, and to review the material following each lecture. Following each lecture, the instructor will link each topic description to a PDF file containing the majority of the slides shown in the lecture. The homework assignments will be linked from the table as well.

Week	Date	Topic	Homework	Reading
1	Sept. 6	Organization of the Nervous System	--	Chs. 1, 26 (pp. 664-666); appendix
2	Sept. 13	Electrophysiology	Assignment 1 Due	Chs. 2, 3, 4
3	Sept. 20	Synaptic Transmission	Assignment 2	Chs. 5, 6
4	Sept. 27	Synaptic Plasticity	Assignment 3	Ch. 8
5	Oct. 4	<b>Midterm Exam 1</b>		
6	Oct. 11	Somatosensory Systems	Assignment 4	Chs. 9, 10
7	Oct. 18	Eye & Retina	Assignment 5	Ch. 11
8	Oct. 25	Central Vision	Assignment 6	Chs. 12, 24 (pp. 616-629)
9	Nov. 1	Auditory & Vestibular Systems	Assignment 7	Chs. 13, 14
10	Nov. 8	<b>Midterm Exam 2</b>		
11	Nov. 15	Motor Systems	Assignment 8	Chs. 16, 17
12	Nov. 22	Language & Memory	Assignment 9	Chs. 27, 31
13	Nov. 29	Neuroscience Techniques	Assignment 10	pp. 16-21, 42, 63, 163-4, 297, 715-17
		<b>Final Exam</b>		

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

**Evaluation**

The student is responsible for understanding all material covered in class (lectures and Brain Teaser exercises) and in the homework assignments. Any material covered in class or in homework assignments may appear on exams, including material that does not appear in the assigned readings.

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

<b>Item</b>	<b>Weight</b>
Brain Teaser Exercises	15%
Homework Assignments	15%
Midterm Exam 1	20%
Midterm Exam 2	20%
Comprehensive Final Exam	30%

The student's course grade will be determined from the student's course percentage score, as follows:

<b>Grade</b>	<b>Score</b>	<b>Grade</b>	<b>Score</b>	<b>Grade</b>	<b>Score</b>	<b>Grade</b>	<b>Score</b>
A+	90-100	B+	77-79	C+	67-69	D+	57-59
A	85-89	B	73-76	C	63-66	D	53-56
A-	80-84	B-	70-72	C-	60-62	D-	50-52
						F	0-49

**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. If this is done, then the name (typed) and signature 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. Each answer will receive either zero, half, or full-credit.

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 2, 4, and 4 points each. 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  $1 + 4 + 2 = 7$ , and the score will be reported as 70%.

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.

Prior to submitting their first homework assignment, students must complete the plagiarism tutorial. A signed acknowledgment of understanding must be submitted along with the first homework assignment.

### Brain Teasers

The brain teasers are in-class exercises designed to encourage critical thinking about neuroscience.

Some of the Brain Teaser exercises will require a calculator; the student should bring the McMaster Standard calculator (Casio FX-991) to class.

At least one brain teaser will be given in each class; the number of brain teasers will not usually exceed 3 per 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 percentage score is the number of brain teaser points earned divided by the total number of points possible. For example, suppose that, in the first two weeks of the course, 4 brain teaser exercises are given, worth 2 points each. If a student earned 1, 2, 2, and 1 on these four brain teasers, respectively, then the student's brain teaser percentage score after two weeks will be 6 out of 8, or 75%.

The student's running brain teaser percentage score is reported online in the check marks system.

### Exams

The exams will contain multiple choice questions, as well as some questions requiring drawings and short written answers.

A few questions will require calculations; the student should bring the McMaster standard calculator (Casio FX-991) to all exams. Only the McMaster standard calculator will be allowed.

Midterm exam 1 covers material from the first four course topics (weeks 1-4)

Midterm exam 2 covers material from the next four course topics (weeks 6-9)

The final exam is comprehensive; it covers material from all course topics.

Each exam is given a mark on a scale from 0 - 100%.

The student's exam marks are reported online in the check marks system.

**Create-a-Question:** As an optional exercise, students are encouraged to try to generate an excellent exam question of their own. Please email the instructor with your proposed exam question and answer. Questions that are carefully and articulately worded, and that probe student understanding of important concepts, will be considered for inclusion. The instructor 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 it is used on an exam, your name will not be attached to your question, but a note will be attached to indicate that the question was student-generated. Furthermore, if it is used, your question may be edited and/or otherwise modified by the instructor.

### Extra Credit

Students who provide an excellent, original answer on the Heads-Together forum, in response to another student's question regarding the course material, can earn an extra credit 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.

Each student can earn up to a maximum of 1 extra credit percentage point per week. The teaching assistants will read the forum each week in search of excellent original answers, and bring these to the attention of the instructor for final evaluation.

The student's extra credit points, if any, are reported online in the check marks system.

The extra credit points will be applied to the student's next exam score. For example, a student with 3 extra credit points, who scores 80% on an exam, will receive an exam mark of 83%. Extra credit points are added to the exam score up to a maximum of 100% on the exam. Any remaining points are then held over to the next exam. For example, if a student with 3 extra credit points scores 98% on an exam, then the exam score will be recorded as 100%, and the student's remaining extra credit point will be held over for the next exam.

### Course Percentage Score Calculation Formula

The following formula is used to calculate the student's course percentage:

$$\text{Course percentage score} = (\text{course homework score})(0.15) + (\text{course brain teaser score})(0.15) + (\text{midterm exam 1 score})(0.2) + (\text{midterm exam 2 score})(0.2) + (\text{final exam score})(0.3)$$

### Missed Work

If a student misses a class period or an exam due to illness or personal circumstances, it is the student's responsibility to notify the instructor and to submit appropriate documentation (e.g. note from physician) to the appropriate Faculty/Program office. A mark of zero will be entered for all missed Brain Teaser exercises, homework assignments, and exams unless the Faculty/Program office gives its approval. (If a student is unable to attend a class, then the student may submit the homework assignment by email, prior to the class period, to the instructor. Late email submissions will not be accepted.)

Missed class periods: If Faculty/Program office approval is obtained for missed class periods, the total number of Brain Teaser points in the course used to calculate the student's Brain Teaser percentage score will be reduced by the number of excused Brain Teasers that the student missed. Similarly, if Faculty/Program office approval is obtained for missed homework, the total number of homework points in the course used to

calculate the student's homework percentage score will be reduced by the number of excused homework assignments that the student missed.

**Missed exams:** If Faculty/Program office approval is obtained, exams missed due to illness or personal circumstances may be made up, or the course grade may be redistributed such that more weight is applied to the other exams, at the discretion of the instructor. Make-up exams, if given, may differ in format and specific content from the original exam. For example, an oral make-up exam may be used in place of a written original exam.

### **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>

For specific information on plagiarism and how to avoid it, please complete the plagiarism tutorial. Once you have completed the tutorial, you must print out and sign your acknowledgment of understanding. Your signed acknowledgment of understanding must be submitted along with your first homework assignment.

### **Online Privacy**

This course makes use of an online discussion forum. You should be aware that your chosen forum username 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, mark-check username, and passwords). 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 username 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.