Course description

PSYC 407 is a junior/senior level course designed as an introduction to the basic concepts and techniques of behavioral neuroscience. The goal is to provide background and hands-on experience with a range of experimental strategies, laboratory techniques, and data analysis approaches used in studying the neural basis of behavior.

Neuroscience is an intensely exciting and fast-moving field of study. We have chosen lab exercises to involve you in that excitement and introduce you to the pleasures of research on the boundary between behaviors and the neural mechanisms that control them. You will be doing conceptually rich lab projects using neuroscience techniques that allow you to get your hands dirty, while not requiring you to become world-class neurosurgeons or electronics wizards. For instance, you will do microsurgeries, record action potentials in nerves and muscles using multiple electrode types, study simple neural circuits, design and run several types of behavioral experiments, and learn the basics of designing neurobiology studies. During our lecture/discussions we will explore theoretical aspects of the labs, talk about examine diverse research strategies in neuroscience, practice methods for effective communication of experimental results, and design the ‘perfect’ experiments we would do after NIH gives us a $52,000,000 research grant.

We will use invertebrates as experimental subjects for our surgical work because they provide readily approachable, student-friendly ‘model’ systems with a minimum of logistic complication. The concepts and techniques match those in the vertebrate world - same neurotransmitters, same action potentials, same synaptic mechanisms - with the advantage of fewer neurons and relatively ‘simpler’ neural circuits.

Examples of topics and concepts covered in the course include:
- neuromodulation
- sensorimotor integration, including proprioceptors and reflexes
  - CNS plasticity
  - receptive fields
  - central pattern generators producing rhythmic movement
  - attention switching
  - design of simple neural circuits
  - directionality of movement and sensory reception
  - neural bases of aggressive behavior
There will be two lecture/discussions each week. These are essential to successful completion of the labs. These classes will briefly review basic neuroscience concepts and then expand on material necessary to understand what you will do in the lab and why. Throughout the course, we will emphasize experimental design and some of the specialized techniques neuroscientists use.

A crucial component of the classes are the discussions, often facilitated by breaking into small groups. All students are expected to contribute to these discussions. Because of this, your regular and consistent attendance is crucial. Although attendance per se is not part of the final grade computation, participation is (see below), and you can’t participate if you are not present. Just as an aside, we’ve seen many times that students who regularly skip class are clearly clueless about what goes on in the lab, their lab reports are poor, and they crash and burn on their exams.

Students will attend one three-hour lab each week. The first few minutes of the lab will be a brief discussion of the basic idea of the lab and an introduction to new techniques and/or equipment. You will then work in groups of 2-3 to complete the exercise during the rest of the three hours.

Very few students start this course with experience as microsurgeons or neurophysiologists, and most are nervous about handling the complexities of nerves and electrodes and knobs and wires. Not to worry ... The staff will walk you through everything slowly and carefully.

Throughout the afternoon, there will be informal discussions of both practical and theoretical aspects of your experiments. By the end of the day, each group will have data that they will analyze using simple graphs and basic statistical tests, and then interpret based on discussions in the lectures, the lab itself, and the reading. Each group or each individual, depending on the particular lab, will present the results in a written lab report (a worksheet) each week.

You do not need to purchase any special equipment for the lab. We will provide all the equipment and tools. You should, however, always bring a notebook, a printed copy of the lab manual section for the week, and a flash drive. Although not required, many students bring laptops so they can enter data directly into a spreadsheet, which saves time and effort.

We don’t use lab coats. You should wear closed-toed shoes (no sandals) and pants, slacks, or long skirts so that your legs are covered.

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A major goal of the course is to give you a taste of what doing neuroscience research is really like. This means you will need to think like a neuroscientist. Some of the most frequent discussion questions will be: What is your hypothesis? What experiments would you do to show ...? Do you really believe that experimental result? How do you interpret your data? The exercises are designed to emphasize problem solving - both conceptual and practical. The staff won’t always tell you the answer to a question, but will encourage you to work it out yourself. By the end of the semester you will be able to design and carry out a behavioral neurobiology project similar to the ones we do in lab, and you will be able to communicate your results in an effective, clear, professional manner.
Each week you will have a lab manual section to read and understand in preparation for the lab. Occasionally, I will also post supplementary readings that may or may not be required depending on the particular lab.

I am continuously updating the manual, often based on student experiences and comments. You will typically find the write-up for the next week’s lab (including the worksheet questions) posted on CANVAS during the weekend before the lab begins.

There are two optional texts that should help you with the concepts we use in the lab. They are quite pleasant reading with lots of ‘real life’ examples. One of the books is the text for PSYC 301 and it goes into greater depth on the biology behind complex behaviors. Both have great graphics that should help you with the anatomy and physiology.

**The Human Brain Book**
by Rita Carter  
**ISBN:** 978-0756654412  
List price: **$40.00**

**Biopsychology (any edition)**
by John P.J. Pinel  
**ISBN:** 0-2058-3256-3  
List price: **$120.00**

There will be an on-line quiz each week that you must take before coming to lab. The quizzes are timed (5 min.), open book, and must be completed independently. The quizzes test your understanding of the material in the lab manual for that week. Students who have read the lab manual before taking the quiz and understand the week’s lab will do well, others will do badly. Failure to complete a quiz before the start of lab results in a score of zero. Each quiz will be worth 24 points. The first two quizzes are practice (scores not counted).

**Do not underestimate the importance of the quizzes.** I have seen students drop half a letter grade or more in their final course grade because of consistently poor quiz performance.
Students will hand in a worksheet write-up for each week’s lab. Specific questions to be answered in the worksheet are included with each week’s lab manual section. Worksheets are focused reports that provide a concise way to communicate your results and conclusions from the lab. For most labs, the group members will hand in a single worksheet. All members of a group will receive the same score. See CANVAS for information on the equal contribution issue.

Communicating effectively is one of the very most important skills you must have for success in any field. For this course you will need to learn how neuroscientists communicate their results so you can produce successful worksheets. Early in the semester, we will provide detailed instructions for each write-up and discuss techniques in lecture. As the semester moves on, you will take progressively more responsibility for determining and using the most effective way(s) to communicate your results. The worksheets vary in difficulty, becoming more detailed and requiring more analysis as the semester goes on.

I have put a set of guidelines for writing the worksheets on CANVAS as well as an example scoring sheet. Be sure to read these carefully.

Each worksheet will be worth 100 points. The lowest score from the worksheets handed in before October 17th will be dropped.

Completed worksheets are due before your lab section begins on the following week. Worksheets handed in late incur a 7 point penalty per late day or fraction thereof.

- We will frequently want to pool data from several groups, or even from all of the sections, to be sure that everyone has full data sets to use for their worksheet write-up.
- Every student is expected to share data freely, willingly, and in a timely manner with other students in the course.

There will be a midterm exam and a comprehensive final examination. Both will cover theoretical material, the conceptual bases of some of the techniques, experimental design, and data interpretation. Exams will generally consist of 3-6 questions that will require for their answers short paragraphs and labeling/drawing diagrams and graphs.

Each of the two exams will be worth 300 points.

The final course score will simply be the points earned as a percentage of the total possible points. However, the final score will be adjusted to include: 1) a ‘Participation Score’ that will range from -4 to +4 course score percentage points. This will reward students whose effort has gone far beyond that of even a very good student. It will also be used to penalize students whose effort in the class has been poor (for instance, not contributing to lecture discussions, being repeatedly unprepared for lab, not actively participating in lab/lecture activities, failing to share data with other students); and 2) a ‘Contribution Score’ that will range from 0 to -4 course score percentage points. See CANVAS for details.

Letter grades will be assigned using an equal divisions scale, e.g. 80.00 to 83.29 = B-, 83.30 to 86.69 = B, 86.70 to 89.99 = B+
Incompletes

An "incomplete" will be assigned as a grade only in cases of compelling and documented need. Incompletes are normally reserved for students experiencing a catastrophic event near the end of the semester. To qualify for an incomplete, the student must have finished a substantial portion of the course and be performing at a "C" level or better. The student will be asked to sign an ‘incomplete contract’ stipulating the requirements and due dates for completion of the course.

Course Policies

PSYC 407 will follow the general University-wide policies for undergraduate courses that you can find here: Policies for Undergraduate Courses

What follows are policies specific to this course and brief descriptions of the general policies.

CANVAS for PSYC 407

We have a CANVAS site for the course and will be using it extensively. It will be:
- a source for basic information (lab manual, readings, syllabus, etc.)
- the mechanism for taking quizzes
- a communications channel for course information of immediate importance
- a convenient way for students to communicate and work together
- a source for study materials before each test
- a vehicle for reporting and keeping track of grades

To access CANVAS, go to ELMS which is both a portal and a source of help and information about the system. If you have trouble logging on or other issues, try the OIT Help Desk

Absences

Because of the nature of the course, regular attendance is extremely important. An occasional missed lecture is not a serious problem. Absence from a lab session, however, is a major issue. Make-up labs are not possible because of both equipment requirements and time constraints. **When the reason is compelling and with adequate prior notification (normally two weeks), we can sometimes have the student attend one of the other lab sessions for that week.** Compelling reasons include things like religious observances, graduate school interviews, presenting a paper at a scientific conference (not just attending the conference). Compelling reasons DO NOT include, for instance, work scheduling issues, family events, and other non-academic/professional activities.

If a debilitating illness or an emergency situation will make it impossible to attend lab or take an exam, **it is mandatory that you notify me as soon as possible, preferably before or on the day of the exam/lab.** You must present complete and valid documentation before any makeup arrangements can be made. Failure to fulfill these requirements will result in a grade of zero.
The University System of Maryland policy provides that students should not be penalized because of observances of their religious beliefs, students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences for religious observances in advance. Notice should be provided as soon as possible but no later than the end of the schedule adjustment period. Prior notification is especially important in connection with final exams, since failure to reschedule a final exam promptly can have very serious academic consequences.

No computers, phones, or tablet devices are permitted during lectures.

Personal electronics present an irresistible distraction, detract from the cooperative learning environment, and unfairly affect other students. Based on ever-increasing volumes of research evidence, the distractions created by electronics in the classroom interfere with learning and active participation. In a small, discussion-based class like ours, that is counterproductive. (The exception is when a computer is required for a DSS accommodation.)

Laptops and tablets can be used in the labs. They will often be helpful for collecting and processing data. Phones may not be used in lab.

The University of Maryland has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for understanding what constitutes a Code violation and are responsible for upholding all of integrity standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit Student Honor Council website.

If you have a documented disability, you should contact Disability Support Services 0126 Shoemaker Hall. Each semester students with documented disabilities should apply to DSS for accommodation request forms that you can provide to your professors as proof of your eligibility for accommodations. This form should be provided at the beginning of the semester. Special arrangements for each individual test should be made at least a week before the test date. The rules for eligibility and the types of accommodations a student may request can be reviewed on the DSS web site at The Counseling Center.

Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning. CourseEvalUM will be open for you to complete your evaluations for fall semester courses during the last two weeks of classes. You can go directly to the website (CourseEvalUM) to complete your evaluations. By completing all of your course evaluations each semester, you will have the privilege of accessing the summary reports for thousands of courses online at Testudo.
Tentative Laboratory Schedule

(we have some flexibility in the length of each module, we may replace one or more modules with new projects, and we may change the sequence of labs)

LAB EXERCISE

**No labs (but will have lectures as usual)**

**No labs (but will have lecture on Wednesday)**

September 11th
Interfacing motor and sensory systems: electric signals in fish. Concepts/goals: recording and measuring electric signals; electrodes; compound action potentials; sensory world based on electric pulses.

September 18th
Motor function and proprioception I: timing the Achilles stretch reflex. Concepts/goals: surface electromyograms; conduction velocity; monosynaptic reflex; simple data analysis; CNS anatomy; two–channel neural recording.

September 25th
Motor function and proprioception II: effects of vibration on posture. Concepts/goals: methods for quantifying posture and movement; function of muscle spindles and proprioception; unilateral and bilateral function.

October 2nd

October 9th
Sheep brain dissection – introduction to nervous system structure. Concepts/goals: simple surgical techniques; CNS organization; basic vertebrate CNS structures.

October 16th
Posture control for communication: crayfish motorneurons. Concepts/goals: motor neuron activity; microdissection; suction electrode recording; multiunit action potential patterns; neuromodulators; neural code.

**Midterm examination**

October 16th
Posture control for communication: crayfish aggression and dominance hierarchies. Concepts/goals: postural signaling; dynamics of aggression; effects of neuromodulators on behavior.
LAB EXERCISE

October 30th
Sensory systems: cockroach leg spines. Concepts/goals: neurophysiological recording; sensory receptors; neural codes; receptive fields; directionality.

November 6th
Sensory systems: wind detection for escape. Concepts/goals: multiunit action potential patterns; microdissection; hook electrode recording; giant interneurons; threshold; latency.

November 13th
Sensory systems: directional responses to wind. Concepts/goals: coding of directional information; ablation experiments; contralaterality

November 20th
No labs (but will have lecture on Monday)

November 27th
Sensory systems: touch and taste. Concepts/goals: neural codes; sensory resolution; variations in receptive field size; population code vs. labeled line; chemosensation.

December 4th
Frontal lobe functions: multitasking. Concepts/goals: task switching; control of attention; task interference; procedural memory; cortical independence; quantification of very complex behaviors.

December 16th
Final examination – 8:00–10:00 am

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