Course overview

We will discuss neuroscientific breakthroughs, focusing on classic experimental papers from many different decades of the past one hundred and twenty years. In most weeks we will also include a current paper that has its intellectual roots in the findings of the earlier paper, and demonstrates their importance in behavioral studies. Questions to be covered will include: How are sensory maps organized? How does the brain build itself? How far is brain specialization predetermined versus customized to experience? What computations can neurons perform? What are the physical and chemical bases of these computations? Can we measure the neural correlates of perception and thought?

In addition to increasing our knowledge of the week’s topic, we will discuss what makes a paper a “classic”: Has it continued to influence modern scientists? Did it change the course of neuroscience, psychology or clinical practice then or subsequently? Was it well designed? Did it introduce a powerful new technique?

We will address these questions and more by studying the basics of neuroscience from a textbook, and comparing classic and current experimental literature to understand progress in neuroscience, especially as it relates to behavior and psychology. Our reading of the literature will be critical, with a focus on good scientific design.

Course requirements

Dr. Brew’s permission to join the class is required. Attendance at the first day of class is required. Each week, students will participate in a two-hour seminar. Class time will be devoted to the presentation and discussion of journal articles. The textbook reading is intended to provide background knowledge on the relevant topics. The publications have been chosen to cover a wide range of topics and to serve as a stimulus for discussion. Two students sign up to lead the discussion each week. Each week the class will end with a short presentation by Dr. Brew covering the background to the following week’s topic and papers. Ideally, students will prepare their presentations with input from Dr. Brew, during office hours and/or by e-mail.

Prerequisites

Mind, Brain and Behavior (Psych 1010) or an equivalent biological-based psychology class is required. Courses in statistics or research methods would be helpful, but are not required. The permission of the instructor is required in order to register.

Course objectives

This course fulfills the Seminar Requirement for the Psychology Major and the Advanced Seminar Requirement for the Neurobiology and Behavior Major.

The goals of this course are:
• to gain an advanced understanding of neurobiological research by reading primary scientific literature
• to gain an advanced understanding of current knowledge in neurobiology
• to gain understanding of what makes an experimental paper a “classic”
• to gain understanding of good scientific design
• to read, understand and orally present primary scientific literature from psychology and neuroscience journals
• to be able to critically evaluate published research and discuss its merits, caveats and alternative interpretations
• to develop a review commentary or research proposal on a research topic by reading and evaluating published research

Weekly readings/assignment and participation (25%)

You will be expected to carefully read two or three scientific research papers each week. The chosen papers will usually be primary research reports from seminal findings on the topic of the week. One will be a “classic” and the other will be more current, though in some weeks, the classic paper will also be recent. Some basic background knowledge of the week’s topic is also expected, which you will achieve by reading chapters from the textbook, or the review article cited in the assigned reading. Everyone will post a substantial comment, thought or question on the paper before class on the Discussion Board of Courseworks, which will serve as a basis for discussion during class.

Presentation of two papers (40%)

Each week, 2 or 3 of you will present one of the assigned readings in an approximately 30 minute slide presentation and initiate and lead a short discussion of the paper. Each student will present 2 papers during the semester. Written feedback will be provided one week following the presentation.

Mid-term (5%)

This will be pretty casual. It’s mostly to give the instructor an idea of your writing ability, analytical strengths, and to ensure the class is not leaving some people floundering.

Research review paper (30%)

A term project will be required, on a topic of your choosing from material covered during the seminar (~10-15pg). It will be a research review paper centered on one of the classic papers we have covered, but focusing on either several papers contemporary to and related to that classic paper, or on several modern papers that could be regarded as intellectual descendants of the classic. It should include discussion of the papers’ broad influence, and critique of the experimental design. Detailed information will be given at the start of the course. The project will require that you meet individually with the instructor to get approval on the topic and outline. Outline due November 16th, for a ten minute presentation of your paper on December 8th, the final day of classes.

Class policies

Attendance: You are expected to come to class each week prepared to discuss the assigned papers. Your unexcused absence will be noted and reflected in your
participation grade. Make-up ‘participation’ for preapproved excused absences will be arranged on an individual basis.

Assignments: Paper presentations are assigned based on solicited preferences during the first week of the semester and once assigned may not be changed. In the case of a documented medical or family emergency, alternate arrangements will be made to present the paper individually during office hours. The due date for the term paper is firm, and as such, one letter grade will be deducted for each day it is late.

Academic Integrity: "The intellectual venture in which we are all engaged requires of faculty and students alike the highest level of personal and academic integrity. As members of an academic community, each one of us bears the responsibility to participate in scholarly discourse and research in a manner characterized by intellectual honesty and scholarly integrity. . . . In practical terms, this means that, as students, you must be responsible for the full citations of others’ ideas in all of your research papers and projects; you must be scrupulously honest when taking your examinations; you must always submit your own work and not that of another student, scholar, or internet agent." From the Faculty Statement on Academic Integrity - www.college.columbia.edu/academics/integrity-statement. Cheating on assignments or exams and plagiarism are very serious violations within the academic community. Students are expected to do their own work on all tests and assignments for this class. You are expected to always act in accordance with the Columbia honor code. Any student found cheating or plagiarizing in this class will be reported to Columbia’s Office of Judicial Affairs and Community Standards for evaluation and academic discipline. If you have questions about any aspect of academic integrity at Columbia, please refer to the following link: www.college.columbia.edu/academics/integrity and if you have specific questions about the judicial process, please see www.college.columbia.edu/academics/disciplinaryprocess.

Class Schedule

(Please note that readings and topics may be subject to change based on enrollment number and student preferences).

Week 1. September 8th. What are neurons? Santiago Ramon y Cajal and Camillo Golgi

Introduction to seminar, including information on: course format, evaluation, discussion board posts, presentation of papers, class discussion, term paper, mid-term test (an hour-long written test critiquing a paper’s experimental design and assessing its impact on neuroscience, psychology, and the world).

Discussion of what makes a paper a classic and what comprises good scientific design. Introduction to the methods used by Cajal and Golgi. (Introduction to the week 2 topic).


Week 2. September 15th. Cortical function: hemispheric lateralization


Week 3. September 22nd. Cortical specialization


Week 4. September 29th. Neuronal correlates of perception


Week 5. October 6th. Memory and the hippocampus


Week 6. October 13th. The hippocampus and space


Week 7. October 22nd. Mid-term followed by instructor-led presentation and discussion on the same topic.

Week 8. October 29th

(November 3rd is the election day holiday).

Week 9. November 10th. The biophysics of neurons


Week 10. November 17th. Mechanisms of neuronal computation


Week 11. November 24th. Optogenetics

Week 12. December 1st. New neurons when adult


Week 13. December 8th. Last day of class

Presentations of Term Papers: Present the class with the most interesting part of your term paper (10 minutes each, prizes will be given). No assigned reading this week.