

UN3019 Brain Evolution

Course description:

If an engineer were to build “the brain”, they would not reproduce any of the brains that exist on Earth. Our brains were not designed to perfection, but are a result of millions of years of evolution and adaptation. The goal of this course is to provide an overview of brain evolution, ranging from the evolution of the first neurons to the origin of the human brain. Specifically, the course will focus on recent insights emerging from studies of development, gene expression, and neural circuit architecture. The evolutionary perspective on commonly used terms, such as “neuron” and “brain”, and general insights on brain organization and function emerging from comparative studies will be discussed.

Targeted audience: this course is designed for advanced undergraduate students. It is intended for neuroscience students who want to learn more about brain evolution, and for biology and E3B students interested in the brain as a “case study” in evolutionary developmental biology. Students majoring in Neuroscience and Behavior that have already attended UN3004 Neurobiology I will be prioritized. Students enrolled in other majors should have attended at least Introductory Biology I and II, or equivalent, and preferably an introductory course in neuroscience; these students will be admitted with the instructor’s permission. Auditors will not be accepted.

Learning Goals:

By the end of this course, students will be able to:

1. Describe the main questions in the field of brain evolution
2. Discuss the concepts of “neuron”, “nervous system”, “brain”, and “cerebral cortex” from an evolutionary perspective
3. Give examples of mechanisms or processes underlying the evolution of complex brains
4. Describe what distinguishes the human brain from the brains of other mammals.
5. Evaluate and critically assess articles from the primary literature in the field

Required Text: There will be no required textbook for this course; each week you will be assigned papers or book chapters from the scientific literature. These readings will be posted in Courseworks.

Course Format: The course will consist of two introductory lectures and twelve classes with student presentations followed by short lectures from the instructor. The first two introductory lectures will provide essential background for the rest of the course.

The following twelve sessions are organized as follows:

First, a student or a pair of students presents a paper from the primary literature, focusing on the main goal of the paper and on its significance. Then the class splits into

smaller groups, and each group works on a discussion point related to the paper. At the end, the class reconvenes and each group reports to the rest of the class.

The last half hour is dedicated to a lecture that introduces the topic of the following week.

Week	Dates 2023	Topic
1	Jan 20	Lecture: Course introduction, the relevance of an evolutionary perspective in neuroscience. How to read and present a scientific paper
2	Jan 27	Lecture: Evolution of nervous systems: overview of problems and approaches
3	Feb 3	What is a neuron? Evolution of synapses
4	Feb 10	What is a neuron? Behavior without nerve cells
5	Feb 17	What is a nervous system? Nerve nets
6	Feb 24	What is sleep? How has it evolved?
7	March 3	What is a brain? Patterning of the neuroectoderm
8	March 10	What is a brain? Evolution of motor control Abstract and Bibliography due
	March 13-17	Spring Break
9	Mar 24	How do complex brains evolve? The case of cephalopods
10	Mar 31	What is the cerebral cortex?
11	April 7	What is unique about the human brain? #1 Size and gyrification
12	April 14	What is unique about the human brain? #2 Neuron types

13	April 21	What is unique about the human brain? #3 Connectivity
14	April 28	What is unique about the human brain? #4 Evolution of language
	May 8th	Final Essay due

[Link to the sign-up page for papers here](#)[Links to an external site.](#)

Grading: grading is based on the paper presentation, class attendance and participation, and the Final Essay. The Final Essay (~10-12 pages) will be about a topic of choice in brain evolution. An Abstract (400 words max) and an initial Bibliography for the Final Essay are due on March 10. The Final Essay is due on May 8th. Students are encouraged to meet the instructor during office hours to discuss the topic of choice and relevant literature; although a list of potential topics will be provided, students are encouraged to choose their own topic according to their personal interests.

The grading scheme will be as follows:

Presentations: 30%

Attendance and participation: 30%

Abstract and Bibliography: 10%

Final Essay: 30%

Late submission of the Final Essay is generally not allowed; exceptions will be considered only after approval from the Academic Advisor.

Overview of Syllabus:

The content of the course in one picture:

Course Summary:

Date	Details	Due
Sat Jan 28, 2023	Assignment Paper sign-up	due by 11:59pm
Fri Mar 10, 2023	Assignment Midterm grade	due by 11:59pm
Tue May 9, 2023	Assignment Final Essay and final grade	due by 11:59pm