

Fall 2024

IB 460: Evolution of Intelligent Systems

Course Time and Location (Full Semester, 4 credits undergraduate and graduate credit)

Lecture	(AL1)	TR	11am-12:20pm	Room NHB 2083
Lab	(EN1)	R	1pm-3:50pm	Room NHB 3011
Lab	(EN2)	R	4pm-6:50pm	Room NHB 3011

Instructors

Faculty Instructor: Dr. Daniel J. Miller | millerdj@illinois.edu

Office Hours: 12:20 pm – 2:20 pm Tuesday in Morrill Hall 665

Teaching Assistant: XXXXXXX | xxxxx@illinois.edu

Office Hours: By Appointment [xx-xx pm] in Morrill Hall [xxx]

Learning Outcomes

1. Form an integrative understanding of brain organization across the molecular, cellular, and systems levels of organization.
2. Draw functional relationships between brain organization, perception, and behavior.
3. Critically discuss the major trends in the evolution of neural systems.
4. Critically discuss the mechanisms of cognitive evolution.
5. Perform comparative gross anatomical wet lab dissections.
6. Perform histological methods to identify neuroanatomical structures.
7. Build teamwork skills in a neurobiology laboratory setting.
8. Collaborate to summarize current scientific knowledge of a problem in neurobiology.
9. Conduct and interpret a structured statistical analysis.

Prerequisites

- IB 302 (or consent of instructor): this course is for advanced undergraduates (junior/senior) and graduate students in the life sciences.

Course Description

This course delves into how the brain evolved and how our lived experience is shaped by this evolutionary history. We will investigate the evolution of cognition across eukaryotic organisms. In the laboratory, we participate in gross anatomical dissections to examine large scale changes across organisms, as well as detailed examinations of cellular microstructure. Lab time will provide students hands-on brain dissection, histology, and microscopy experience, while lecture will focus on explaining the mechanisms of cognition and the evolution of brain organization. Assignments enable the motivated student to develop professional skills and hone their scholarly interests. **As a 4 credit hour course, students are expected to spend roughly 8 hours of work apart from instructional time on the course.**

Synopsis: A foundational survey of how natural selection has generated complex neurobiological structures, and how brain organization supports cognitive specializations.

Course Plan & Activities

Course Web Site and Learning Management System

Course materials including lecture presentations (as PDFs) will be posted on the Canvas course site (canvas.illinois.edu). Lectures typically will be posted the day before class but may have some information omitted (e.g., when we will cover the information through in-class discussions). The required textbook is available in the library and the instructor has requested that it be put on library reserve.

Required Textbooks

- Stanley Jacobsen & Elliott M. Marcus. *Neuroanatomy for the Neuroscientist*. 2019. Second Edition. Springer New York. (This textbook is available from the UIUC bookstore and online.)

Relevant Additional Reading

- Georg F. Striedter & Glenn R. Northcutt. *Brains Through Time: A Natural History of Vertebrates*. 2019. Oxford University Press.
- Yong, Ed. *An Immense World: how animal senses reveal the hidden realms around us*. 2022. First Edition. Random House.

Attendance & Absence Policy

I expect students to attend all lectures and labs per assigned sections, and that students will contact instructional staff if an absence is excusable, to arrange any possible make up work. There will be no make-ups for exams or quizzes other than for documented illnesses, accommodations granted, or other approved reasons. If you anticipate difficulties in attendance, please reach out and let me know as soon as possible to avoid unwanted delays in processing and accounting for your coursework! However, we also understand a variety of situations may ensue and so look forward to accommodating reasonable requests and situations, and request any concerns be brought to your instructor's attention as soon as possible. Late assignments are subject to the same considerations of reasonableness and timeliness, with the caveat that they are generally not permitted except with justification.

Assignments

Lecture attendance: (n=26 lectures x 5 points each) Students are expected to attend and participate in lecture, and attendance will be recorded. We will do both individual and group work (assigned randomly by alphabetical order) that ties into the laboratory exercises and culminates in the laboratory field trips and written report (including a group self-assessment).

Lecture Group Abstract, Report, and Presentation: (25 points, 25 points, 50 points, respectively) Specifically, we will have a group presentation on a fundamental issue in neuroscience ('Science Q' group), and an individual literature review (below). We will also form and work in groups to complete a presentation and short written report, in which each group presents their research into a specific brain structure. The group presentation has three sequential milestones: first, the class discusses topics and subdivides into groups by research topic; second, each group presents an abstract and list of resources used (non-peer-reviewed

material allowed) in preparation for their presentation; third, each group presents an oral presentation and delivers a short written summary (~1,000 words).

Lecture Literature Review Paper (Annotated Bibliography, First Draft, Final Draft): (100, 150, 200 points, respectively) Students complete an individual literature review paper. The literature review has three sequential milestones: first, the student will prepare an annotated bibliography on a topic of their choice in neuroscience; second, the student will prepare a draft literature review based on their bibliography, and on which they will receive feedback from the instructor; third, the student will incorporate their feedback and submit a final revision at the end of the semester as their final examination. Graduate students will be held to a higher standard than undergraduates, and the literature review will for example be 15 pages with 30 citations for graduates rather than 10 pages with 15 citations for undergraduates.

Laboratory Wet & Dry Labs and Quizzes: For the weekly laboratory sessions, students will perform both wet (n= 11x20 pt) and dry lab exercises (n= 11x10 pt) that are reviewed with periodic quizzes (n= 10x10 pt). The weekly wet lab consists of groups dissecting each region in the survey across animals in the collection. The weekly dry lab consists of groups identifying and measuring all cell types in the survey across brain regions in the collection. Specifically, we will divide into groups for 'macro' wet lab, and 'micro' dry lab sections, along with individual quizzes. Quizzes will be primarily composed of wet lab exercises, but may incorporate key ideas from dry lab exercises and lecture.

Laboratory Group Poster: (100 points) The group projects will each culminate in peer-review style poster presentations at the end of the semester in Lecture (100 pt). Final presentations will be a mix of wet and dry lab work, such that each group will present on a given brain region's gross comparative anatomy as well as its internal microstructure. In the penultimate lab section, we will conduct the data analysis and finalize each group's poster for presentation at during the final days of lecture. Our final lab will tentatively be a Lab Field Trip to perform conventional histology and microscopy.

Composition of Grading

Lab – Weekly Wet Lab	(n=11x20pts)	220 pts
Lab – Quizzes	(n=10x10 pts)	100 pts
Lab – Weekly Dry Lab	(n=11x10 pts)	110 pts
Lab – Lab Group Poster		100 pts
<i>Lab – Section Total</i>		<u>530 pts</u>
Lecture – Attendance	(n=26 x 5 pts)	130 pts
Lecture – Group Abstract, Report, Present	(25:25:50 pts each)	100 pts
Lecture – Paper Annotated Bibliography		100 pts
Lecture – Paper First Draft		150 pts
Lecture – Paper Final Draft		200 pts
<i>Lecture – Section Total</i>		<u>680 pts</u>
Grand Total		1210 pts

* We will use the A +/- grading system on a total of 1,210 pts.

Grading Scale:

A+/A/A-	:	97/94/90
B+/B/B-	:	87/84/80
C+/C/C-	:	77/74/70
D+/D/D-	:	67/64/60
F	:	below 60

Academic Integrity

The University of Illinois at Urbana-Champaign *Student Code* should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>. Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <http://studentcode.illinois.edu/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Course Policies

Students with Disabilities or Special Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide the instructor with a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES). To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should apply for services with DRES and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail disability@illinois.edu or visit the DRES website at <https://dres.illinois.edu/>. Here is the link for information to apply for services at DRES, <https://dres.illinois.edu/information-before-you-apply/application-process/>.

Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to *Family Educational Rights and Privacy Act* (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <http://registrar.illinois.edu/ferpa> for more information on FERPA.

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized

screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself. If you are in immediate danger, call 911.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or <http://odos.illinois.edu/community-of-care/referral/>). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe. Further, we understand the impact that struggles with mental health can have on your experience at Illinois. Significant stress, strained relationships, anxiety, excessive worry, alcohol/drug problems, a loss of motivation, or problems with eating and/or sleeping can all interfere with optimal academic performance. We encourage all students to reach out to talk with someone, and we want to make sure you are aware that you can access mental health support at the Counseling Center (<https://counselingcenter.illinois.edu/>) or McKinley (<https://mckinley.illinois.edu/>). For mental health emergencies, you can call 911 or walk in to the Counseling Center without appointment.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. Students should complete the [Request for Accommodation for Religious Observances form](#) should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality: wecare.illinois.edu/resources/students/#confidential. Other information about resources and reporting is available here: wecare.illinois.edu.

Emergency Response Recommendations

Emergency response recommendations and campus building floor plans can be found at the following website: <https://police.illinois.edu/em/run-hide-fight/>. I encourage you to review this website within the first 10 days of class.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (<https://conflictresolution.illinois.edu>; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

Chosen Names at UIUC

If you want a chosen name to appear in academic portals, please follow the instructions here: https://www.uillinois.edu/about/policies/preferred_first_name_statement. If you would like a chosen first name to appear with a legal last name on your diploma, information will be included in graduation e-mails from the university. Be advised that in some situations, the name on the diploma may need to match your legal name.

Course Schedule

Date	Topic for Lecture	Lab Activities	Readings
20-Aug-24	Syllabus & Logistics		Neuro Ch 1 (1-34)
22-Aug-24	Methods Field Trip: Cryosectioning	'Micro/Macro' Lab Groupings & Exercises 1: Orientation	Neuro Ch 2 (35-56)
27-Aug-24	Anatomy 1: Spinal Cord		Neuro Ch 4 (87-109)
29-Aug-24	Evolution of Molecular Signaling	Quiz, 'Micro/Macro' Exercises 2: Spinal Cord	Nair et al., 2019
3-Sep-24	Evolution of Cellular Life		Koonin 2014
5-Sep-24	Anatomy 1: Brainstem	Quiz, 'Micro/Macro' Exercises 3: Brainstem	Neuro Ch 5 (110-145)
10-Sep-24	Cellular Signaling Systems		Nair et al., 2019
12-Sep-24	Evolution of Neural Cells	Quiz, 'Micro/Macro' Exercises 4: Brainstem	Arendt et al., 2019
17-Sep-24	Neural Temporal Binding		Wallace & Stevenson, 2014
19-Sep-24	Diversification of Neural Cells	Quiz, 'Micro/Macro' Exercises 5: Brainstem	Tosches et al., 2021
24-Sep-24	Anatomy 2: Hypothalamus		Neuro Ch 9 (210-234)
26-Sep-24	Evolution of Nervous Systems	Quiz, 'Micro/Macro' Exercises 6: Hypothalamus	Arendt et al., 2016
1-Oct-24	Peripheral Nervous System		Catala & Kubis, 2013
3-Oct-24	Central Nervous System	Quiz, 'Micro/Macro' Exercises 7: Hypothalamus	Funess & Stebbing, 2017

8-Oct-24	Anatomy 3: Thalamus		Neuro Ch 8 (189-209)
10-Oct-24	Neural Evo-Devo: Mammals	Quiz, 'Micro/Macro' Exercises 8: Thalamus	Kaas et al., 2012
15-Oct-24	Anatomy 4: Basal Ganglia & Cerebellum		Neuro Ch 12, 13 (265-301)
17-Oct-24	Development of Neural Physiology	Quiz, 'Micro/Macro' Exercises 9: Basal Ganglia	Neuro Ch 3 (57-86)
22-Oct-24	Perceptual Systems		Neuro Ch 6 (146-165)
24-Oct-24	Command Systems	Quiz, 'Micro/Macro' Exercises 10: Cerebellum	Neuro Ch 7 (166-188)
29-Oct-24	Anatomy 5: Cerebral Cortex		Neuro Ch 10 (235-251)
31-Oct-24	Neural Evo-Devo: Primates	Quiz, 'Micro/Macro' Exercises 11: Cerebral Cortex	Miller et al., 2012; 2013
5-Nov-24	Combinatorial Percepts		Wallace & Stevenson, 2014
7-Nov-24	Monitoring Systems	Quiz, 'Micro/Macro' Exercises 12: Cerebral Cortex	Schall et al., 2020
12-Nov-24	Executive Function		Preuss & Wise, 2022
14-Nov-24	Neural Evo-Devo: Humans	Quiz, 'Micro/Macro' Poster Preparation Time	Miller et al., 2019
19-Nov-24	No Lecture for Thanksgiving		
21-Nov-24	No Lecture for Thanksgiving	No Lab for Thanksgiving	
26-Nov-24	Group Presentations - Macro		
28-Nov-24	Group Presentations - Micro	Methods Field Trip: Histology	
3-Dec-24	Group Presentations - Science Q		
5-Dec-24	Finals Prep	Finals Prep	
10-Dec-24	Finals Prep		
12-Dec-24		Paper Final Due	Due Dec 12 th @ 11:59 pm