

BIOLOGY 354 Spring 2019
TECHNIQUES IN NEUROSCIENCE
Lecture: Monday, Wednesday 9:00-9:50 am RITA 273
Lab: Wednesday 1:30-5:45 pm RITA 141

Instructor: Dr. Jeffrey D. Triplehorn

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Office location: RITA 117

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Office hours: Monday 10-11 am and By appointment

1. Course prerequisites and Co-requisite(s) or Prerequisite(s)

Prerequisite: BIOL 351 or PSYC 351

and

MATH 250 or (PSYC 211 and PSYC 220) or PSYC 250

and

Permission of instructor

2. Course description

An intensive “hands-on” laboratory-focused course incorporating several techniques used in neuroscience research, including electrophysiology, neuroanatomy, histology, and behavioral analysis. Students will use these techniques to investigate various concepts in cellular and systems neuroscience. Students will engage in scientific discourse and present ideas in both verbal and written form. Lectures two hours per week; laboratory four hours per week.

3. Instructional objectives and student learning outcomes

- a. Enhance student knowledge of experimental design, analysis, and communicating experimental results;
- b. Develop skills in different techniques used in neuroscience research and apply knowledge of molecular, cellular, and systems neuroscience;
- c. Develop competence in data collection, interpretation, and evaluation of neuroscience research that foster critical thinking skills about research;
- d. Enhance student ability to read and evaluate primary scientific literature and apply knowledge gained to research problems.
- e. Promote the development of technical written and oral communication skills

4. Required reading and materials

There is no text available for a class such as this. A lab manual prepared by the instructor will be required and be provided as a PDF. Some labs may have additional readings from the primary literature. References will be provided for articles available at Addlestone Library or otherwise be provided by the instructor. ***Each lab will also have a detailed lab guide for that day's experiment that must be read prior to coming to lab!***

5. Course policies and procedures

The class will meet three times per week. There will be two *50 minute lecture sections* and a *4 ½ hour combined lecture/lab section* with the following exception:

Brain tissue cutting and histology

We will meet as a class during the normal lecture time and students will schedule sessions lasting 3-4 hours throughout that week to slice their rat brain. You will also need to come in a second time with your lab partner to examine them under the microscope and complete the assignment. This is necessary due to the limitations of available equipment for sectioning and viewing brain sections. I will be as accommodating as possible, but it is up to **you** to plan ahead accordingly and to discuss any potential problems with me as early as possible. ***Inability to perform the labs during those weeks due to scheduling issues will incur the penalty described below (see Evaluation).***

5a. Lecture component

The lecture will vary throughout the semester, but the material covered will consist of four general topics:

- 1) presentation of necessary background material for the next lab provided by the instructor;
- 2) a “debriefing” of the previous lab, including what went right and wrong, solutions that were attempted (and the outcomes), and results that different groups obtained;
- 3) class discussions to scenarios posed by the instructor regarding a research, methodological, or conceptual question pertinent to the next lab;
- 4) discussions of other neuroscience techniques not performed in the labs.

5b. Lab component

The lab portion will begin with a lecture covering the necessary technical information relevant for that day’s lab. Potential trouble spots and solutions will also be highlighted. **Students must read through all lab procedures and required background material prior to the lab and should bring up any questions, clarifications, and/or concerns during this period.** Working in groups of two, students will be in charge of preparing the experiment (i.e. setting up the equipment, performing the surgeries, obtaining the recordings, etc.), collecting and documenting the necessary data, and interpreting that data.

5c. Expectations

Students are expected to participate in all aspects of the class. This includes:

- 1) actively participating in lecture and lab discussions;
- 2) attending both lab and lecture (i.e. **attendance is mandatory to both**);
- 3) reading all necessary material **before** coming to lab;
- 4) engaging in the experiments;
- 5) handing in assignments.

Since we are dealing with live animals (both vertebrates and invertebrates), it is important to read and be familiar with that day’s procedures before coming to lab and to ask questions regarding the procedures. Given the nature of the labs, rescheduling or lab make-ups will not be possible.

5d. Penalties for lateness or missing lectures or labs

It will become immediately evident that we have a lot of material to go over in the two 50 minute lectures per week. Besides providing information that will enhance your experience in this course, the lectures include critical information that will help you perform the experiments. This information will expedite your performance of the labs, not only allowing you to finish during the allotted time but also obtain better data! Furthermore, lectures address the ethical treatment of the research animals. The majority of the experiments included in this course involve terminal procedures. It is disrespectful to the animals (regardless of whether they are vertebrates or invertebrates) to be late or miss lectures or labs.

Although this should be enough to have students show up and be on time for each lecture and lab, this has not always been the case. Therefore, the following penalties will be levied for being late or missing classes:

Late to lecture or lab = 3% deduction per incident

Missing lecture = 6% deduction per incident

Missing lab = Final grade will be reduced by two-third grade for each lab missed
(for example, from B+ to B-; from C to D+)

The late or missed lecture penalty will be assessed on the next assignment that is due. ***Since things do happen, each student is allowed to either be late twice or miss one lecture without penalty. A student that misses lecture after already being late once will incur a 3% penalty on the next assignment.***

If you have a graduate school or medical school interview that will cause you to miss lab, talk to me as soon as possible and definitely before you miss the lab.

I also reserve the right to prevent any student from performing a lab if I consider the student untrained due to missing certain lectures and/or successive lectures that would put the experimental animals or equipment in jeopardy.

6. Technology Policy

There will be no use of cell phones, computers, iPads, iPhones, etc. during class. These devices are disruptive to other students in the classroom and to my teaching. If your cell phone goes off during class, you may be asked to leave for the day. All devices are to be turned off and put away (not left on your desk) until class is dismissed.

7. Grading policy and grade assignment

Grades will be based on effort, conceptual understanding of the material and interpretation of data in both written and oral forms. Grades will not be based on proficiency with the techniques.

Each student will be expected to complete **four (4) lab worksheets** (Modules 1, 2, 3, and 5), **one (1) lab report** (Module 4), and **a final presentation** (during the final exam period). The worksheets provide a concise way to report your results and conclusions from the lab work and require substantially less work than the full lab report. The full lab report will be in the format of a scientific paper (Abstract, Introduction, Material/Methods, Results, Discussion, References). These reports will pull together all aspects of the laboratory work for that module and will be 10-15 pages long (for the Introduction, Material/Methods, Results, Discussion portions).

The final presentation will be on a recent advancement in neuroscience techniques, chosen by the student **but approved by the instructor**. It cannot be on a technique covered in the course (lecture or lab) or in the Seminar in Neuroscience course (BIOL/PSYC448). The presentation will consist of an overview of the technique and its implementation in neuroscience research from the primary literature. This will be a PowerPoint presentation, 15-20 minutes in length, presented to the class during the final exam period.

Assessment of assignments will be based on a letter grade scale converted to a numerical value based on the table below. Each portion of the assignment (i.e. each question for worksheets or each section for the lab report) will be assigned a letter grade, with average being the final grade for the assignment. The final course grade for each student will be computed by taking the simple average of the worksheets, lab report, and final presentation. **The worksheets and presentation are equally weighted, the lab report is worth *double*.**

Grade	Numerical value
A+	100
A	95
A-	91
B+	88
B	85
B-	81
C+	78
C	75
C-	71
D+	68
D	65
D-	61
F	55

Average Percentage	Final Grade
93% and higher	A
90-92.9%	A-
87-89.9%	B+
83-86.9%	B
80-82.9%	B-
77-79.9%	C+
73-76.9%	C
70-72.9%	C-
67-69.9%	D+
63-66.9%	D
60-62.9%	D-
<60%	F

8. Late assignment policy

You are expected to turn in the assignments on time. Failure to do so is equivalent to failing to meet a deadline. If you fail to meet the assignment deadline, the highest grade you can earn is the lowest of the assignments turned in on time, minus one half-grade. For example, if the lowest grade in the class was a "B" on the assignment, a "B-" would be the highest grade you could get on the assignment (assuming it would have received an "A" if submitted on time). I will not accept an assignment after I have returned the graded assignments to the class. If you have a personal or family emergency, the same policy listed above for the exam (with respect to the documentation) applies. **Electronic copies of take-home assignments will not be accepted!**

9. Animal use

Students should be fully aware that the laboratory exercises in this course use living animals and that many of the exercises involve non-survivable surgical procedures. The animals involved in this lab include crayfish, cockroaches, frogs, and rats. Our laboratory procedures for the vertebrate animals will be in complete compliance with the codes of animal care and humane treatment established by the College and by state and federal governments. All of our laboratory procedures for vertebrates must be evaluated and approved by the College's Animal Care and Use Committee before we can use them in a lab class. Further, the staff of this course fully subscribe to the tenet that any responsible scientist or student (or any other person, for that matter) must treat animals (both vertebrates and invertebrates) humanely and with respect.

As such it is very important for students to attend all lectures and read all required material prior to attending lab. The live preparations will only be viable for an undetermined period of time. Coming to lab prepared (understanding the surgery, what data will be collected and why, how the experiment will be performed to collect the necessary data) will allow you to conduct the experiments in the most efficient manner. This will allow you to perform the surgery faster, resulting in a more viable preparation and higher quality data. More importantly, coming unprepared for lab is very disrespectful to the animals (both vertebrates and invertebrates) since the majority of the procedures are terminal.

10. College of Charleston Honor Code and Academic Integrity

Discussion among peers is an important and valuable aspect of science. However, each of you will be expected to hand in assignments individually. The assignment turned in must be an example of ***your own individual work***. This includes both written portions ***and*** graphical presentations. The only exceptions to this are:

- 1) neural traces printed from your experiments;
- 2) data provided by the instructor who will explicitly state that the data may be shared. **The same neural trace printouts may only be shared by members of the same group (i.e. no sharing of printouts between groups) unless discussed with and permitted by the instructor prior to submission.**

In all other cases, lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each incident will be examined to determine the degree of deception involved.

Incidents where the instructor determines the student's actions are related more to a misunderstanding will be handled by the instructor. A written intervention designed to help prevent the student from repeating the error will be given to the student. The intervention, submitted by form and signed both by the instructor and the student, will be forwarded to the Dean of Students and placed in the student's file.

Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XXF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student's transcript for two years after which the student may petition for the XX to be expunged. The F is permanent. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

Students should be aware that unauthorized collaboration--working together without permission-- is a form of cheating. Unless the instructor specifies that students can work together on an assignment, quiz and/or test, no collaboration during the completion of the assignment is permitted. Other forms of cheating include possessing or using an unauthorized study aid (which could include accessing information via a cell phone or computer), copying from others' exams, fabricating data, and giving unauthorized assistance.

Research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the instructor.

Students can find the complete Honor Code and all related processes in the *Student Handbook* at <http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.php>

11. Accommodations for students with disabilities

The College of Charleston abides by Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act. Any student eligible for and needing accommodations because of a disability is requested to speak with the professor during the first two weeks of class or as soon as the student has been approved for services so that reasonable accommodations can be arranged. Students should apply for services at the Center for Disability Services/SNAP (843-953-1431) located on the first floor of the Lightsey Center, Suite 104.

12. Center for Student Learning

I encourage you to utilize the Center for Student Learning's (CSL) academic support services for assistance in study strategies, speaking & writing skills, and course content. They offer tutoring, Supplemental Instruction, study skills appointments, and workshops. Students of all abilities have become more successful using these programs throughout their academic career and the services are available to you at no additional cost. For more information regarding these services please visit the CSL website at <http://csl.cofc.edu> or call (843)953-5635.

13. Lab safety Policy

Read the SSM lab safety policy I distributed in class and posted on OAKS. Pay specific attention to the sections on proper clothing (including shoes) to wear in lab. Also, note that no food or drink is allowed in the lab.

TENTATIVE CLASS SCHEDULE

Week (Mon)	Topics	Lab (Wednesday)	Assignment
Module 1			
1 (1/7)	Review of action potentials; introduction to recording biological signals	Week 1 = Further lecture material; introduction to lab equipment (1/9)	Read lab manual
2 (1/14)	Invertebrate nervous systems; crayfish abdominal anatomy; EKGs; analysis of biological signals	Week 2 = Data acquisition/software tutorial; recording and analyzing electrical activity (EKGs); introduction to microsurgery (1/16)	EKG background Module 1 Lab worksheet Due Week 3 Wed Lab (1/23)
Module 2			
3 (1/21) 4 (1/28)	1/21 MLK DAY (no class) Week 3 = Suction electrodes, unit identification Week 4 = multiple electrode analysis, neuromodulation	Week 3 = Suction electrode recordings from crayfish r3s nerves controlling abdominal posture (1/23) Week 4 = r3s data analysis; cluster analysis (1/30)	Module 2 Lab worksheet Due Week 6 Wed Lecture (2/13)
Module 3			
5 (2/4) 6 (2/11) 8 (2/25)	Stereotaxic surgery; non-invasive methods of recording brain activity	Week 5 & 6 = Rat stereotaxic surgery (2/6 and 2/13) Week 8 = Tissue cutting and histology (2/27)	Module 3 Lab worksheet Due Week 13 Wed Lecture (4/10)
Module 4			
7 (2/18) 9 (3/4) 10 (3/11)	Week 7 = Wind-detecting cercal sensory system of cockroaches; Behavioral analysis of stimulus detection and localization Week 9 = Tract tracing and histology Week 10 = Neurophysiological analysis of stimulus detection and localization	Week 7 = Cockroach escape behavior (2/20) Week 9 = Giant interneuron backfills and rat brain histology (3/6) Week 10 = Hook electrode recordings from cockroach wind-sensitive interneurons; directional encoding (3/13)	<u>Complete Lab report</u> Based on cockroach behavioral, physiological, and neuroanatomical study of the wind-escape system (not including the circuit mapping) Week 11 FRIDAY 9am (3/29)
SPRING BREAK March 18-22			
Module 5			
11 (3/25) 12 (4/1)	Tungsten/glass microelectrodes, CNS multi-unit recordings, how brains organize information (i.e. spatial maps); sensorimotor integration	Week 11, 12 = Frog tectal recordings and mapping visual space (3/27, 4/3)	Module 5 Lab worksheet Due Week 13 Wed Lab (4/10)
Module 6			
13 (4/8) 14 (4/15)	Intracellular recordings; electrical stimulation; synaptic plasticity	Week 13, 14 = intracellular recordings from crayfish muscle and synaptic plasticity (4/10, 4/17)	
15 (4/22)	Other techniques wrap-up	No lab	
	FINAL PRESENTATION	During Final Exam Time April 29 8-11AM	