BIOLOGY 446 (credit 3 hours)
NEUROPHYSIOLOGY LABORATORY
Spring 2016

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Required Texts
None. Handouts and www based content.
http://web.as.uky.edu/Biology/faculty/cooper/Bio450-AS300/Bio446-650-Spring2016.htm

Supplementary Materials
Readings from the primary literature will be assigned on occasion. These articles will be posted on Blackboard or the web page for you to download and print.

Time: Tues - 1:00 to 1:50 PM Lecture; Thurs - 1:00 to 3:50 PM Lab
Multidisciplinary Science Bldg.
725 Rose Street, Room 155B.
This is the red brick and stucco building directly across the street from Biology (Thomas Hunt Morgan Building), right next to the UK clinic parking garage
Course Description

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The course will focus on the experimentation in primarily neurophysiology with some emphasis in muscle physiology. Generation of receptor potentials in sensory neurons will be measured as well as action potentials in axons. Pharmacological experimentation of ionotropic and metabotropic receptors subtypes and second messengers signaling will be conducted. The key role of ion channels and transporters in regulation of the membrane potential will be covered in great detail. The concept of electrochemical equilibrium will be introduced and quantitative description of the equilibrium membrane potential will include discussion of Goldman and Nernst equations and their applications. The mechanisms of action potential generation, as a result of synaptic and receptor stimulation within a neural cell, will be measured in terms of voltage gated ion channels.
The mechanisms of neuron-neuron communication through electrical and chemical synapses will be examined in live preparations. The function of gap junction ion channels will be examined and measured at electrical synapses. The complex intracellular mechanisms controlling neurotransmitter release at the chemical synapses will be examined. The proteins participating in the SNARE complex, involved in the synaptic vesicles fusion, as well as the molecular machinery involved in synaptic vesicles recycling will be emphasized along with quantal analysis of synaptic transmission. The historical introduction of the quantal hypothesis and its experimental conformation will be covered. Synaptic plasticity will be covered up to the latest discoveries in the field.

Course Objectives
By the end of this course, you should:
1. Have a conceptual understanding of the information processing in the nervous system.

2. Understand the molecular mechanisms that enable signal transmission in the nervous system in terms of receptor potentials, synaptic potentials and action potentials.
3. Know what are the cellular specializations and the molecular machinery involved in the neuron-neuron communication at the state of the art level.
4. Develop a basic knowledge of the sensory processing.
5. Be able to understand and critically analyze research papers in the field of Neuroscience.
6. Be able to develop new ideas and suggest future research directions in the field of Neuroscience.

The overall objective of the course is to develop insightful understanding of the neurological processes at molecular and cellular level by experimentation. The course will complement other courses offered within the new Neuroscience Major we are establishing on campus.

Pre-requisites are BIO 302 and/or BIO 350 and /or consent of instructor

Course Work/Grading

Overall

Grades will be based on exams, homework assignments, and class participation. There will be two exams. Homework due dates and exam dates are listed in the schedule at the end of this document.

- Class participation: 10% (includes attendance, adding to the discussion during lectures and journal clubs, and actively participating in in-class exercises such as problem solving and other activities)
- Conducting all laboratory exercises 30% (review of lab notebook, attendance)
- Homework/problem sets: 20%
- Lab report 20% (submitted in a journal publication format)
- Exam 1: 10%
- Exam 2: 10%

All exams are required of all students. If you are unable to take an examination as scheduled, it is your responsibility to contact me before the exam. There will be make-up exams for excused absences over similar material. Unexcused absences from an exam will result in a score of zero for that test. Homework and problem sets that are turned in late will be marked down a point each day they are late, and they must be turned in before those that were turned in on time are returned, unless an excused absence. If an excused absence a student will have 1 week to hand in the material.

Quizzes
Quizzes will be assigned to each topic. The quizzes score will be used as an extra credit toward your exam score. Four quizzes within the semester and each is worth 10 points.

Attendance
Required for all laboratory sessions.

Format
In this course, you will learn the fundamentals of neural processing through a variety of activities, including lectures, problem sets, independent/group study, and in-class exercises. Please note that you are responsible for all the material in the assigned chapters, including figures, summaries, and "boxes," regardless of whether it is covered in lectures. Thus, you will be responsible for covering some material from the text or readings on your own.

Blackboard/Class Communications
Course announcements, assignments, lecture outlines and additional materials will be posted online using Blackboard. Exams and homework dates will remain fixed. Updates to this syllabus (regarding topics and reading) will be posted; please check periodically. You will also receive important course announcements via your UK e-mail account. If you do not use your UK e-mail account, you need to activate it. It is strongly recommended that you check your e-mail regularly. I may send messages-sometimes with attachments-to the class using this medium. You should also feel free to e-mail me if you have any questions or problems. Feel free to call me as well, if you prefer a more personal communication. I am also available during the office hours. If you would like to meet with me at another time, please don't hesitate to e-mail or to call, and I can schedule a time to meet.

Honesty and Civility
You must abide by UK's Code of Conduct which prohibits:
1. Academic dishonesty and impropriety, including plagiarism and academic cheating.
2. Interfering or attempting to interfere with or disrupting the conduct of classes or any other normal or regular activities of the University.
We take plagiarism and other forms of cheating very seriously. If you have any questions as to whether something is plagiarism, please ask me, or, if that's not possible, assume that it is and don't do it!

Disabilities
Any student who needs accommodation because of a disability should contact me privately to discuss the specific situation as soon as possible. The Office of Disability Resources and Services. They can coordinate reasonable accommodations for students with documented disabilities.

TOPICS AND READINGS—TENTATIVE SCHEDULE
Please note that this is a tentative schedule and may be modified depending on how the course is progressing. All changes will be announced in advance, and students will be well aware of them—particularly regarding what is going to be included on exams.

Week, Topics, Student-driven In-class Activities

Week 1. - Learn about equipment (extracellular & intracellular amps, microscopes, electrode puller). Solutions and laboratory tools. Animal care. Lab notebooks & reports.

Week 2. - We will start on the bread board to learn about OHM's law and electrical conduction .....(see this lab Page- Neuron model)

Week 3. - Earthworm preparation to learn about conduction velocity and refractory periods .....(see this lab Page- Earth worm experiments)

Weeks 3 & 4. - Measure membrane potentials in crayfish abdomen muscles and plot Rp vs [Na]o graphs and Rp vs [K]o graphs. (see this lab PAGE- RP, K, Na)

Weeks 3 &4 . - Measure facilitation and depression in tonic and phasic neuromuscular junctions in crayfish abdomen muscles. We will learn how to stimulate motor nerves and record EPSPs/IPSPs. (see this lab PAGE- EPSPs)

Week 5. - Learn to record from proprioceptors (extracellular) in the crab leg and relate to joint positions. Research paper discussion. (see this lab PAGE- Joint receptors in a crab)

Week 6. - Learn how to forward fill neurons from the crab leg proprioceptors (CoCl2, 4-Di-2 ASP) as well as stain with methylene blue. (see this lab PAGE- Staining of Joint receptors in a crab)

Week 7. - Review - EXAM 1 - Learn to record from tension receptors in the crab leg related to muscle length and contraction. (see this lab PAGE- tension nerve recordings)

Week 7. - EEG Human lab (go to lab EEG lab page)

Week 8. - Introduction to the leech nervous system and practice dissection. Staining of leech ganglia.

Week 8. - Learn how to dissect the leech ventral nerve cord and obtain intracellular recordings from identified neurons. Current injections and threshold measures. Potentially two intracellular electrodes and record in situ synaptic connections. Investigate the ionic currents making up the action potentials. (see this lab PAGE- Leech ganglion lab)

Week 8 & 9. March 5 & 7, 2013 - -Mapping skin receptive fields on the leech while recording from neurons. Dye fills. (see this lab PAGE- Leech Skin lab)

2015 - Spring break

Week 10. - Learn how to remove and culture leech neurons for forming synapses in culture. (see this lab PAGE- Leech neuron culture lab)

Week 11. -Catch up on experiments and analysis day. Graph data, catch up on homework and literature gathering. Plot I V curves and use Ohms law to determine Rm with crayfish skeletal muscle.

Week 11. - Quantal analysis of synaptic transmission: Crayfish NMJ record quantal responses..(see this lab PAGE- quantal analysis)

Week 12. Sensory recordings from the cockroach cerci. (see this lab PAGE- cockroach cerci)

Week 13. Sensory recordings from the cockroach cerci. (see this lab PAGE- cockroach cerci)

Week 13. Vision: crayfish caudal photo receptor in crayfish.

.....(see this lab PAGE- Crayfish photoreceptors lab)

Week 14 (lecture). Vision: Horse shoe crab photo receptors.

.....(see this lab PAGE- Horseshoe crab photoreceptors). A paper on the responses PDF

Week 14. No class for lab. Work on your own out of lab for write ups.

Week 15. - Make up any labs needed. Make sure lab report is going along OK. Pass out take home exam.(Exam 2)

Week 16. (Finals week) Turn in final exam and reports.