Neurobiology 211 ***Molecular and Developmental Neurobiology***

Location and Time:
Goldenson 422 — *Tues, Thurs, Fri 9 to 11 am*
Half course (spring term). — **First Meeting: Tuesday Jan 27th, 9 am**

Course Director:
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Prerequisite: Neurobiology 200 or permission of instructor.

Overview: This course provides an integrated overview of the molecular and cellular events that create the nervous system and enable its function throughout life. We will start with a general introduction to the molecular tools and model systems used to study nervous system development and function. Lectures will then track from early stages of development to the formation of mature, functional circuits. The goals are: to learn the basics of neural development, to understand how behavior is controlled by genes, and to become familiar with outstanding questions in the field as well as current techniques and approaches. Lectures will provide general background, but are not intended to be comprehensive. Rather, specific areas of investigation will be covered in detail, focusing on current issues, unresolved problems, and common experimental approaches used in each field. Students will read and discuss related papers in the discussion sessions. Emphasis will be given to learning how to identify an important question and develop a feasible research plan, including a lecture on how to write a grant proposal and a mock study section. In addition, technique workshops will be held to introduce students to the practical application and interpretation of the methods commonly used to study nervous system form and function. The final exam consists of a grant proposal; grades will also be determined by successful completion of homework assignments and class participation.

Lectures: Lectures are divided into six units, with two complementary lectures each week addressing specific topics in molecular and developmental neuroscience. Lectures will provide a general overview, with a focus on the big questions in the field and how these questions are approached experimentally. We will cover the major advances and summarize the current unresolved issues. Lectures will also serve to introduce the class to any techniques or concepts that are relevant to the paper chosen for discussion. Students will read additional papers related to the lecture and participate in online discussions through the Piazza course page to respond to prompts provided by the faculty and TAs.

Discussions: For each pair of lectures, students will be assigned two related papers: one to be discussed in the online discussion forum that week (running from Thursday-Tuesday), and one for an in-class discussion on the following Tuesday. Before meeting on Tuesday, students will hand in a one-page summary of the paper that will be discussed in class (see below). The discussion will be led by 2-3 student leaders, with assistance from faculty. Student leaders are required to meet in advance with the faculty to discuss the paper and plan the discussion; leaders will also read additional papers so they can provide extra expertise during the discussion. In addition to critiquing the paper for flaws in experimental design or interpretation, the group will discuss how the results fit into a broader context and influence future studies in the field. Overall participation grades will be determined by the level and quality of participation in both the online and in-class discussions. Student leaders for in-class discussions will receive grades for their presentations and effectiveness of the discussion.

Homework: There will be six homework assignments. Five assignments will be related to the assigned paper. Each summary is one page maximum (11 pt Calibri font, 0.8" margins, single spaced). The summary should describe the major question and approach, followed by a discussion of the main conclusions and any caveats or problems noted. Most importantly, each summary will end with a discussion of what could be done next to follow up on the main results. Five summaries must be handed in; students may choose which of the eight assigned papers to write about. The sixth assignment is to critique two grants for a mock study section held on March 24th. Guidelines for the grant critiques will be provided at the lecture on Grant Writing.

Homework should be emailed to neurobio211@gmail.com by 8 am on Tuesday morning. There are no extensions and late assignments will not be accepted.

Grant Proposals: A major component of this class is the preparation of a 7 page NRSA-style grant proposal: 1 page of Specific Aims and a 6 page research plan. Students will be assigned topics and given a list of papers related to their topic. They must write a proposal for experiments that extend the findings in one of those papers. A lecture will be presented before spring break to introduce students to the principles of grant writing. In addition, students will read and evaluate grant proposals in a mock study section. Subsequently, each student will give a summary of their topic and specific aims during a 10 minute presentation to the class, followed by a 10 minute discussion. A draft of the specific aims must be submitted at the time of the presentation and then revised one week later. The entire proposal is due on April 24th (the original submission, or "A0"), followed by a mandatory one-on-one meeting with one of the faculty mentors. Following this meeting, students may either choose to accept the score received on the A0 as their final grade for the grant, or they may submit a revised version (the "A1") along with a one-page rebuttal addressing the critiques/comments from the original submission. The specific aims draft, presentation, required one-on-one meeting, and overall ability to incorporate feedback count for 40% of the grade on the grant; the A0 and A1 will each count for 30%. If no A1 is submitted, the A0 will count for 60% of the overall grant grade. The proposals will be graded on the basis of: how well is the question explained, is the experimental approach appropriate and novel, and is the grant written clearly and logically?

Grading:
Homework assignments (5 paper summaries, 2 grant critiques): 30%
Participation (includes attending lectures and in-class/online discussions): 30%
Grant Proposal: 40%

Course Schedule (pg. 1 of 2):

Date	Class	Lecturer	Homework	Workshop
Unit 1: Tools in Molecular Neuroscience				
Tues Jan 27	Introduction to model organisms and experimental approaches	**Goodrich**		
Thurs Jan 29	Manipulating genes in the mouse brain	**Kaeser**		
Fri Jan 30	Assessing gene expression in neurons	**Datta**		
Tues Feb 3	*A Sample Discussion: laterality*	**Datta**	**Summary 1†**	
Unit 2: Wiring the Nervous System				
Thurs Feb 5	Cortical development and neurogenesis	**Lehtinen**		
Fri Feb 6	How is gene expression regulated?	**Gray**		
Tues Feb 10	*Discussion*	**Lehtinen**	**Summary 2**	
Thurs Feb 12	How are axons and dendrites specified and shaped?	**Goodrich**		
Fri Feb 13	How is the actin cytoskeleton regulated?	**Segal**		Gene Expression
Tues Feb 17	*Discussion*	**Goodrich**	**Summary 3**	
Thurs Feb 19	How do axon guidance molecules create a stereotyped wiring pattern?	**Gu**		
Fri Feb 20	How do neurons select a specific post-synaptic target?	**Goodrich**		*In Vitro* Assays
TBA	*Discussion*	**Goodrich**	**Summary 4**	
Unit 3: Molecular Mechanisms at the Synapse				
Thurs Feb 26	How do neurons secrete transmitters?	**Kaeser**		
Fri Feb 27	How is synaptic transmission controlled and regulated?	**Kaeser**		Biochemistry
Tues Mar 3	*Discussion*	**Kaeser**		
Thurs Mar 5	How are proteins processed by the ER?	**Kaplan**		
Fri Mar 6	How are receptors trafficked to the membrane?	**Kaplan**		Imaging/Microscopy
Tues Mar 10	*Discussion*	**Kaplan**	**Summary 5**	
Thurs Mar 12	How do cells send and receive signals?	**Ginty**		
Unit 4: Grant Writing				
Fri Mar 13	Grant Writing	**Greenberg/Goodrich**	**TOPICS DUE**	
Tues Mar 17	SPRING BREAK			
Thurs Mar 19				
Fri Mar 20				
Tues Mar 24	Mock Study Section	**Goodrich**	**Grant Critiques**	
Thurs Mar 26	Presentations (1/3)	TBA	**1st Draft of Specific Aims (due at presentation)**	
Fri Mar 27	Presentations (2/3)	TBA		
Tues Mar 31	Presentations (3/3)	TBA		

Course Schedule (pg. 2 of 2):

Date	Class	Lecturer	Homework	Workshop
Unit 5: Making, Breaking, and Remaking Connections				
Thurs April 2	How do neuron-glia interactions influence synaptogenesis?	Stevens		
Fri April 3	How are cells, processes, and synapses eliminated?	Stevens		Wildcard (based on student suggestions)
Tues April 7	*Discussion*	Stevens	**Summary 6**	
Thurs April 9	What controls the opening/closing of critical periods?	Fagiolini		
Fri April 10	Neurodevelopmental disorders: from synapse to circuit	Fagiolini		
Tues April 14	*Discussion*	Fagiolini	**Summary 7**	
Thurs April 16	When and how does neurogenesis occur in the adult brain?	Harwell		
Unit 6: Genes and Behavior				
Fri April 17	How do genes mediate behavior?	Datta		
Tues April 21	*Discussion*	Datta	**Summary 8**	
Thurs April 23	How does a molecular understanding of basic cell biology inform our understanding of a common neurological disorder?	Schwarz		
Fri April 24	Approaches to study the genetics of neurological disorders in humans	McCarroll	**GRANT DUE (A0)**	
Fri May 8			**DEADLINE FOR GRANT RESUBMISSION (A1)**	

† All students must complete 5 of the 8 possible summaries. Grant Critiques are required.