NEUR 1040 **Introduction to Neurogenetics** **Spring 2017**

INSTRUCTOR: Dr. Karla R Kaun

OFFICE: SFH 362

E-MAIL: [email]

CLASS TIME/LOCATION: Tues/Thurs Time TBA, Location TBA (In 2016 was 10:30-11:50am)

TUTORIALS: Time/Place TBA (In 2016 was Mon or Thurs 5:00pm-7:00pm, Sidney Frank Hall 350)(see handout for list of dates)

TEACHING ASSISTANTS: Katie Yanagi **[email]**
Rachel Souza **[email]**

COURSE DESCRIPTION: Recent advances in molecular biology and molecular genetics have allowed researchers to test specific hypotheses concerning the genetic control of behavior and neurological disease. This course will familiarize you with the relatively new and exciting field of neurogenetics. We will cover basic topics, new ideas, and unsolved problems in neurogenetics primarily through an assigned text. However, neurogenetics is essentially a "frontier" area in neuroscience, and the best way to approach this topic is by scientific literature, which will be covered in some lectures. Information derived from various animal model systems, including worms, flies, zebrafish, mice and humans, will be covered with a focus on techniques such as classical genetics, molecular genetics, genomics, and behavioral neurobiology.

PREREQUISITES: NEUR 1020 ***(An introductory genetics course such as BIOL0470 is recommended but not required)***

COURSE OBJECTIVES: Upon successful completion of this course, students should be able to demonstrate the following competencies:

(1) an understanding of the central theories and methodologies that define the field of neurogenetics and the ability to use the vocabulary that embodies this knowledge;

(2) an understanding that science is a continual process of investigation and interpretation and that scientific knowledge progresses via the support and rejection of competing hypotheses;

(3) an ability to approach issues regarding genes and their influence on neurological disease and behavior with a critical mind and educated perspective;

(4) an understanding and appreciation for how research in neurogenetics is carried out and how classical, molecular and behavioral genetics intertwine;

(5) an ability to communicate the material you have learned through discussion, scientific writing and oral presentations.

CREDIT HOURS: Total time spent in and out of class for this course is estimated at ~180 hours. Over the 15 weeks of this course, students will spend 4 hours in class each week (3 hours lecture and 2 hours of tutorial every 2 weeks, or 60 hours total). Although specific out-of-class time investments may vary for individual students, a reasonable estimate to support this course's learning outcomes is 120 total out-of class hours, or on average, 8 hours weekly over a 15-week term. Out-of-class preparation will regularly include about 3 hours per week of reading (45 hours total). In addition to this ongoing preparation time, students are expected to allocate about 30 hours over the course of the term to writing assignments and 45 hours for the oral presentation, content review and preparation for lectures and tutorials.

REQUIRED TEXTS: The content of this course is very current, and thus there is no available textbook encompassing the entire course content. The following textbook will be helpful in understanding and applying some of the genetic tools we are covering in the course. Readings will be posted on Canvas should you be interested in more in-depth understanding of most of the course topics.

***Introduction to Genetic Analysis**, by Griffiths, Wessler, Carroll & Doebley. 11th Ed W.H.Freeman & Co (2015). (~$45-$200).*

RECOMMENDED TEXTS: You will be expected to develop your writing skills as this course progresses. Each assignment, including your final term paper will be evaluated on writing ability and style. The following book may be helpful in developing your writing skills: ***The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century**, by Steven Pinker* (~$15)

If you do not have a strong background in neurobiology, and would like more background reading the following textbook may be helpful: ***Principles of Neurobiology**, by Liqun Luo. Garland Science (2016). (~$95)*

GRADING:

Evaluation:	**Due Date**	**% final grade**
ASSIGNMENTS (5 in total, each worth 6%)	See Tutorial Schedule	30
PAPER OUTLINE	Mar 23, 2017 @ 10:30am	10
ORAL PRESENTATION	April 24-28, 2017	10
PAPER	May 10, 2017 @ 10:30am	40
LECTURE PARTICIPATION	N/A	5
TUTORIAL PARTICIPATION	N/A	5
TOTAL POINTS		**100**

ASSIGNMENTS for this course will all revolve around a topic in neurogenetics that you choose. At the beginning of the course, you will choose a particular neurogenetic topic that interests you: for example a particular disorder or behavior. The lecture material will be focused on types of approaches for solving neurogenetic problems and you will be expected to apply that information to your chosen topic for each question set. Since one of the goals of this course is to develop your communication skills, you will have the opportunity to receive peer feedback on your written assignments in tutorials before handing in your assignment. All assignments should be submitted on the first class of the week following your tutorial section.

NOTE: Make-up assignments will only be given in cases of a college accepted excused absence that has been documented.

You will be assigned 5 short writing assignments, each worth 6% of your grade. Each assignment is typically one question in which you will be asked to apply a certain approach or technique to your chosen topic of interest. Answers to these questions will be discussed during your tutorials; you will lose both assignment and participation points if you do not adequately complete and discuss the questions. These assignments will be graded on both content and writing style. Detailed assignment explanations and rubrics will be provided in advance of assignment due date.

Your **five assignments** will be based on the following topics:

1. Genetic and Epigenetic inheritance
2. Genome editing
3. Worm genetic screen
4. Fly binary system for temporal and spatial gene specificity
5. Zebrafish functional circuit mapping using genetic techniques

FINAL PAPER: The purpose of your paper is to summarize and synthesize recent original research on a neurogenetics topic of your choice, using papers from academic journals. You will essentially write a "review" paper about a topic you choose at the beginning of the course. This could include a particular behavior, or disease/phenomenon that is linked with behavior. To ensure that your topic is one that is currently being actively studied, use PubMed to find at least three recent (i.e. 2010 or later) original research papers on your topic. Be sure that your sources are research papers and not review papers. Review papers are often present in journals but do not contain original results; they summarize other people's work—which is basically what you'll be doing in this assignment. You can read older review papers and to give you background information, but the bulk of your paper should focus on explaining the original research papers. Your paper should be 1200-1800 words, not including references. Your explanations should reflect your own understanding and intellectual synthesis of the research, making it clear that you have a full understanding of the information.

PAPER OUTLINE: For the paper outline you will write one paragraph explaining your general topic, your thesis (where applicable), and your overall approach. The rest of the outline should include a topic sentence for each paragraph followed by bullet points listing your main arguments. Then list your sources, and include 1-2 sentences for each reference to explain specifically how that source will contribute to your project. You **must** demonstrate that you have spent significant time reading your sources. Your grade will be based on the specificity and novelty of your proposed project, the breadth and quality of the sources you have found, and the depth with which you have read and understood your sources. It is highly recommended that you meet with Dr. Kaun or your TA to go over your paper outline prior to handing it in.

ORAL PRESENTATION: At the end of term, you will be expected to give a 3 min data-blitz style presentation on the topic you choose to write your paper. You will be permitted a maximum of 2 slides and each presentation will be followed by 2 min of questions from your peers. You will present to smaller groups in your tutorials, and will be evaluated on presentation style, organization and inclusiveness, scientific content, and scientific analysis and interpretation.

Paper outline with annotated bibliography is due by the start of class on March 23, 2017; the final paper is due 10:30am on May 10, 2017.

TUTORIAL SECTIONS for this course will consist of eight participation-driven discussions moderated by your teaching assistant. You will be expected to have thought about and prepared discussion points for the topic for each discussion prior to your tutorial section. You will be graded on your participation including intellectual contribution to the discussion and thoughtful questions asked.

The topics listed below will be discussed during tutorial sections:

1. What topic are you choosing for your paper and why?
2. Genetic and Epigenetic inheritance (assignment discussion)
3. Genome editing (assignment discussion)
4. Worm genetic screen (assignment discussion)
5. Fly binary system for temporal and spatial gene specificity (assignment discussion)
6. Zebrafish circuit mapping (assignment discussion)
7. Public speaking for science workshop
8. Student presentations on paper topic

CLASS PARTICIPATION: The material in this course is best absorbed through interactive learning practices. Class participation is key for this process. Your class participation grade will be determined by your level of preparation and participation in both the lecture and tutorial discussions. Participation during lectures will be based on assigned readings either from your text, scientific papers or news articles posted on Canvas. Participation during tutorials will be, for the most part, based on the assignment you hand-in at your tutorial section.

OFFICE HOURS: Dr. Kaun's usual office hours will be Mondays from 10am-12pm. If for some reason I won't be available during that block of time, a substitute time will be posted on Canvas. Alternatively, I am happy to arrange another time to meet with you. Feel free to schedule a meeting with me *via* email.

STUDENTS WITH DISABILITIES: Please inform me if you have a disability or other condition that might require some modification of any of these course procedures. You may speak with me after class, during office hours or by appointment. For more information contact Student and Employee Accessibility Services at 401-863-9588 or SEAS@brown.edu. Students in need of short-term academic advice or support can contact one of the deans in the Dean of the College office.

ACADEMIC INTEGRITY: Plagiarism and cheating are serious offenses and are more harmful to you, the student, than to the university. Please refer to the Brown University Academic and Student Conduct Codes for details regarding Brown University's policy on academic integrity and penalties for violating the academic code.

LECTURE SCHEDULE:

Date	Title	Reading Assignment
Jan 26	Introduction to Course Cell biology of a neuron and how genes define neuronal diversity.	Syllabus Course information
Jan 31	Understanding how genes encode proteins and how genetic information gets transmitted.	Chapters 7,8,9 from Introduction to Genetic Analysis, Griffiths et al (2015).
Feb 2	The bits in between: post-transcriptional, post-translational and epigenetic modifications	Chapter 12, Section 12.3-12.5 from Introduction to Genetic Analysis, Griffiths et al (2015).
Feb 7	Science Writing Workshop	
Feb 9	Qualitative *vs* quantitative genetics in humans	Chapter 19 from Introduction to Genetic Analysis, Griffiths et al (2015) **Guest lecture**
Feb 14	Modern sequencing: basic lab methods and neurobiological applications	Chapter 14 from Introduction to Genetic Analysis, Griffiths et al (2015).
Feb 16	Transgenes and their application in neurogenetics	Model organism workshop: Chapter 10 and 16 from Introduction to Genetic Analysis, Griffiths et al (2015).
Feb 21	**NO CLASS** – long weekend	
Feb 23	Gene targeting and genome editing (CRISPR/Cas9)	*See posted material for supplemental readings* **Guest lecture** *Assignment 1 due*
Feb 28	Optogenetics	*See posted material for supplemental readings*
Mar 2	Pharmacogenetics	*See posted material for supplemental readings*
Mar 7	*C. elegans* basic biology, genetics and genetic tools	pg 802-803 from Introduction to Genetic Analysis, Griffiths et al (2015). *Assignment 2 due*
Mar 9	*C. elegans* in current neurogenetics research	**Guest lecture**
Mar 14	*C. elegans* genetic screens	*See posted material for supplemental readings*
Mar 16	*D. melanogaster* basic biology, genetics and genetic tools	pg 804-805 from Introduction to Genetic Analysis, Griffiths et al (2015).
Mar 21	*D. melanogaster* binary genetic systems for spatial and temporal control	*See posted material for supplemental readings*
Mar 23	*D. melanogaster* as a model to study addiction (research lecture by Dr. Kaun)	*PAPER OUTLINE DUE*
Mar 28	**NO CLASS** – spring break	
Mar 30	**NO CLASS** – spring break	
Apr 3	*D. rerio* basic biology, genetics and genetic tools	*See posted material for supplemental readings* *Assignment 3 due*
Apr 6	*D. rerio* genetic approaches to circuit mapping	
Apr 11	*M. musculus* basic biology, genetics and genetic tools	pg 806-807 from Introduction to Genetic Analysis, Griffiths et al (2015). *Assignment 4 due*
Apr 13	*M. musculus* binary genetic systems	*See posted material for supplemental readings*
Apr 18	*M. musculus* genetic approaches to circuit mapping	*Assignment 5 due*
Apr 20	Conserved circuit and genetic mechanisms between model organisms	*See posted material for supplemental readings* **Guest lecture**
Apr 25	Last Class - Peer Editing Workshop for Final Paper	*Oral Presentations during tutorials*
Apr 27	Make-up class (if needed)	
May 2	Make-up class (if needed)	
May 10		*FINAL PAPER DUE*

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Rachel Souza **[email]**

TUTORIAL SCHEDULE: **TBA (**2016 = Mon 5:00-7:00pm SFH 350 or Thurs 5:00-7:00pm, SFH 350)

Week	Discussion Topic	Assignment Due
Feb 6	What is your chosen neuro-related disorder / behavior, what is its genetic origin, and why did you choose it?	
Feb 13	Briefly describe the genetic inheritance of your chosen disorder / behavior. Describe a (potential) method of epigenetic regulation of your chosen disorder / behavior.	Assignment 1 Draft due Feb 13 Final due Feb 23
Feb 27	Describe an experiment using genome editing to make a mutation in your gene(s) of interest. What are the benefits and limitations of this method?	Assignment 2 Draft due Feb 27 Final due Mar 7
Mar 20	Describe a chemical mutagenesis screen in worms that can be used to screen for mutations of interest related to your chosen disorder / behavior. What are the benefits and limitations of this method?	Assignment 3 Draft due Mar 20* Final due Apr 3
Apr 3	Describe use of a binary system in flies to restrict gene expression in a select subset of cells specifically during the adult stage in order to understand the mechanism underlying your disorder / behavior of interest. What are the benefits and limitations of this method?	Assignment 4 Draft due Apr 3 Final due Apr 11
Apr 10	Describe use of a binary system in zebrafish to map and understand the function of a circuit implicated in your chosen disorder / behavior. What are the benefits and limitations of this method?	Assignment 5 Draft due Apr 10 Final due Apr 18
Apr 17	Public speaking for science workshop	
April 24	Student Oral Presentations	

* Please note that your paper outline will also be due this week!