instructor: Sarah Siegrist PhD
contact: ses4gr@virginia.edu
office hours: W 9:00-11:00am, Gilmer 145

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BIOL 4015: Neural Development Lab: From stem cells to neural circuitry
Location: Gilmer 145
Meeting Time: TuTh 9:00-11:00am

Did you know....

Bones and skin have an amazing ability to self-repair. Even your liver can fully regenerate following a partial hepatectomy. Yet one organ, perhaps your most vital, has no or very limited ability to self-repair. As budding research scientists, we will take a hands on approach and begin to investigate why are brains are so useless at regeneration. What will we discover? A master gene for brain regeneration? How about a network of genes? Research labs across the world are asking and investigating these same types of questions. Does the next Nobel Prize belong to you and your peers? Let's find out....

Getting started....

Our brains are filled with neurons and glia that organize into neural circuits that provide us with the capacity to think, feel, breathe, and do everything else we do or don't do. By far, the majority of these neurons and glia were generated decades earlier, during development, when neural progenitors divided at prolific rates. These progenitors, which include a dedicated population of neural stem cells, divided continuously to ensure that sufficient numbers of molecularly diverse populations of both neurons and glia were produced. Yet, in brains of most adult organisms (including us), these neural stem cells are no longer present, having differentiated, undergone apoptosis, or exited from the cell cycle into quiescence, a state of non-proliferation. It is precisely this population of quiescent neural stem cells that has caught the attention of stem cell and regenerative biologists alike. Why? It is our hope that by inducing quiescent neural stem cells to re-enter the cell cycle and produce new neurons and glia, we can repair neural tissue that has been damaged by injury or disease. In order for this prospect to come to fruition, several hurdles must be overcome. First, we must develop a better molecular and cell biological understanding of stem cell quiescence. Are their hallmarks or molecular markers that indicate or predict quiescence? Why are some adult stem cells more quiescent than others? Why would adult stem cells even enter quiescence? What determines if stem cells enter or exit from quiescence? As a class, we will attempt to answer these questions (and more) through reading of the primary literature, in class discussion and problem solving, and hands on experimentation.

Long-term, this class will help you in developing....

- An informed understanding of the role stem cells play in development, adulthood, and disease.
- A rigor in your reading and digestion of scientific knowledge that allows you to think critically.
- An ability to discuss scientific topics current in headline news with friends and family members .
- A sense of joy in reading, discovering, and finding value in science in your everyday life.

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OK, (whatever) what am I really going to learn....

1. Gain a foundational knowledge of basic principles relevant in stem cell biology.
2. Learn to read deeply the primary literature.
3. Engage in scientific discovery, from experimental design to drawing of conclusions.
4. Develop novel testable hypotheses, based on readings and experimental outcomes.
5. Communicate "your science" effectively with your peers, instructors, and broader community.

What does working in an academic lab look like?

People have different experiences working in acadmic research labs and that is because academic reseach labs vary tremendously. Some are quite large in size, with many people working collaborately in small groups or independently, on quite different but, related research projects. Other labs are quite small in size and have a more narrow research focus, but nonetheless equally productive and stimulating. These labs, whether big or small, continue to provide furtile grounds for training the next generation scientist. In fact, most of major scientific discoveries have occured in academic research labs. Perhaps that next great discovery will occur here in this lab this semester by you....

How is this class different from the other Biology classes?

To those of you who have always wanted to work in a research lab, but haven't had the opportunity....now is your chance. You essentially are all now students working in my lab. My role as Principle Investigator (PI) is to guide you in your scientific thought and experimental setup and design. Your role as students is to read the literature and do the experiments. Together we will engage as a team working together to solve the next big questions in Biology.

What do I have to do to get an "A"?

1. participate and engage in activities in and outside of lab:

   a) Individual participation grade (20%): based on your participation in whole group discussions, during journal clubs (student run), during lectures (PI run), and in lab.

   b) Group participation grade (20%): based on your participation as an individual in your research group. Also based on participation by your group in your journal club presentation, poster presentation, and in carrying out experiments. Remember science is collaborative by nature.

2. Research notebook (10%): every scientist maintains a lab notebook to record their daily activitie
3. Research proposal (20%): every student will write a research proposal. Research proposals are what scientist write and submit to secure funding from public and private agencies.
4. Oral Poster presentation (20%): oral poster presentation and social hour. Your group will put together a poster and present their poster to the broader UVA biology community at the end of the semester. Poster presentations are the main format scientist use in presenting their results at scientific meetings across the world.

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5. Quizes (10%): two quizes to assess that we are learning what we need to be learning. These will be short, true/false, fill in the blank, short answer etc.

Working in groups....inside and outside of class

Each student will be assigned to a group. There will be four groups working as small research teams in the lab. Your role in the group will be to work collaboratively with your peers. Working together in groups will lessen the time that you individually will have to spend working in the lab. I expect that all members will share the work load equally.

Best practices for working in groups: Communicate! get contact information for your group members, email, cell phone, whatever works for you. Set up a schedule and stick with it. Realize that part of your "homework" will be coming to lab and doing experiments on your own time. Everyone will have key card access to Gilmer and to PLSB. The key for 145 Gilmer is upstairs in my mailbox outside of the Biology office. When imaging samples on the confocal microscope, at least two students must be working together at all times.

Other Logistics....

1. You will have access to a Google calender for sign up on the spinning disk confocal microscope as well as the fluorescent stereomicrocopes in PLSB.
2. There is another lab class in 145 Gilmer from 1-4 Monday, 1-4 Tuesday, 2-3 Wednesday and 2-3 Thursday. Please be respectful if you come in during those times to do something quick and try to stay out of their way.
3. You will store your images on a server that you will have access to through your UVA computing ID and email password.
4. Syllabus with reading assignments posted on collab as well as crosses that need to be set up.
5. Each student will have their own set of forceps, probes, dissection dishes etc. Please label them and keep track of your stuff. Forceps are expensive and fragile, so don't drop them!
6. Each group will maintain their own Drosophila lines. Make sure you flip your stocks!

A brief note on academic intergrity....

I trust you all to do your best at all times and not cheat. Any form of cheating including plagerism is taken very seriously and will absolutely not be tolerated. Questions? Please come talk to me.

Questions.....

Course Schedule

Week of	Big Picture Question	Topics Covered	Readings	Lab Work	Crosses/ animals
08/25	Welcome!	syllabus and class philosphy		tour of lab space (145 Gilmer and PLSB) and lab notebook	
08/27			YES	pipetting 101, introduction to Drosophila husbandry	
09/01	"...and sometimes these dollars go to projects that have little or nothing to do with the public good. Things like fruit fly reseach in Paris, France, I kid you not."	Drosophila as a genetic model system and introduction to practical Drosophila genetics	YES	Balancer chromosomes, dominant markers, virgining, setting up crosses, and collecting animals	
09/03			YES	GAL4/UAS and UASRNAi transgenics	
09/08	...but flies are so small. How could they have a brain?"	Drosophila CNS development in a nutshell	YES	whole animal brain imaging (L1), brain dissections (L3), and immunofluorescene (guest speaker Xin Yuan)	
09/10			YES	GFP fluorescence and epifluorescence	
09/15	"Mom stop taking pictures...." Identifying neural stem cells in vivo	molecular markers and image analysis, use of primary and secondary antibodies, and fluorescent reporters	YES	GFP fluorescence and use of epifluorescence stereomicroscopes ...continued	
09/17	Reading the scientific literature	tips for journal club presentation		analyze specimens ...continued	
09/22	"...really mom, ENOUGH!"	laser scanning confocal microscopy and spinning disk confocal microscopy (*guest lecture, Dr. Kartsen Siller*)	YES	spinning disk confocal microscopy, scanning confocal and possibly light sheet	

09/24				analyze specimens ...continued	
09/29	"To proliferate or to differentiate.... that is the question"	symmetric versus asymmetric cell division, and stem cell states (quiescence, proliferation, differentiation, apoptosis)	YES	pick your poison: mudRNAi, prosRNAi, cnnRNAi, pros O/E, miRHG with wornGAL4 and dpnGAL4 drivers	
10/01				analyze specimens ...continued	
10/06	**Reading Day/no class meeting**				
10/08	**Journal Club #1**		YES (JC#1)	analyze specimens ...continued	
10/13	"It's late at night...." Do you know where your stem cells are?	molecular and cellular composition of the stem cell niche		imaging cortex glia	
10/15	**QUIZ #1**			analyze specimens ...continued	
10/20	"If you build it, they (he) will come...." Building the stem cell niche.	role of Insulin/PI3-kinase signaling in the neuroblast glia niche	YES	manipulating PI3-kinase in cortex glia and other growth signaling pathways	
10/22	**Journal Club #2**		YES (JC#2)	analyze specimens ...continued	
10/27	Writing 101: Crafting a scientific research proposal	generating a hypothesis and designing specific aims to test your hypothesis		analyze specimens ...continued	
10/29	**Journal Club #3**		YES (JC#3)	analyze specimens ...continued	

11/03	Did you eat your breakfast....." Nutrient-dependent regulation of neural stem cell proliferation	glycolysis and the Warburg effect (*guest lecture, Dr. Conor Sipe*)	YES	starvation, amino acid depletion, and other alterations of diet	
11/05	**Journal Club #4**		YES (JC#4)	analyze specimens ...continued	
11/10	"Godzilla attacks...." Human diseases associated with neural stem cell defects	learning and memory, cancer, micro/macrocephaly	YES	experimental design: based on your research proposal ...continued	
11/12	student driven research projects				
11/17	**QUIZ #2** student driven research projects				
11/19	student driven research projects				
11/24	student driven research projects				
11/26	**thanksgiving day (UVA closed)**				
12/01	student driven research projects	Also ...How to make and present a Poster			
12/03	student driven research projects				
12/08	Practice Poster presentations (to class)				
WED 12/16	**Poster presentation and social hour**	date to be confirmed and location pending			
FRI 12/18	**Written Research Proposal due**	email to me by noon please			