FRONTIERS IN EXPERIMENTATION AND IMAGING

SCRB 164 | FALL 2023

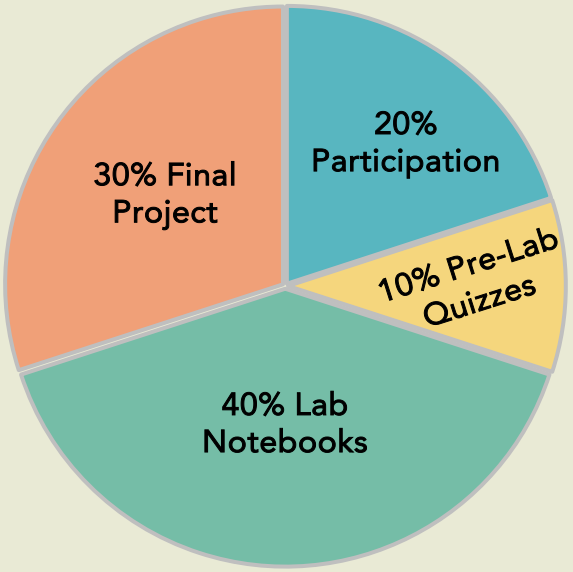
Frontiers in Experimentation and Imaging is an interdisciplinary, laboratory-based course which seeks to explore the organization of cells and tissues using microscopy. Through a series of lectures, laboratory experiments, and student-designed research projects, students will learn experimental design, cutting edge methods (such as expansion microscopy), and data analysis. With microscopes in hand, we will venture from the fertilization of the zygote, to complex architecture of the brain, and to reversing the subcellular defects of aging. Join us for discovery and experimentation.

CLASS MEETINGS
Wednesday and Friday
1:30 – 4:15 PM
Northwest B141 Lab

COURSE CANVAS PAGE
https://canvas.harvard.edu/courses/121941

TEXTBOOK
The material covered in this course is not in a textbook. Course discussions will draw from current papers in the field.

STUDENTS ARE GRADED ON:



INSTRUCTOR

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TEACHING FELLOWS

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STUDENT HOURS:
Tuesdays 2-3pm via Zoom

PREREQUISITES:
LS1A/LPSA, LS1B, and SCRB 50 or MCB 60

In this course...

PARTICIPATION

As a small hands-on lab course, it is crucial that students take an active role in both lecture and lab during the semester. Attendance at all classes is **mandatory**. Students are expected to not only attend class, but importantly, to respectfully listen to peers and instructors and actively participate in class and group discussions. During lab, students are expected to thoughtfully design their experiments, come to lab prepared, perform each experiment carefully, work as a team, and maintain good lab etiquette and citizenship. See the Modules > Guidelines > Participation page for more information and a participation rubric.

PRE-LAB QUIZZES

Students are required to read through each week's lab protocol and supporting documents/videos before coming to lab. It is crucial that you are familiar with the expectations and the experimental sequence before you start your experiments. Pre-lab quizzes are designed to ensure you have read and understood your experimental protocol(s) for that lab. The questions will give you the opportunity to think about the concepts behind the experiments, the rationale behind each experimental protocol, the sequence of steps within a protocol, and how the protocol is adapted to your specific experiment. Pre-lab quizzes will be a mixture of multiple answer, fill-in-the-blank and/or matching-style questions related to the protocol. The purpose of these quizzes are about learning, so you will have an unlimited number of attempts to receive at least an 80% to get full credit. See the Modules > Guidelines > Pre-Lab Quizzes page for more information.

LAB NOTEBOOKS

A Benchling electronic lab notebook will be used for documenting your lab work this semester. In these reports, students will describe the purpose, experimental steps, observations, results, and discussion of your experiments along with answering guidance questions. The lab notebook entries are typically due a week the completion of each lab. Due dates are posted in the Course Schedule. See the Modules > Guidelines > Lab Notebooks page for more information and a lab notebook rubric.

FINAL PROJECT

The final project will take place over the last five weeks of the semester and give you the opportunity to design a mini-research project using the techniques you learned in the first half of the course to explore cellular changes in progeria, a genetic disease of aging. The final project will consist of three components: I) an experimental plan proposal, II) a group project presentation, and III) a final lab report. For the experimental plan proposal, you will work with your group and teaching staff to develop an experimental plan for testing several different pharmacologic interventions for progeria and assess their effects in cellular phenotypes. During the group project presentation, your group will discuss your results, conclusions, and future ideas from your mini-research project with the class. Lastly, the final project report will be formatted akin to a scientific paper where you will summarize the experiments performed, the results obtained, and what you concluded and learned from these results. See the Modules > Guidelines > Final Lab Project page for more information.

Course Schedule

Week	Date	Wednesday	Date	Friday
1	9/6	Lecture 1: Introduction to course and basic microscopy Lab: Lab safety and pipetting tutorials	9/8	Lab 1: Immunofluorescence (Day 1) **DUE: Pre-lab quiz 1*
2	9/13	Lecture 2: Protein imaging: What, why, how? Lab 1: Immunofluorescence (Day 2)	9/15	Lab 2: HCR RNA-FISH (Day 1) **DUE: Pre-lab quiz 2*
3	9/20	Lecture 3: RNA imaging: What, why, how? Lab 2: HCR RNA-FISH (Day 2) **DUE: Pre-lab quiz 2*	9/22	Lab 2: HCR RNA-FISH (Day 3)
4	9/27	Lecture 4: Super-resolution and expansion microscopy Lab 3: Expansion microscopy (Day 1) **DUE: Lab1 Notebook* *Pre-lab quiz 3*	9/29	Lab 3: Expansion microscopy (Day 2) **DUE: Lab 2 Notebook*
5	10/4	Lecture 5: Image analysis: What, why, how? Lab 3: Expansion microscopy (Day 3) **DUE: Lab 2 Notebook*	10/6	Lab 4: Cell profiler Demonstration **DUE: Pre-lab quiz 4*
6	10/11	Lecture 6: Live imaging: What, why, how? Lab 5: Cell culture basics **DUE: Pre-lab quiz 5* *Lab 3 Notebook*	10/13	Lecture 7: Independent project introduction and planning Lab: Independent project workshop
7	10/18	Guest Lecture: Preimplantation embryogenesis imaging Lab 6: In vitro fertilization (Day 1) **DUE: Pre-lab quiz 6*	10/20	Lab 6: In vitro fertilization (Day 2) **DUE: Experimental Proposal*

Course Schedule

Week	Date	Wednesday	Date	Friday
9	10/25	Lab: Independent project workshop 2 Review experimental proposals	10/27	Lab: Independent project experiments *DUE: Lab 6 Notebook
10	11/1	Lecture 8: Advanced optical methods – Spatial Proteomics Lab: Independent project experiments	11/3	Lab: Independent project experiments
11	11/8	Lecture 9: Optical screens Lab: Independent project experiments	11/10	Lab: Independent project experiments
12	11/15	Lecture 10: RNA sequencing and Spatial transcriptomics Lab: Independent project experiments	11/17	Lab: Finalize all data analysis
13	11/20	NO CLASS – Thanksgiving Recess	11/22	NO CLASS – Thanksgiving Recess
14	11/27	Lab: Final Project Office Hours	11/29	*Project Presentations*
14	12/4	NO CLASS – Reading Period	12/6	NO CLASS – Reading Period
15	12/11	*DUE: Final Lab Report*		

Course Logistics

Attendance Policy

In this course, we are committed to provide all students with an intellectually stimulating environment that promotes individual learning and scholarly growth and also protects the health and safety of our entire community. To that end, while we expect students to attend all classes in person throughout the semester, we have put in place specific policies that will ensure learning continuity should the possibility arise that you cannot attend class in person due to COVID-19 or other illness. We ask that you err on the side of caution in all instances when deciding whether to attend class in person. To prevent disruption in learning, all lectures will be recorded. Should you determine that it is unsafe or unwise to attend in person, please send a message to the teaching staff, and we will provide you with a personal link to view any missed lectures and work with you to determine the best way to make up the missed lab experiments. Any questions, concerns or requests for accommodation beyond this policy should be raised with the teaching staff directly. We thank you in advance for your help in maintaining a safe, healthy and respectful learning community.

Course Logistics

Inclusivity

This class strives to be an inclusive community, learning from the many perspectives that come from different backgrounds and beliefs. As a community, we aim to be respectful to all, regardless of race, ethnicity, religion, gender or sexual orientation. We expect that members of the teaching team and students will create an environment that facilitates inquiry and self expression, while also demonstrating diligence in understanding how others' viewpoints may be different from their own.

Late Work Policy

Late work will be deducted 10% of the total score per day late (up until the day at which the answers are posted on the website. No credit will be given after this point). Extensions are rarely granted except for medical emergencies with proper documentation.

Academic Integrity & Collaboration Policy

Familiarize yourself with the Harvard Honor Code and citation guidelines below. **Know the rules – ignorance is no defense!** All written work submitted to the course must be the student's own. Students may discuss work with others (for example, lab notebooks), but should be sure to write everything in their own words. Students also may not copy writings from textbooks, journals, or lab protocols without proper citations.

Plagiarism is a very serious offense. For guidelines on how to properly cite work, please see:
http://projects.iq.harvard.edu/files/lifesci/files/guide_to_citing_in_the_life_sciences.pdf
For resources and guidelines on academic honesty, please see: http://honor.fas.harvard.edu

Artificial Intelligence Policy

This course encourages students to explore the use of generative artificial intelligence (GAI) tools such as ChatGPT for all assignments and assessments. Any such use must be appropriately acknowledged and cited. It is each student's responsibility to assess the validity and applicability of any GAI output that is submitted; you bear the final responsibility. Violations of this policy will be considered academic misconduct. We draw your attention to the fact that different classes at Harvard could implement different AI policies, and it is the student's responsibility to conform to expectations for each course.

Accommodations for Students with Disabilities

Students needing academic adjustments or accommodations because of a documented disability must present a letter from the Accessible Education Office (AEO) and speak with the instructor by the end of the second week of the term. Failure to do so may result in the instructor's inability to respond in a timely manner. All discussions will remain confidential (instructor will contact AEO to discuss appropriate implementation).