7.55 Case Studies in Modern Experimental Design

Units: 2-0-7
Lecture: F11-1 (4-253)

Focuses on enhancing students' ability to analyze, design and present experiments, emphasizing modern techniques. Class discussions begin with papers that developed or utilized contemporary approaches (e.g., quantitative microscopy, biophysical and molecular genetic methods) to address important problems in biology. Each student prepares one specific aim of a standard research proposal for a project that emphasizes research strategy, experimental design, and writing.
L. Guarente, F. Solomon
No required or recommended textbooks

February 5 Introduction and organization

I. Unfolded Protein Response
February 12 Background: Sidrauski et al., Harding et al.
February 19 Korennykh et al.
February 26 Han et al.

II. Senescence
March 4 Background – Hayflick & Moorhead and Bodnar et al.
March 11 Coppe et al
March 18 Baker et al

March 25th –Spring Break

III. Parabiosis
April 1 Background – Conboy et al (we may add another)
April 8 Villeda et al
April 15 Lofreddo et al.

IV. Resveratrol
April 22 Background – Howitz et al. and Kaeberlein et al.
April 29 Hubbard et al.
May 6 Cao et al.

Writing project:
Before 1 March: Meet with Lenny or Frank to discuss topic and scope
4 March: Submit a draft of the specific aims section

18 March: Submit a draft of the experimental procedures section

2 April: Submit a draft of the background and significance section

23 April: Submit a draft of the proposal to a colleague TBD for a review

6 May: Submit the final version of the proposal to Lenny and Frank

Final evaluation: Lenny and Frank will read all the proposals. We will evaluate them by the same criteria that study sections use.
7.55: Case studies: experimental design in biology.

Class sessions:
The discussion component of the course will meet twelve times after an organizational session during the first week of the semester. We will deal with four topics in three-week groups. The first weeks in each group will address two papers in the field that defined the major problems. The second and third weeks will focus on modern approaches to those problems. The topics this year are: the unfolded protein response; senescence at the cellular level; mechanism of drug action; and parabiosis - signaling at the systemic level.
The tentative syllabus is:

February 5  Organizational meeting

I. Unfolded Protein Response
February 12  Background: Sidrauski et al, Harding et al.
February 19  Korenykh et al.
February 26  Han et al.

II. Senescence
March 4  Background: Hayflick and Moorhead; Bodnar et al.
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Writing project:
The pre-doctoral fellowship proposals many of you will have written describe a student-sized project – one that a student could reasonably expect to complete in three to four years. The format of those proposals is so constrained that there is little room for description of experimental details, controls, or interpretations and consequences of the outcomes – all of which are crucial elements of proposals for support you will likely submit in the future. The writing components for this class are designed to introduce you to writing real research proposals for independent science. During the course of this semester, each of you will write one specific aim of a research proposal from the position of the Principal Investigator. Your final document will be no more than 4 pages long - single-spaced, including any figures. (In contrast, a normal NIH proposal from a lab has 3 or more aims, and is 12 pages long).
As does a normal NIH proposal, your proposal will contain the following sections:
Specific aims.
Briefly describe the aim and any sub-aims it includes.

Background and significance.
Place the project in context and justify its importance. Address how your research will move the field forward.

Experimental procedures.
Lay out the experiments in sufficient detail that a reviewer fairly knowledgeable in your field can follow them and accept that they are feasible. Describe critical controls, how you would interpret the likely results, and point out potential issues and how you would address them. To provide you with a model, we will post at least one funded grant provided by the NIH.

Topic: You may choose to write on any scientific problem you wish – one you have worked on, one you’ve read about, one you think you might work on. Because of this unlimited range, and because the study section (that is, the review panel) is limited to Lenny and Frank, your proposals will have to be written at a level that allows trained scientists who are not necessarily expert in your field to follow the proposal. This partial mismatch between proposal and reviewers mimics the real world.

Schedule: We’ve spread out the proposal writing through the semester, with each section due on dates listed below. The order in which sections of the grant are due is meant to provide a framework for how a “real” grant should be written, section by section, and in that order. Prior to writing, each of you will meet with one of us to discuss the proposal, to help you define a project that fits the criteria. Crucially, very near the end of the process, you will give a late draft of your proposal to another student in the class, chosen by us, to review it or everything: science, clarity, logic, and language. We include this step for several reasons, not least to underscore how important it is to have outside, independent eyes look at research proposals before they get formal review. We also think critiquing another person’s writing is a good way to make your own writing better. Both Lenny and Frank will read final versions and evaluate them by the same criteria that study sections use.

Before 1 March: Meet with Lenny or Frank to discuss topic and scope
4 March: Submit a draft of the specific aims section
18 March: Submit a draft of the experimental procedures section
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