

## Advice to Students Taking Preliminary Examinations

**Overview:** All students must pass the Preliminary Examination to be admitted to Candidacy for the Ph.D. degree. Thus, part of the purpose of this exam is to determine whether or not a student has the necessary ability and motivation to earn a Ph.D. degree. However, this is far from the only purpose of this exam. The Prelims requirements are designed to ensure that you have thought deeply about your project, that you know the background literature well, and that you have been productive. We also expect you to learn a great deal in this process about writing and oral presentations from your advisor and the senior members of your research group. At this stage of your development as students, it is unlikely that you will have developed all the skills you need to be a successful Ph.D. Your Prelims Committee will help you identify your strengths and the areas in which you need to improve so that you can reach your maximum potential as a student.

The preliminary examination consists of four parts:

- 1) Preparation and submission of *a proposal for your Ph.D. thesis*, to be written in standard grant format (see below). Your committee will look for evidence that (1) you understand your project and future research directions at the appropriate level, and (2) the project you propose is important and worth the investment of ~ three years of your time.

You should be aware that the answer to these questions is not always the same. If the committee feels that you are knowledgeable and motivated enough to get a Ph.D., but that the project is unlikely to be practical or sufficiently important for the time expenditure it requires, they may ask you to discuss your project again with your advisor and re-write the proposal. The committee may also decide that you have met the requirements of the exam, but ask you to carry out a series of experiments to test the feasibility of your approach and then to meet again in three or six months. Remember, your committee's job is to help you turn out the best Ph.D. thesis that you can. Any additional requirements are for your benefit.

- 2) A *written examination*, provided to you by your committee. The purpose of this exam is to probe your knowledge of fundamental biochemistry and of specialized areas related to your thesis more humanely and effectively than can be done in a short oral exam. Most committees use this format to address areas of the proposal that are not clear, or to probe your understanding of key points in greater depth than you can provide in a 12-page proposal. Taking this portion of the exam very seriously will make your oral exam much easier.
- 3) A *research seminar* that focuses on the results of your project(s) and your progress to date. The committee will use this portion of the Preliminary Examination to assess your productivity, as well as to provide additional information about the depth of your understanding of your project. *This seminar should not be an oral presentation of your proposal.* Focus on what you have

done, rather than on the research you have proposed for the future. Be sure to provide an adequate introduction that places the work you have done in the context of the overall field and the major goals of your research group. Think about BMB talks you have heard that were effective, and try to model your seminar on one of these talks. See also the links below for giving effective scientific presentations.

- 4) An *oral exam* with your committee after your research presentation.

**Expectations of the Committee.** To be admitted to candidacy for a Ph.D. degree we expect you to show the ability to conduct research *independently*, to demonstrate that you are sufficiently motivated to earn a Ph.D. degree, and to have demonstrated sufficient progress toward taking intellectual ownership of your research project. As you prepare for your exam, think about how you will demonstrate that:

- 1) You have been productive in your research project.
- 2) You understand the goals of your research project in detail.
- 3) You understand the background literature in your field. *You should not only know what other researchers have concluded, but you should also understand the experiments that led to those conclusions and you should be able to explain whether or not you agree with them.*
- 4) You can plan and execute experiments independently.
- 5) You are able to lay out a plan for your thesis research. We understand that not everything goes according to plan, or that there might be a key experiment you need to complete before you can be sure of your plan. If this is the case, make that clear and explain how you plan to demonstrate the feasibility of your approach and any back-up plans you may have.
- 6) You keep up with the literature in your field, read broadly in high-impact journals, and attend seminars.

**Thesis Proposal.** No later than three weeks before the scheduled exam date, you must submit a 12-page single-spaced page or a 24 double-spaced page, NSF- or NIH-style grant proposal to your Ph.D. examination committee. A copy of the proposal must also be submitted to the Graduate Office. The proposal should have the following sections:

- 1) **Specific Aims (~ 1 page).** The specific aims should ***not*** be a simple laundry list of the experiments you have done or plan to do in your thesis research. This section should include a brief (1-2 paragraphs) description of *why the question your project addresses is important and why the approach you have taken is a good one*. You should then list your specific aims, *explaining how they related to the goals you have laid out*. It is important that you use this space to make it clear which questions you aim to answer in your research project.

Grant-writing experts suggest that you write this portion of your proposal before you write anything else. The idea is that a reasonably intelligent reader should be convinced in only a page that your proposed work is worth doing. Moreover, the

reason that your project is important should be clear in the very first paragraph. Show it to several colleagues, inside and outside your research group, in addition to your advisor. If your readers cannot tell what you plan to do and why, you have not sufficiently defined your proposed aims.

Be sure to avoid “look and see” formulations. Your aims should not be to “study” a problem, but to “determine the factors required for” or to “develop a novel method for,” etc.

- 2) **Significance (~1/2 -1 page).** The goal here is not simply to show how much you’ve learned about your project. You will have a chance in the other three portions of your exam to demonstrate your command of all the relevant background for your project. Instead, you should lay out the state of the field in your area, explain why it is important to address the questions you’ve posed, and explain why your approach is a good one.

You will almost certainly cite previous publications from your laboratory (or a collaborator’s lab); please do so explicitly. Doing so makes it much easier for your committee to judge the feasibility of your proposed research.

Example: “The Oakley lab has recently developed a method to map inter-strand interactions in the coiled coil domain of the E. coli structural maintenance of chromosomes (SMC) protein, MukB. In the proposed work, we apply that method to map the structure of the SMC protein from *B. subtilis*....”

Experimental details should wait until the Proposed Research Section.

- 3) **Approach (10 pages, divided evenly among aims).** This section should answer the following questions, separately for each aim:
  - a. What will be done.
  - b. What are the means that will be used to accomplish this aim?
  - c. What might go wrong? What alternative approaches might you try?
  - d. What are the expected outcomes and why are they important?

For each aim, you should (1) introduce the aim; (2) justify the importance of the experiment and document the feasibility (preliminary data); (3) explain the research design; (4) provide expected outcomes; and (5) briefly address potential problems and alternative approaches.

**Remember that your written document must be approved by your advisor before you can submit it to you committee.** Allow sufficient time to make corrections before your deadline.

**A note about Figures.** Chose your figures with care. Your background, preliminary results, and proposed research sections should all contain effective figures. Do not use

figures from published works that are not exactly appropriate for your needs; take the time to create your own. *If you do use figures drawn by a lab member or from the published literature, be sure to include an appropriate citation.* Be sure to label axes for graphs you show and to provide helpful figure legends. Remember that you do not have to show every piece of data you have ever collected. Include the figures within the pages of the document as you refer to them.

**Research Seminar.** You should plan your research seminar to last about 45 minutes, leaving time for questions from the audience. As you will have a much broader audience than you would for a group meeting, be sure to include sufficient background so that the audience can understand why your problem is important. You should also explain the state of the art in the field when you began your research, and then pose the questions your research will answer. The bulk of the talk will describe your research progress. At the end of this portion, you should include a brief (~5 min) description of the research directions you intend to pursue to complete your Ph.D. thesis. There is no need to go into detail about the methods you will use; your proposal and oral exam will cover these aspects of your thinking.

We will provide a seminar on effective scientific presentations, using material from Prof. Suzanne McConnell at Stanford University.

You can find her Powerpoint presentation at the following link:  
[postdocs.stanford.edu/education/Scientific%20Management%20Series/Presentation\\_Sue%20\\_McConnell.ppt](http://postdocs.stanford.edu/education/Scientific%20Management%20Series/Presentation_Sue%20_McConnell.ppt)

You can also find her on YouTube: <https://www.youtube.com/watch?v=Hp7Id3Yb9XQ>

**Written and Oral Examinations.** The goals of these portions of the exam are to clarify any questions your committee may have about your proposal, to probe your understanding of the proposed research, including the relevant background, and to probe the breadth of your understanding about biochemistry. Remember that your committee is trying to help you develop as a scientist. All third year students have areas of strength and weakness. Your committee will help you to understand yours so that you can build on your strengths and address any weaknesses that can limit your development as a scientist.

If your committee poses closed-book questions, they will be directed at your understanding of basic biochemistry and knowledge that is essential for your project. Open-book questions can allow you time to think about deficiencies in your research proposal, the techniques involved in future experiments, areas less closely related to your research, or important recent developments in biochemistry. Your answers to the written exam will help your committee decide how best to approach your oral exam. ***You will have an entire week between your written and oral exams, which should give you time to address any areas of weakness in your written exam.***

You are not expected to have an answer to every question that is posed in the oral exam. If you don't know, say so. Otherwise, you will waste valuable time talking about something you don't understand. Don't be afraid to ask for clarification from your committee if you don't understand a question. Sometimes, the most difficult questions to answer are the simplest. It's normal to be a bit nervous at first, but most students settle down after a couple questions and have a productive discussion with their committees.

**Deficiencies and Revisions.** We expect that it will not be uncommon for committees to identify deficiencies, even in very strong students, that must be addressed before you can be admitted to Candidacy. In this case, the Prelims Executive Committee will ask you to revise all or part of their written document or to retake one or more aspects of the examination. Should you be asked to do so, you should not see this as an indication that you are not a strong student. Indeed, as committees seek to develop the full potential of each student, they often ask more of strong students. Treat the additional requirements as a learning experience that will help you to be a stronger scientist as you continue your Ph.D. work.