Graduate Program in Genetics and Genomics
Boston University School of Medicine

QUALIFYING EXAM GUIDELINES FOR STUDENTS

The qualifying exam is an important step for a Ph.D. student that allows you to focus on the context of your thesis work in the field, and the theory behind the approach you plan to use. Additionally, the exam allows student to display their critical thinking skills. These goals will be accomplished through a combination of written and oral components. The written components are a grant-style thesis research proposal that focuses on the student's dissertation research. The oral exam will be based on these written components and will test the candidate's general knowledge of the fields of Genetics and Genomics. The Qualifying Exam is meant to be a "go/no go" point that will determine if the student has the skills necessary for continuing on to Ph.D. Candidacy and for completing a Ph.D. degree. It is the Program's intent that the Qualifying Exam be a rigorous assessment of candidate's abilities

Examining committee membership

The examining committee consists of five faculty members at Boston University plus one of the GPGG Directors who will be a sixth non-voting member. The chair of a student's examining committee may ***not*** be their thesis advisor and must be a core member of the GPGG. Overall, the five voting committee members must include at least three GPGG faculty members and two members may have faculty appointments in other departments/programs at Boston University. All committee members must have appointments in the Division of Graduate Medical Sciences. The composition of the committee must be approved in advance by the GPGG Directors. The members of your examining committee should be chosen in consultation with your thesis advisor and on the basis of their expertise in the research areas represented in your written proposal. The inclusion of one of the Directors will help to ensure that Qualifying Exam format and standards are consistent among all students across the years. If there is discrepancy between the quality of a student's proposal(s) and GPGG standards, set in part by comparison with other Departments/Programs in the School of Medicine, the Director will communicate with the examining committee to express any concerns.

Setting the date

The qualifying exam ***must*** be completed no later than ***September 30 immediately preceding your third year***. The date should be set by considering, with the advice of your thesis advisor, what sorts of preliminary experiments you would like to be able to refer to in your proposal. Towards this end, sketching out 3-4 specific aims of your thesis well in advance is a valuable exercise. Realize, however, that the amount of preliminary experiments at this point in your graduate career likely will not be particularly extensive. Also realize that your ability to pass your exam will not depend on how many experiments you have completed to date. Rather, the focus is on evaluating your critical thinking skills. In fact, the process of preparing for your exam

will sharpen your thinking about the project, and delaying the exam date to achieve preliminary results may be counterproductive. Instead, approaching your exam as a chance to prepare yourself further for carrying out your dissertation research will help you get the most out of this experience.

The written research proposal
This is a grant-style proposal that focuses on the student's dissertation research.

Proposal tips and student responsibilities

- Students will begin development of the proposal by preparing an abstract for review by members of a student's examining committee. These abstracts should be prepared at least 4 weeks prior to the student's designated exam date.
- The student should be working on an outline of the complete proposal and prepare a draft at least 3 weeks prior to the exam date.
- In preparing and refining the proposal, students should read the literature broadly. For instance, if your project is related to stages of cancer, you should read about the type of cancer you study, other types of cancer, normal development of that tissue type, normal functions of genes you suspect may be involved, etc. Because of the intense reading required, it is recommended that students devote themselves to studying for 4-6 weeks.
- Once the first draft is prepared, students should get feedback from all examining committee members to continuously improve the written proposals.
- A final version of the proposals should be distributed to both the examining committee at least 7 days prior to the exam.
- Your proposal should also be distributed in advance to lab members and mentors for feedback, and final versions should be distributed to the same people prior to holding practice exams.

Guidelines
The written grant proposal section of the exam should conform to current NIH R01 grant rules and style. (Adapted from: http://deainfo.nci.nih.gov/extra/extdocs/gntapp.pdf)

Length and Formatting: The research strategy section can be no longer than 12 pages including figures (but not references). Use Arial 11 pt font and 0.5 inch margins. One extra page outlining the Specific Aims may be included.

Research Strategy/Plan is organized into three sections: Significance, Innovation, and Experimental Approach. You may address Significance, Innovation and Approach for each Specific Aim individually, or address Significance, Innovation and Approach for all of the Specific Aims collectively.

Content:
The Research Strategy should answer the following questions:

- What do you intend to do?

- Why is this worth doing or what is the significance of the research? How is it innovative?
- What has already been done in general, and what have other researchers done in this field? Use appropriate references. What will this new work add to the field of knowledge?
- What have you (and your collaborators) done to establish the feasibility of what you are proposing to do?
- How will the research be accomplished? Who? What? When? Where? Why?

Suggestions:

1. Make sure that all sections are internally consistent and that they dovetail with each other. Use a numbering system, and make sections easy to find. Lead the examiners through your research plan.
2. Show knowledge of recent literature and explain how the proposed research will further what is already known.
3. Emphasize how some combination of a novel hypothesis, important preliminary data, a new experimental system and/or a new experimental approach will enable important progress to be made.

RESEARCH PLAN PART 1: Specific Aims

Purpose: The purpose of the specific aims is to describe concisely and realistically the goals of the proposed research and summarize the expected outcome(s), including the impact of the proposed research will exert on the research fields involved.

Recommended Length: The recommended length of the specific aims is one page.

Content:

The specific aims should cover:

- Broad, long-term goals;
- The specific objectives and hypotheses to be tested;
- Summarize expected outcomes; and
- Describe impact on the research field.

Suggestions:

1. Generally, the Specific Aims section should begin with a brief narrative describing the long-term goals or objectives of the research project and the hypothesis to be tested. This is followed by a numbered list of the Aims.
2. List succinctly the specific objectives of the research proposed, e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology.
3. Make sure your specific objectives or hypotheses are clearly stated, are testable, and adequately supported by citations and preliminary data. Be sure to explain how

the results to be obtained will be used to test the hypothesis.

4. *Be as brief and specific as possible*. For clarity, each aim should consist of only one sentence. Use a brief paragraph under each aim if detail is needed. Most research Proposals will have 2-4 specific aims.
5. Don't be overly ambitious. A small, focused project is generally better received than a diffuse, multifaceted project.
6. Be certain that all aims are related. Have someone read them for clarity and cohesiveness.
7. Include a brief statement of the overall impact of the research studies.

RESEARCH PLAN PART 2: Significance

Purpose: The Significance section should explain the importance of the problem or describe the critical barrier to progress in the field that is being addressed. Explain how the proposed research project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields. Describe how the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field will be changed if the proposed aims are achieved.

Recommended Length: 1/2-1 page

Content:

It should cover:

- The state of existing knowledge, including literature citations and highlights of relevant data
- Rationale of the proposed research
- Explain gaps that the project is intended to fill
- Potential contribution of this research to the scientific field(s) and public health.

Suggestions:

1. Make a compelling case for your proposed research project. Why is the topic important? Why are the specific research questions important?
2. Establish significance through a careful review of published data in the field. Avoid outdated research. Use citations not only as support for specific statements but also to establish familiarity with all of the relevant publications and points of view.
3. Highlight why research findings are important beyond the confines of a specific project i.e., how can the results be applied to further research in this field or related areas.
4. Clearly state public health implications.
5. Stress any innovations in experimental methods (e.g., new strategies, research methods used, interventions proposed).

RESEARCH PLAN PART 3: Innovation

Purpose: Explain how the application challenges and seeks to shift current research or clinical practice paradigms. Describe any novel theoretical concepts, approaches or methodologies, instrumentation or interventions to be developed or used, and any advantage over existing methodologies, instrumentation, or interventions. Explain any refinements, improvements, or new applications of theoretical concepts, approaches or methodologies, instrumentation, or interventions.

Recommended Length: The recommended length of the innovation section is 1/2-1 page.

Content:
The innovation section should include the following:

- Explain why concepts and methods are novel to the research field.
- Focus on innovation in study design and outcomes.
- Summarize novel findings to be presented as preliminary data in the Approach section.

Suggestions:

1. Describe how the application differs from current research or clinical practice paradigms.
2. Provide a careful review of the current literature to support the innovative methodologies, approaches, or concepts of your research.
3. Demonstrate familiarity with novel methodologies.
4. Summarize novel findings to be presented as preliminary data in the Approach section.

RESEARCH PLAN PART 4: Experimental Approach

Purpose: The purpose of the experimental approach section is to describe how the research will be carried out.

Recommended Length: The maximum recommended length of the approach section is 10-11 pages.

Content:
The research design and methods section should include the following:

- Preliminary studies, data, and experience relevant to the application and the experimental design.
- Overview of the experimental design.
- A description of methods and analyses to be used to accomplish the specific aims of the project.
- A discussion of potential difficulties and limitations and how these will be overcome or mitigated.

- Expected results, and alternative approaches that will be used if unexpected results are found.
- A projected sequence or timetable (work plan).
- If the project is in the very early stages of development, describe any strategy to establish feasibility, and address the management of any high-risk aspects of the proposed work.
- A detailed discussion of the way in which the results will be collected, analyzed, and interpreted.
- A description of any new methodology used and why it represents an improvement over the existing ones.

Suggestions

Number the sections in this part of the application to correspond to the numbers of the Specific Aims.

1. Preliminary data may be included before the Specific Aims sections. Alternatively, integrate preliminary data with the methods description for each Specific Aim.
2. Avoid excessive experimental detail by referring to publications that describe the methods to be employed. Publications cited should be from your or a collaborators lab, if at all possible.
3. If relevant, explain why one approach or method will be used in preference to others. This establishes that the alternatives were not simply overlooked. Give not only the "how" but the "why."
4. If employing a complex technology for the first time, take extra care to demonstrate familiarity with the experimental details and potential pitfalls.
5. Explain how the research data will be collected, analyzed, and interpreted.
6. Develop alternative strategies for potential problems.

The oral exam

The written proposal and critique are tested in an oral exam administered by your qualifying exam committee. The student will give a brief (20-30 minute max) presentation to review the key points of your proposal for the examining committee. Under no circumstances should extra slides be included in a presentation as backup for projected questions. The presentation should serve as a basic outline of your written proposal and should not be considered as comprehensive. You can safely assume that all committee members have read your written proposal! For further guidance on presentation mode, discuss the options with your exam committee chairperson. Upon conclusion of the presentation, your examiners will begin asking you questions focused on your thesis proposal and general knowledge. Topics often include, but are not limited to:

1. Other experimental approaches that could be used to test a proposed hypothesis (e.g., from other disciplines),
2. Basic theory underlying experiments,
3. Experimental design and data analysis,
4. Related experiments in the literature, and

5. Related systems in the literature.

The best way to prepare for this phase of the exam is to conduct practice exams with your peers, especially post-docs and experts in the field. This will help you to get a flavor of potential questions and to maintain poise under exam conditions. The exam chair will conclude each portion of your exam and ask you to leave the room while the committee confers on your performance.

When you are invited back into the room, the focus will shift to your paper critique. Again, the exam will continue with oral questioning and a private evaluation by the committee. The entire exam should last approximately 2-3 hours in duration. You will be given feedback immediately after completing your exam.

The qualifying exam will include a review of the student's academic history at BUSM, which will primarily include rotation reports and grades. Thus, you will need to provide your committee a transcript (unofficial will suffice) of your tenure at BUSM and ask the GPGG administrator (Joe Hebert) to provide the committee a copies of your rotation reports.

The exam outcome

Your examining committee will be evaluating the written and oral components of your qualifying exam based on the following criteria:

- the logical organization of your proposals,
- the clarity of your proposals,
- your scholarship and level of preparation,
- the originality of your proposals,
- your delivery of the talk,
- your responsiveness to questions,
- your depth of knowledge,
- your ability to answer questions when you are unfamiliar with the answer, and
- your poise.

The exam outcome will fall into one of three categories:

1. *Pass* – Congratulations on your commendable performance on a grueling exam. Nancy will work with you and your committee to put your post-qualifying exam raise into place.
2. *Pass with modifications* – The committee felt that overall your performance was good but that one or more specific areas needed improvement. They may ask you to rewrite your proposal(s), to give a research seminar, or to be re-examined on a focused area.
3. *Fail* – The committee felt that the student was not adequately prepared for the exam. In order to pass, the student must retake the entire exam, both the written

and oral components. If appropriate, the possibility of withdrawing from the program will also be discussed.

Now what?

Once you've completed your qualifying exam, it is time to enact those experiments you proposed for the exam. Also, reflect on your exam experience to see in what areas you may want to deepen your knowledge. Likewise, consider which of your committee members were most helpful to you in the process. Who gave you the most helpful, constructive feedback? Who suggested the most insightful experiments? Who helped keep you on track when you were feeling unfocused? These people are the ones you will probably want to ask to be on your dissertation advisory committee. This committee will be composed of the student's advisor and at least four other faculty members with a minimum of two faculty members from the Graduate Program in Genetics and Genomics and one Division faculty member from an outside graduate program. You may also consider inviting a specialist in your field from a neighboring institution. The dissertation advisory committee should meet at least 12 months after your qualifying exam and annually thereafter. However, increasing the frequency of these meetings, to every 6 months for example, has been known to increase student focus and shorten the time to degree.

Congratulations on advancing to Ph.D. candidacy, and enjoy the experience!