MOLECULAR MEDICINE QUALIFYING EXAMS
General Student Information

November -2nd year in Program

Attend qualifying exam overview meeting of students and their mentors with the Molecular Medicine Director and Track Leaders. Qualifying exam requirements and specific timeline (with deadlines) will be provided at this meeting. *Students are responsible for advising mentors not in attendance of the information presented.*

I. Written Proposal Overview

PhD: December through March **MD/PhD: May through July**

Prepare the 7 page ORIGINAL written proposal as the first part of the qualifying exam (see MMED guidelines for instructions). The proposal must be comprised of the student's original ideas and literature research performed by the student. The proposal may be related to the student's research thesis proposal under development, but does not have to be. NO PRELIMINARY DATA ARE REQUIRED. Preliminary data that support the proposal may be included, but will not contribute to the grade. Delay in submission of the proposal to "obtain more data" will not be accepted.

NOTE:*This proposal cannot be redacted from the PI's grants. Mentors should not provide original ideas for the proposal, but may answer student questions and provide suggestions for editing to guide the student in preparing a well-written proposal.*

PhD: Mid-February **MD/PhD: Mid June**

SUBMIT to Track Leader: (i) a one-page PDF document containing the Title and Abstract of the proposal (including Hypothesis and Specific Aims), and (ii) a one-page PDF document listing all completed course work. The Track Leader will use this information to select the members of the Qualifying Examination Committee from the entire pool of GPILS faculty. (*Optional:* you may suggest to your Track Leader 1-2 names of faculty who have knowledge of the research area of the proposal).

PhD: Mid-March **MD/PhD: Mid-July**

- SUBMIT the final written proposal to the Track Leader as an electronic PDF document. A title page should be included that contains the following statement "I certify that this is my original work" with the student's signature. The Track Leader will NOT provide critical feedback on the written proposal. The Track Leader will distribute the proposal to the Qualifying Examination Committee members for assessment.

NOTE: Significant delay in submitting the written proposal may be considered as a failure in the first attempt of the oral examination.

Hint: If you have not already started to study for the oral examination, you should begin at this time.

- If the written proposal is satisfactory, the student will be informed and provided with the composition of their Qualifying Examination Committee. The student must then proceed to contact each member to arrange the date, time, and location for the second phase of the examination, the Oral Exam.
- If the proposal is not satisfactory, the student will be notified of this outcome and must revise the written proposal for resubmission to the committee within 1 month, in accordance with written critical feedback.

Oral exams should be scheduled during April or May, and must be completed by the end of May. MD/PhD Oral exams should be scheduled during August or September, and must be completed by the end of September.

II. Oral Exam Overview:

The Oral Exam will be conducted as described in the Molecular Medicine Student and Faculty Handbook section J-Appedix 3. The mentor attends the Oral Examination, but does not participate and does not vote.

Hint: 'Practice' oral exams are strongly recommended in preparation for the oral exam.

Molecular Medicine Qualifying Exam

(from Molecular Medicine Guidelines)

A. Conditions for taking the Qualifying Exam

In order for a student to be admitted to candidacy, several conditions must be met:

1. Complete program/track course requirements with a minimum 3.0 grade point average.
2. Prepare a defensible NIH-NRSA style research proposal (science portion only), up to 7 single spaced pages plus reference citations.
3. Pass an oral examination.
4. Complete any other track-specific requirements.

These conditions are expected to be met by April/May of the second year for Ph.D. students and before the end of the first year the end of September for M.D. / Ph.D. students.The purpose of the qualifying examination is to test the student's readiness to make the transition from classroom training to thesis research. Students will be expected to demonstrate knowledge of general topics in molecular medicine and topics that derive from their academic coursework, as well as their ability to recognize and address significant research problems by formulating coherent, well controlled experimental designs. The complete guidelines for the Qualifying Exam are provided in **Appendix 3** of the student handbook. They are also included in this document.

B. The Qualifying Exam consists of two parts and is structured as follows:

1. Grant Writing Component

The student will be required to prepare a NRSA-style application as outlined in **Appendix 3**. The research proposal must be the original ideas and work of the student. The topic of the proposal may be related to the student's pending dissertation project, but can be a topic of the student's choice. The purpose is to test the student's ability to develop an original hypothesis and to design feasible experiments to test that hypothesis. No preliminary data is required. Students are permitted to seek advice and consult their advisor or other experts, but the proposal must be the student's own. The student must certify the proposal as his or her own work on the cover page. The written proposal will be submitted to the Qualifying Examination Committee, which will consist of 5 faculty members appointed by the track leader, plus the student's mentor as a non-voting observer. If the Qualifying Examination Committee judges the written proposal satisfactory, the student will begin scheduling the oral exam.

2. Comprehensive Oral Exam

The student will not give a preliminary presentation. Each examiner, in order, will ask a line of questions through 2 rounds of examination. Questions will relate to general knowledge of topics in molecular medicine, with a focus on topics derived from the student's academic coursework as well as their written proposal. Questions will also relate to the student's written proposal, their ability to evaluate the literature and formulate a testable hypothesis, to select appropriate methods, to design well controlled experiments, and to interpret experimental data. Students should be able to justify their choice of problem, the methods to be used to attack it, what given results might mean, what might go wrong, and to describe alternative approaches. The objective of the oral examination is to detect and probe areas of strength and weakness; thus, students may not be able to answer all that they are asked.

The examination process is designed to ensure that students have a fundamental understanding of topics in molecular medicine and can design a coherent series of experiments addressing a particular topic; therefore, the experiments proposed in the written component should be well-considered, well-controlled, and backed-up by alternative approaches. Students should be able to predict and interpret the potential outcomes, and to place the outcomes in the context of how they move the field forward. Since the oral examination tests the 'ability to think on one's feet', students are strongly encouraged to hold informal 'mock examinations' involving their laboratory colleagues, prior to their oral examination.

During the closed oral portion of the exam, students will be tested on their understanding of the proposal as well as their general knowledge of related topics in molecular medicine. Students who do not pass the Qualifying Exam the first time will be given only one additional opportunity to re-take and pass the exam. Successful students are encouraged to further

develop their written proposal, supplemented with preliminary data, for submission to the NIH or another funding agency (e.g., the American Cancer Society or American Heart Association).

After successfully passing both portions of the Qualifying Exam, the completed Qualifying Examination Form (http://lifesciences.umaryland.edu/molecularmedicine/student.aspx), including all signatures, should be submitted to the program manager. Each successful student should also initiate the paperwork for admission to candidacy and will need to obtain the signatures required by the Graduate School on the application form: (http://www.graduate.umaryland.edu/Forms/), and submit the completed application to the Graduate School. Students should ensure that copies of the final approval letter from the Graduate School are provided to the Program Manager so that their graduate research assistantships can be raised to the next pay step.

Appendix 3. (from Molecular Medicine Handbook) Qualifying Examinations

The purpose of the qualifying examination is to test the student's readiness to make the transition from classroom training to thesis research. It consists of two parts: Part 1 is an original written research proposal in the format of an NRSA-style grant application. Part 2 is an oral examination in which students will be tested both on their foundation of knowledge in the field and their ability to orally defend their proposal.

Timing and Scheduling: Unless prior approval by the MMED COGS is obtained, Ph.D. students will take their Qualifying Examination in the spring semester of their second academic year, and no later than the end of their second year in the program. Ordinarily the Oral Exam part occurs in April or May of the second year. M.D./Ph.D. students will take their Qualifying exams before the end of their first academic year in the Program.

Examination Committee: A Qualifying Examination Committee for the student will be selected by the Track Leader, and shall consist of five members of the GPILS Program faculty, plus the Dissertation Advisor (non-voting). The Track Leader receives the proposal from the student, distributes it to the members of the Qualifying Examination Committee (and Program Director), and keeps the student informed of all subsequent decisions of the Committee. The student schedules the oral exam.

Review of the Research Proposal: The Qualifying Examination Committee will review the written proposal to determine whether it is satisfactory within two weeks of submission. If the written proposal is deemed defendable, the Track Leader will be notified by the examiners, and the student asked by the Track Leader to schedule an oral examination at the earliest convenient date. If the written proposal is deemed not satisfactory, it will be returned with examiner's comments for guidance in rewriting. A maximum of one month will be allowed to rewrite the proposal. The time and number of resubmissions allowed for this process will be at the discretion of the Track Leader with consultation and advice from the Qualifying Examination Committee. Program Director will be informed of this outcome and provided with a copy of the written comments.

Oral Examination: The purpose of the oral examination is to test the student's foundation of knowledge and the student's abilities to defend any aspects of the written proposal, including the student's abilities to evaluate the literature relevant to the research topic, to formulate original and testable hypotheses, to select appropriate methods, to design well-controlled experiments, and to interpret experimental data. Students will not give a preliminary presentation in the oral exam. The purpose of the oral examination is not to grade the research proposal *per se*, but to determine readiness of the student to engage in thesis research.

Each examiner, in order, will ask a line of questions within two rounds of examination (*Note to examiners*: please refrain from trying to explain or restate another examiner's question; the student should do that if needed). Students will be expected to demonstrate knowledge of general topics in Molecular Medicine, and topics that derive from their academic coursework as well as their research proposal, whether or not they are asked about them directly. Questions may include justification of the choice of the proposal problem, the methods to be used, what given results might mean, what might go wrong, and alternative approaches. The student should be prepared to utilize a white/black-board to illustrate concepts during the examination. The objective is to detect and probe areas of weakness; thus students should not expect to be able to answer all that they are asked. The oral exam is as much a test of ability to "think on one's feet" as of knowledge.

Students will be given ~10-15 minutes to answer the questions of a given examiner; the examiner may ask a second line of questions in the allotted time, or pass to the next examiner. Other examiners may not answer any questions or provide substantive information to students during the examination. During the exam, the mentor/advisor is not allowed to ask

questions or to comment. If a student is unable to answer a question to the examiner's satisfaction in that time period, the Chair will move on to the next examiner (who may choose to ask a related question or a question on a different subject). The exam will usually last 1-2 hours and is limited to **2.5 hours**. Thus, each examiner should be able to question the student at least twice during the exam.

At the end, the committee will meet and determine whether: (1) the student passes and is recommended for admission to candidacy, or (2) remedial actions are required. Remedial actions will include a defined written remediation or oral remediation to make up deficiencies in knowledge as determined by the Qualifying Examination committee. The advisor will not have a vote, but may join in the discussion and act as an advocate for the student prior to the vote. The final decision shall be determined by a majority vote. Students will be informed of the committee's decision immediately after the examination. Any decision other than a pass will be accompanied with a written statement to the student within 48 hrs outlining not only the reason for the decision, but also the requirements that should be met to achieve a pass. In the case of remedial actions, a second opportunity to pass the Qualifying Exam will be available. In the case of a minor perceived deficiency, the student will be asked to submit a written mini-review or other written report to correct the deficiency. Normally up to one month will be allowed to complete this assignment. In the case of a major deficiency or multiple perceived deficiencies, the student will be allowed one opportunity to retake the oral examination. The second oral examination will be conducted by the original Qualifying Examination Committee as soon as possible. Normally one month, up to a maximum of three months, will be allowed to prepare for a second oral exam. A failure of the Qualifying Examination shall be considered grounds for dismissal from the Program.

The Qualifying Examination Form should be completed during each stage of the process, appended with correspondence pertaining to any remedial actions, signatures obtained, and the original document submitted to the Molecular Medicine program manager.

Instructions for the Written Research Proposal:

1. The research proposal must be an original work of the student. Students are permitted to seek advice and consult their advisor or other experts but the proposal must be the student's own.The student will certify the proposal as his or her own work on the cover page.

2. Read and follow the instructions carefully to avoid delays and misunderstandings. In preparing the application, avoid jargon; not all examiners will be familiar with your specific area of research. For terms not universally known, spell them out the first time it is used, with the appropriate abbreviation in parentheses; the abbreviation may be used thereafter. Define all terms. Remember that it is your job to make your proposal clear and comprehensible to the examiners. They should not be expected to do background preparation for the examination.

3. The maximum length of the proposal is 7 pages, not including Literature Cited. Any tables, graphs, figures, diagrams, and charts must be included within the 7 page limit. Prepare the application single-sided and single spaced, staying within 0.5 inch margins. The print must be clear and legible. Use a standard font (Arial, Times, Courier, Helvetica) and a minimum size of 11 point.

4. The proposal must contain the following sections:

A. Title, Abstract and Certification Page: The first page of the application is the title page with your name, affiliation and lab/mentor name. Please keep the title brief and to the point. The statement 'I certify that this is my original work' and your signature must be on the title page. The abstract should summarize the proposal in less than 350 words on the same page. (This page does not count towards the 7 page limit).

B. Specific Aims (1 page): An introductory paragraph should introduce the grant, followed by clearly stated goals of the proposed research. State the hypotheses to be tested and/or the question that is to be answered clearly. Provide a summary of the expected outcome(s), including the impact that the results of the proposed research will exert on the research field(s) involved. List the specific aims and summarize your experimental approach for achieving each aim. There should be no more than two specific aims.
[Tip: Top-notch research proposals are driven by strong hypotheses. Think of your hypothesis as the foundation of your application -- the conceptual underpinning on which the entire structure rests. Generally applications should ask questions

that prove or disprove a hypothesis, challenge an existing paradigm, or address a critical barrier to progress in the field, rather than use a method to search for a problem or simply collect information.]

C. Research Strategy (6 page limit): Organize the Research Strategy in the specified order using the instructions provided below. Start each section with the appropriate section heading—Significance, Innovation, Approach.

(a) ***Significance*-** Put the significance of your research in the context of 1) the state of your field and 2) the long-term research goals. You may want to address one or several of the following if appropriate:

- Explain the importance of the problem or critical barrier to progress in the field that the proposed project addresses.
- Explain how the proposed 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.

[Tip: This section will require a thorough knowledge of the relevant literature and the ability to critically evaluate existing knowledge to identify the relevant gaps, roadblocks and opportunities in the field. You should demonstrate familiarity with the field and knowledge about the research being done, referring to relevant scientific literature. If you leave out an important work, reviewers will assume you are not aware of it. State concisely the importance and biomedical/health relevance of the research by relating the specific aims to the broad, long-term objectives. Why is the work important? What has already been done? How is it significant?]

(b) ***Innovation*** – Explain how the work is new and unique and how it will add significantly to what's known. You may want to address one or several of the following if appropriate:

- Explain how the application challenges and seeks to shift current research or clinical practice paradigms. If your proposal challenges an existing paradigm, you'll need to build a strong case for your ability to challenge the existing paradigm and your reason for doing so.
- Explain how the proposed project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields.
- Describe how the concepts, approaches or methodologies, technologies, treatments, services, or interventions that drive this field will be changed if the proposed aims are achieved.

(c) ***Approach*** - For each Specific Aim of the project, describe the overall strategy, methodology, and analyses to be used to accomplish the aim.

- Under strategy explain what you want to do and why. This section may include data only if you want to and have data to include, but the presence or absence of data will not influence the grade. If you do include data, keep in mind that the primary purpose of this section is to provide experimental support for the hypotheses to be tested and to demonstrate the technical feasibility of the project.
- Under methodology explain how you are going to do the proposed work. Include sufficient information for a full evaluation of the project, independent of other documents. Be specific and informative, and avoid redundancies. Be sure to mention, where appropriate, which statistical methods you plan to use.
- Under expected results, discuss what results you anticipate and what your interpretations will be if you do or do not obtain those results. (see Hints, below).
- Under possible pitfalls and alternate methods, discuss potential problems, alternative strategies, and benchmarks for success anticipated to achieve the aims.

D. Literature Cited (no page limit): List all references that are relevant to your proposed work. Each reference must include the title, names of authors, book or journal, year of publication, volume number, and page numbers. Use this opportunity to gain experience using reference database software such as *Reference Manager* or *Endnote*. In addition,

highlight the 5 references that are most central to your proposal. These should be the papers that form the theoretical and methodological foundation upon which your proposal rests (choose carefully: your ability to identify these papers will in part indicate your understanding of the field). Examiners may test your understanding of these papers, both their strengths and weaknesses, as part of the exam.

Hints: The following is an abbreviated checklist from the NIH for suggestions about the Research Design and Methodology.

General

Does each experiment correspond to one of the specific aims, and are they stated in the same order?
Do the experiments follow a logical sequence?
Did I use flow charts and decision trees to show paths of experiments and how they will progress?
Have I included sufficient detail to show I understand and can handle the research?
Have I only included information that is needed to state my case, i.e., have I avoided including anything I don't plan to do?
Have I cited references wherever possible?

Approach

Did I state the expected outcome of my research?
Did I list each set of experiments in the same order as my specific aims, linking my experiments to the aims?
Are the methods I chose appropriate to achieve the specific aims?
Did I show why each experiment is important or how it is relevant to the hypothesis?
Are the experiments in a logical sequence, flowing from one to another with clear end points?
Will reviewers think I am knowledgeable about my methods?
Did I justify my choice of methods in detail?
Did I outline my methods in detail?
Did I support my methods with data/references?
Did I provide solutions for potential problems?
Is my proposed model system appropriate?
Did I address difficulties I may encounter with the proposed approaches, show I can handle them, and propose solutions and alternatives?
Did I consider how the limitations of the approaches may affect my results and data?
Did I address possible problems and limitations of the procedures, and propose solutions?
Did I estimate how much I expect to accomplish each year of the grant and state any potential delays?
Did I use enough detail?
Did I include all relevant controls?
Did I anticipate reviewers' questions about the feasibility of what I propose, e.g., how I will gain access to reagents, equipment, or study populations?

Results

Did I show I am aware of the limits to and value of the kinds of results I expect?
Have I convinced the reviewers that I will be able to interpret my results?
Are statistical methods used appropriately?
Did I define the criteria for evaluating the success or failure of a specific test?
Did I state the conditions under which my experimental data would support or contradict my hypothesis?
Did I state the limits I will observe in interpreting results?