Molecular Genetics
UNIVERSITY OF TORONTO

Molecular Genetics Examiner Guides

Basic protocol for chairing a pre-Reclassification/Qualification Exam meeting

1. The assigned Designated Examiner chairs the meeting and fills out the committee meeting evaluation form.
2. The pre-reclass/pre-qual runs like a normal committee meeting, but the student should also provide a synopsis of the proposal they're planning. If it is recommended to proceed to the exam, the committee should provide feedback and information about the exam at the end. Note that unless the student receives an overall score below 70% for the second time in a row on the evaluation, the final decision as to whether to proceed to the exam is the student's. However, students usually follow the committee's recommendation.
3. A critical job of the examiner is to normalize the threshold at which students are recommended to *not* proceed to the exam, e.g. if there is no viable path to success. There is always the option to recommend writing the MSc (completing the degree for existing MSc students, or transferring for PhD students); the students can then ask for the MSc defense committee to recommend admission to the PhD program. The MSc thesis and its defense can serve as both a demonstration that the student is ready for the PhD, and as a critical intellectual experience for the student.
4. If the student is proceeding to the exam, the chair should lead a discussion at the end where the student is made aware of the following:
    a. The timing of events and expectations – i.e., what is due and when.
    b. Point them to the Graduate Handbook, which contains specific instructions.
    c. Students usually take the entire month of April to put together the proposal. They should not be expected to do experiments during this period, though students should anticipate that lab maintenance tasks (e.g., maintaining cell lines or organisms) may continue.
    d. It is allowed (and highly recommended) to consult with other students and lab members on the proposal, the talk, and the exam itself.
    e. Supervisor may only provide general feedback on the proposal.
    f. Most students hold practice talks and practice exams – often more than one. It is particularly helpful if this is done prior to turning in the proposal, and with students who are not in the same lab, as these sessions often expose gaps in reasoning and highlight missing material.
    g. Tell them what happens at the exam, how the scoring works (i.e., what they'll be evaluated on), and the fact that there are multiple possible outcomes.
    h. Explain that the exam covers anything in the proposal (and all the references), techniques, rationale, alternatives, anything they should know by now as someone who was admitted to the program and has been in it for two years, and hypothetical situations to test their scientific thinking.
    i. Ask a few sample questions to give an idea of what it's like.

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Basic protocol for chairing a Reclassification/Qualification Examination

1. Confirm that everyone is present.
2. Student leaves room.
    a. Ask if anyone has anything to talk about
    b. Remind the committee about the following:
        i. The student will be scored in the categories on the form, and everyone will vote independently before any discussion.
        ii. The first three categories are mainly independent of the exam itself.
        iii. Everyone should make sure that enough questions in each category have been asked, particularly broader knowledge and scientific thinking. Students usually know technical details of their proposal very well but easily fall down on scientific thinking (even regarding their own project) and background of all types (including their own project).
        iv. The exam serves multiple purposes. For most students it is a learning experience that doubles as a rite of passage. For others it can serve to instill a bit of humility. It is also an exam, and students that do poorly on it often struggle throughout the remainder of the degree.
    c. Determine order of questioning. Usually:
        i. Student's choice external
        ii. Designated Examiner (previously the exam committee member)
        iii. Student committee member #1
        iv. Student committee member #2
        v. Chair (not required, mainly to fill in blanks)
        vi. Supervisor normally does not ask questions, but may ask clarifying questions only
3. Invite student back in. Tell them they'll have 20 minutes to present uninterrupted, followed by up to 70 minutes of questions, 10 minutes for each examiner, with shorter second round optional for the examiners, time permitting.
4. Time the student presentation. Give a two-minute warning if it looks like they might go long. Announce at 20 minutes, unless they're on the last slide. Do not allow more than 22 minutes.
5. Invite questioners and do the timing. Not required to be super strict, but give a 9 minute warning and at 12 minutes interject and recommend moving on to allow a second round.
    a. Exam cannot exceed 90 minutes, including student presentation.
6. Student leaves the room
    a. The chair should emphasize that giving a pass to a weak student, in order to avoid an uncomfortable situation, often leads to regret, and many more uncomfortable situations later. For reclass exams (i.e. current MSc students), the committee can recommend writing up an MSc for the purpose of extending the learning process – the experience is particularly valuable for those who lack either understanding of the project itself or relevant background, or cannot adequately rationalize the approach or interpret the results. There are several additional options. For PhD students, transfer to MSc ("declass") is also possible, as long as they don't have a U of T MSc in the same field, and this is an option examiners should be aware of. It may not feel great, but is preferable to withdrawal, or proceeding with a PhD that they're not up to.
7. Committee fills out the form before discussion, chair collects.
8. Provide a tally.
9. Discuss as needed.
10. Invite student back in and tell them the result.
11. The Chair reports the outcome to the Department.

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Designated Examiner role at the Reclassification/Qualification Examination

The Designated Examiner (formerly Exam Committee member), together with the Exam Chair, serves to normalize expectations and procedures across examinations.

The Designated Examiner and Exam Chair should ensure that questions in all categories on the scoring form are asked. These include Knowledge Closely Related to the Proposal, Background Knowledge, and Scientific Thinking.

The Designated Examiner and Exam Chair are also responsible for upholding Departmental standards with respect to outcome of the exam. Students who pass the exam are being given a license to complete a PhD in Molecular Genetics. The PhD means that the student can function independently as a scientist – i.e., has sufficient knowledge of a broad field, command of a specialty, ability to design and execute experiments and analyses, complete tasks, write scientific documents, create figures, and present their work effectively to an audience of other scientists.

Failing the exam does not represent immediate dismissal from the graduate program. There are five options listed on the form, and the committee may also ask that specific areas of deficit (e.g., an insufficient proposal) must be corrected.

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Sample questions for the Reclassification/Qualification Examination

Simple questions we ask prospective applicants to the program

- What is the "genetic code"?
- What molecules read the genetic code?
- What is the “central dogma” of molecular biology?
- What is “genetic linkage”?
- What is a protein domain?
- What are the major differences between prokaryotes and eukaryotes?
- What is an “exon"?
- What makes different cell types different from each other?
- How do we “clone” and manipulate DNA in the laboratory?
- How does CRISPR/Cas9 work? Where is this system adapted from?

Generic questions that can be adapted to most proposals

- Before CRISPR, how did we knock out genes? (Or before anything new, how did we do the same thing – reclass and qualifying proposals often contain the latest-and-greatest; ask how the ancients did the same thing – it’s probably in the references, so fair to ask).
- What does BLAST stand for, and what does it do? (or, pick any acronym from the proposal)
- How do you show that XXX is necessary and sufficient for YYY? (e.g. a regulatory element, a gene in a process, etc – most proposals involve some type of functional analysis).
- Definitions, origins, and history of anything in the proposal can be asked.
    - e.g., What is the definition of a promoter vs. an enhancer
- The fundamental requirement of the PhD is to make a contribution to knowledge. PhD students are expected to have commanding expertise in their specialty, as well as an appreciation of the significance of their work in the broader field. Briefly, what is the main contribution that you expect the proposed research will make? How will it contribute to your specialty, and what is the broader significance?

Questions from the Genomics Unit

- What is the Scientific Method?
- What is thought to be the primary source of new genes and new gene functions?
- Why do genes and proteins often fall into families?
- Homolog, ortholog, paralog – what do these terms mean?
- How was the human genome sequenced?
- What is a genetic map?
- Why do some organisms have much bigger genomes than others?
- How are human disease genes identified?

Questions from the Genetics Unit

- Describe Mendel’s laws
- Describe the chromosomal events of meiosis
- What are hyo, hyper, and neomorphs?

- What was the genetic basis for the one gene:one enzyme hypothesis?
- Define genetic epistasis and provide an example.
- What are chromosomal balancers and why are they useful?
- Describe forward versus reverse genetics
- What information can be gained by producing genetic mosaics?
- What is a maternal effect mutation?
- What are positive and negative genetic interaction?
- Give an example of genetic suppression.

Questions from the Proteins and Proteomics Unit

- Describe how post-translational modifications can affect protein function.
- Name three different experimental methods to determine macromolecule/protein structure.
- What are intrinsically disordered regions.
- What are short linear interaction motifs. Give a few examples.
- Name 5 reversible post-translational modifications.
- How can we identify the molecular target of a small molecule?
- What method enables identification of newly synthesized proteins?
- Described a strategy to identify organellar proteomes.
- Provide specific examples of negative controls to incorporate in an immunoprecipitation mass spec experiment.
- What are biomolecular condensates and how do they form.