

Department of Biology

PhD Comprehensive Examination Procedures

Purpose

The purpose of the Comprehensive Examination is to evaluate a student's breadth and depth of knowledge in subject areas defined by their selected subdiscipline(s) (see Appendix 1) within the broader context of Biology. Students must demonstrate to the satisfaction of the Examination Committee (EC) that they possess an adequate knowledge of the literature in their subdiscipline(s) and that they have the ability to pursue and complete original research at an advanced level. Thus, PhD students, upon entering their program, should prepare for their comprehensive exam by being familiar with the general concepts and techniques in their research area (“discipline” or “area of concentration”, as indicated on the Program of Study form), so they are prepared to discuss them in the examination.

Timing

PhD students will complete the comprehensive examination no later than the end of the seventh semester in the doctoral program. It can also take place earlier, e.g., in the fifth or sixth semester, as decided by the student and their supervisor. Students who are unable to take the examination by the end of the seventh semester must request an extension by submitting a letter to the Chair of the Biology Graduate Studies Committee (BGSC) explaining the reason(s) for the required extension. An extension will only be granted if it is approved by the Dean of Graduate Studies.

The student shall be notified of the subdiscipline(s) upon which they will be examined no later than 3 months prior to the examination.

Format

There are two exam options available, as discussed below. The option chosen will be decided by the supervisory committee in consultation with the student.

All exams, regardless of the option chosen, have both a written and an oral component. The written component will consist of a research proposal or paper that is submitted to the EC. Only members of the EC will be able to view the written document. The oral component will be open to the public and will consist of an oral presentation followed by a question-and-answer period.

Examination Committee

The composition of the EC must first be approved by the BGSC. To receive approval, the student's supervisor will submit the “Recommendation for PhD Comprehensive Examination Committee” form to BGSC for review.

The EC consists of five members:

- Chair [Deputy Head (Graduate Studies) or delegate from the Department]
- Supervisor
- Three faculty members from inside or outside Biology, with at least one member being from outside the student's Supervisory Committee

The Chair's role is to oversee the exam. They have the option to ask questions but are not required to do so. All members of the EC are voting members.

Option 1: Research Proposal

Written component

The student will prepare a written research proposal on their thesis topic in the general style of a NSERC Discovery Grant proposal. The proposal should be double-spaced, written in a 12 pt serif font, with 0.75-inch margins on all sides, and be a maximum of 10 pages (not including figures, tables and references). Use page numbers.

The proposal should be organized using the following sections:

- Summary of the proposal (up to 250 words, written in lay terms)
- Background
- Objectives (short- and long-term)
- Methods and proposed approaches
- Preliminary results (if available)
- Future experiments and proposed timeline of research activities
- Expected significance of the research
- References - literature cited in the proposal (maximum 2 pages, not included in the 10-page limit)

The thesis topic should be submitted to the Biology Graduate Administrator along with the "Recommendation for PhD Comprehensive Examination Committee" form. The Graduate Administrator will communicate the approved exam topic and guidelines to the student seven weeks before the examination. The research proposal must be made available to the members of the EC **at least two weeks** prior to the scheduled examination. The EC then has one week to determine if the written proposal is of sufficient merit to allow the oral component of the exam to proceed.

The research proposal will be evaluated in the following areas:

- Originality and innovation
- Significance and expected contributions to the field of research
- Clarity and scope of objectives
- Clarity and appropriateness of methodology
- Feasibility

Oral component

At the beginning of the examination, the student will give a 25-30 minute presentation highlighting the research proposal. Following the presentation, the candidate will be questioned by each voting member of the EC (including the chair, if they wish). The questions asked will be based primarily on the written proposal and presentation, but can also involve related topics relevant to the proposal and falling within the student's subdiscipline(s). The student is expected to be able to discuss key subject areas or fields of research that are related to their own field(s) of study, by answering questions posed by the EC.

Each member of the EC is to be given approximately 15 minutes for questions in the first round, ending with the supervisor. Each committee member is to be given the opportunity for a second round of questions, not to exceed 10 minutes each. At the end of the question period the candidate and audience will leave the examination room while the examiners discuss all facets of the examination and make their decision (see Evaluation and Outcomes section and Appendix 2).

Option 2: Review Article

Written component

The EC shall select a topic within the student's previously determined subdiscipline(s). The topic will generally be broad in scope and can be related to the thesis research. The EC will submit the topic to the Biology Graduate Administrator, on the form (Recommendation for PhD Comprehensive Examination Topic). During the discussion that determines the topic for the examination, the EC should also set a date for the examination. The date should be set with consideration that the candidate must be notified in writing seven weeks before the examination date and one week should be allowed for the BGSC to evaluate the proposed topic. The Graduate Administrator will communicate the topic and guidelines to the student seven weeks before the examination.

The written paper should be prepared using a 12 pt serif font, with 0.75-inch margins on all sides, be double-spaced and a maximum of 20 pages (not including figures, tables and references). Use page numbers. An abstract/summary of the topic (up to 250 words) should be included at the beginning of the paper and should be written in lay terms. Figures or diagrams can be included/appended. The subsequent oral presentation (see below) will be based on the contents of the review paper. The student will submit their paper to the Graduate Administrator and the EC at least two weeks before the examination. The EC then has one week to determine if the paper is of sufficient merit to allow the oral component of the exam to proceed.

Oral component

The student will give a 25-30 minute presentation on the assigned examination topic. As the topic is usually broad in scope, the student is expected to provide a brief introduction followed by a more in-depth review of a narrower aspect of the subject. The student must demonstrate an understanding of the development of the subject, current knowledge, and be able to present a synthesis of the subject and opportunities for future research. After the presentation, the student will be questioned by the EC. The questions asked by the EC will be based primarily on the written paper but can also involve related topics relevant to the article and falling within the student's subdiscipline(s).

Each member of the EC is to be given approximately 15 minutes for questions in the first round, ending with the supervisor. Each committee member is to be given the opportunity for a second round of questions, not to exceed 10 minutes each. At the end of the question period the candidate and audience will leave the examination room while the examiners discuss all facets of the examination and make their decision (see Evaluation and Outcomes section and Appendix 2).

Evaluation and Outcomes

Each component of the examination (written paper/proposal, oral presentation, question-and-answer period) will be assessed using a pass/fail system. To pass the examination, all three components must be deemed satisfactory (pass) based on the criteria presented in Appendix 2.

The EC shall decide the results of the comprehensive examination as follows:

Pass: this will be awarded to students who demonstrate an acceptable knowledge of their area(s) by achieving a satisfactory (pass) in all three exam components. This outcome requires a simple majority vote (ie 3/5) of the EC.

Re-examination: this will be for students who demonstrate an understanding of their research area(s) but who lack sufficient depth and scope, as indicated by a limited number of specific deficiencies in one or two of the exam components. This decision requires a simple majority vote (ie 3/5) of the EC. Only one such re-examination is possible. If a re-examination is to be held, it must be conducted not less than one month and not more than six months after the first examination. The decision of the voting members of the EC following this re-examination can only be “pass” or “fail”, decided by simple majority. Failure will lead to immediate termination of the student's program. There is no option for further re-examination.

Fail: this outcome is for students who are unable to demonstrate an adequate understanding of their research area(s), as indicated by significant deficiencies in one or more of the exam components. This decision requires a unanimous vote of the EC. A simple majority vote will default to the award of “re-examination”. If a student fails the examination, their program is terminated.

Appeals

All appeals must be made in writing to the School of Graduate Studies, clearly stating the basis for the appeal, and must be directed to the Dean or the Chair of the Appeals Committee of the School of Graduate Studies in accordance with Routes of Appeal of Academic Regulations (section 4.6.4 of University regulations, <https://www.mun.ca/regoff/calendar/sectionNo=GRAD-0021>).

APPENDIX 1: Subdisciplines for Biology Comprehensive Examinations (based on NSERC research topic)

Supervisors: Select 1-2 of the following subdisciplines and enter these on the “Recommendation for PhD Comprehensive Examination Committee” form.

Subdisciplines within the area of concentration “**Microbiology**”

- Bacteriology
- Virology
- Protozoology
- Mycology
- Bioremediation
- Environmental microbiology
- Microbial pathogenesis
- Microbial epidemiology
- Symbiosis and beneficial interactions
- Microbial ecology
- Microbial genomics
- Microbial physiology
- Parasitology
- Microbiome
- Microbial communities

Subdisciplines within the area of concentration “**Biochemistry**”

- Metabolic pathways
- Protein structure and function
- Metabolomics
- Enzymology
- Protein-protein interactions
- Proteomics
- Lipidomics
- Biochemical techniques
- Biophysics
- Glycobiology

Subdisciplines within the area of concentration “**Plant Biology**”

- Plant pathology
- Stress physiology
- Plant nutrition and metabolism; photosynthesis
- Plant growth and development
- Plant reproduction
- Silviculture

- Water and minerals in plants
- Crop and pasture production, breeding
- Plant morphology
- Plant secondary metabolism
- Hormone biology
- Plant growth regulation (metabolism and biosynthesis)

Subdisciplines within the area of concentration “**Animal Physiology**”

- Neurophysiology
- Endocrinology
- Animal reproduction and breeding
- Animal morphology
- Animal nutrition and husbandry
- Veterinary sciences
- Behavioural neuroscience
- Systems physiology (cardiovascular, respiration, urinary...)
- Animal feeding, nutrition (nutrigenomics) and metabolism
- Animal disease, pathogens and pathology
- Animal toxicology/ecotoxicology
- Quantitative physiology, mathematical modelling
- Biophysics
- Sensory and motor systems
- Muscle and movement physiology/biomechanics
- Ecophysiology/environmental physiology/environmental stress

Subdisciplines within the area of concentration “**Molecular Genetics**”

- Gene regulation and expression
- Gene and chromosome structure
- Signal transduction for gene expression
- Transcription factors
- Quantitative genetics/genomics
- Epigenetics
- Genome sequencing and analysis
- Genome editing, transgenic organisms
- Transcriptomics/RNA expression, RNA sequencing
- Post-transcriptional regulation
- Proteomics

Subdisciplines within the area of concentration “**Evolutionary and Developmental Genetics**”

- Population genetics
- Comparative genetics

- Gene transfer
- Developmental epigenetics
- Cell differentiation
- Phylogenetics

Subdisciplines within the area of concentration “**Ecological and Evolutionary Applications**”

- Climate change
- Conservation biology
- Conservation genetics
- Ecotoxicology
- Endangered species
- Fisheries, wildlife and forestry
- Management
- Habitat loss
- Harvesting
- Invasive species
- Resource selection
- Silvics
- Population viability
- Species recovery

Subdisciplines within the area of concentration “**Quantitative Approaches**”

- Bioinformatics
- Biomathematics
- Biostatistics
- Computational neuroscience
- Statistical genomics and genomic analysis
- Multiscale modelling
- Computer simulation of protein, nucleic acid and membrane structure/dynamics

Subdisciplines within the area of concentration “**Ecology and Evolution of Behaviour**”

- Behavioural syndromes
- Cooperation and conflict
- Foraging
- Habitat selection
- Information gathering
- Kin selection
- Mate choice
- Mating systems
- Patch uses
- Sexual conflict
- Social organization

Subdisciplines within the area of concentration “**Ecosystem Patterns and Processes**”

- Decomposition
- Diversity and stability
- Ecological engineering
- Energy flow
- Food webs
- Isotope signatures
- Nutrient cycling
- Physical and chemical dynamics
- Size spectra

Subdisciplines within the area of concentration “**Spacial Patterns in Ecology and Evolution**”

- Biogeography
- Dispersal
- Distribution
- Geographical information systems (GIS)
- Geographical ranges
- Habitat fragmentation
- Island biogeography
- Landscapes
- Migration

Subdisciplines within the area of concentration “**Ecological Function**”

- Constraints and trade offs
- Development
- Ecological stoichiometry
- Ecophysiology
- Life cycles
- Performance indicators

Subdisciplines within the area of concentration “**Populations and Communities**”

- Community assembly
- Community structure
- Competition
- Demography
- Indirect effects
- Metapopulations
- Multi-kingdom interactions
- Population dynamics
- Predator-prey dynamics

- Species interactions

Subdisciplines within the area of concentration “**Evolutionary Processes**”

- Adaptation
- Character displacement
- Co-evolution
- Density and frequency dependence
- Evolutionary genetics
- Life history
- Phenotypic plasticity
- Sexual selection
- Speciation

Subdisciplines within the area of concentration “**Mathematics and Statistical Models in Evolution and Ecology**”

- Bioinformatics
- Capture, mark, recapture theory
- Ecological and evolutionary models
- Evolutionary games
- Model selection
- Resource models
- Statistical theory
- Stochastic processes

Source: https://www.nserc-crsng.gc.ca/professors-professeurs/grants-subs/dgplist-psdliste_eng.asp#1501

APPENDIX 2: Evaluation Criteria for Comprehensive Exam

(1) Written Paper/Proposal

- **Abstract/Summary:** summarizes the main components of the paper/proposal; written in lay terms (up to 250 words maximum)
- **Introduction/Background:** Strong introduction of topic's key question(s); background information explains topic's scope and importance; key concepts and theories are well explained
- **Body:**
 - Paper: Research results and trends are accurately reported; research results and trends are well interpreted; areas of controversy are identified and discussed; open questions and future directions are identified
 - Proposal: Short and long-term objectives are clearly defined; methodology is clear, appropriate and feasible; proposed work is original and innovative; significance and expected contributions to the field of research are discussed
- **Figures and Tables:** are well designed and complement the text
- **Grammar and Mechanics:** paper/proposal is logically organized and generally free of grammatical, spelling and punctuation errors; page limits and formatting guidelines are followed:
 - Proposal: double-spaced, 12 pt serif font, 0.75-inch margins on all sides, maximum of 10 pages (not including figures, tables and references)
 - Paper: double-spaced, 12 pt serif font, 0.75-inch margins on all sides, maximum of 20 pages (not including figures, tables and references)
- **Citations:** key publications are cited and include recent publications from the literature; citations and literature cited match and are formatted uniformly

(2) Oral Presentation

- **Content:** Presentation demonstrates a thorough understanding of the topic; the information presented is accurate and complements the written paper/proposal
- **Organization, Delivery and Style:** Presentation is clear, logical and well organized; presentation is well paced with a good flow; student speaks to the audience and not the screen, and does not rely on notes; student uses grammatically correct sentences and appropriate vocabulary; the speech is fluid with appropriate inflection, and is loud and clear enough to be heard by the audience; the body language is relaxed and self-confident
- **Design:** Presentation slides are visually well designed and aesthetically pleasing; text is visible and minimal on each slide, and is generally free from errors (spelling, punctuation, grammar, formatting, etc.); visuals used are effective in enhancing the presentation

(3) Questions and Answers

- **Content:** Student understands the theories/concepts important to the examination topic; student understands the questions and their contexts; student acknowledges limitations of knowledge
- **Organization, Delivery and Style:** Student answers the questions clearly, fully, and concisely; students ask questions and engages in discussion with the examiners; the student's body language and speech are effective and comfortable, and they make eye contact with the examiners