

MASTER OF SCIENCE BIOSCIENCE, TECHNOLOGY & PUBLIC POLICY (BIOL)

June 28, 2021

Chair: Professor Craig Willis

The power of science to change the face of modern society is growing at an ever-increasing pace. Science and technology are tools that can and do improve the human condition in many ways. But the rapid pace of change also brings unforeseen consequences and challenges. Science and technology cannot develop effectively within a social vacuum. The objective of this program is to train students in the advanced methods of science, and to place this body of knowledge in the broader context of modern society.

Biology plays an ever-increasing role in the development of science and technology, and all aspects of the discipline are changing with advances in a variety of fields including health research, genetics and genomics, evolution, physiology, natural resource management, conservation and protection, molecular biology, environmental science, animal behaviour, cellular biology and many others. Our program provides students with a skill set that prepares them to work in both academia and industry at an advanced level in every area of biology.

The program's specific objectives are to:

1. Provide students with breadth and depth of knowledge in their field of study while providing the skills to communicate effectively and to make informed decisions.
2. Provide an understanding of the ethical problems facing our society, and an appreciation of the full range of human, aesthetic and environmental values.
3. Train students in science and ethics, science and public policy and science in the context of global relations.

Admission (Deadline February 1)

Applicants for admission to the program must hold a recognized 4-Year Bachelor of Science or equivalent with a minimum overall GPA of 3.0 (70%) and no grade less than C+ in the last two years of full-time university study.

Further inquiries should be directed to the Bioscience Graduate Program Chair. Applications are available online at the Faculty of Graduate Studies website. It is recommended that prospective students secure a research supervisor prior to applying into our program.

REQUIREMENTS FOR AN M.Sc. IN BIOSCIENCE, TECHNOLOGY & PUBLIC POLICY

Students are enrolled in the Masters program for a minimum of two years and take a minimum of 12 credit hours of courses. A major research project culminating in a Master of Science thesis must be completed and successfully defended to graduate from the program. As a condition of admission, each MSc student must have a supervisor who is a member of the Faculty of Graduate Studies at the University of Winnipeg and belongs to a Department within the Faculty of Science at the University of Winnipeg (e.g. Biology, Environmental Studies and Science, Geography, Physics, Chemistry) or is an adjunct professor in the Dept. of Biology at the University of Winnipeg. The supervisor provides direction to the student on the program of study, directs research, and supervises thesis work. The student must also have a thesis committee including the supervisor and at least two other faculty members to help guide and review thesis research. Course work includes three elements: core bioscience courses; courses in BioScience & Technology and courses that place science in the broader context of society. Students are required to obtain a minimum average GPA of 3.0 and no grade less than B in all required coursework.

Courses:

Students must complete a combination of required courses (and elective courses if required). Supervisors may assign more than the minimum 12 credit hours for a student degree program. With the exception of Seminars in Biology, and at the discretion of the Bioscience Graduate Program Chair, students are allowed to substitute up to 3 credit hours with a course taken from a different Institution.

Required:

- GBIO 7101 Seminars in Biology (3 credits, continuing throughout registration period)
- GBIO 7111 Thesis course (continuing throughout registration period)
- GBIO 7103 Bioscience and Policy (3 credits)

Electives:

Minimum 3 credits from Core Bioscience Curriculum

- GBIO 7402 Current Topics in Ecology (3 credits)
- GBIO 7304 Current Topics in Genetics & Genomics (3 credits)
- GBIO 7100 Directed Studies in Life Sciences (3 credits)

Minimum 3 credits from Bioscience & Technology Curriculum

- GBIO 7201 Molecular Biotechnology (3 credits)
- GBIO 7202 Geographic Information Analysis (G.I.A.) (3 credits)
- GBIO 7102 Directed Studies in Biosciences and Technology (3 credits)
- GBIO 7104 Analysis of Biological Data (3 credits)

Other Bioscience and Policy Curriculum courses that might be of interest

- MULTI 7219 Summer Institute - Infectious Diseases Policy (3 credits)
- ENV/GBIO 4617/7617 Ecology and management of species at risk (3 credits)

COURSE DESCRIPTIONS

A. CORE BIOSCIENCES

GBIO-7100(3) DIRECTED STUDIES IN LIFE SCIENCES

This course is designed to allow students to undertake a project in an area of their interest. The project may take the form of a literature review, it may be experimental in nature, or it may involve analysis of existing data. Evaluation is based upon, but not limited to, writing a report summarizing the student's findings. The supervisor and student must submit a proposed plan of study which must be approved by the Bioscience Graduate Program Chair prior to commencement of the course. A student may receive credit for this course only once.

PREREQUISITE: Consent of the Bioscience Graduate Program Chair.

GBIO-7101(3) SEMINARS IN BIOLOGY This course consists of seminars presented by students on their thesis research topic. Attendance by students is mandatory during the two years of their studies. Students in their first year are expected to present at least, but not exclusively, the appropriate background to their topic of research, the rationale and objectives to their study and some aspects of the methodology. Students in their second year are expected to add to their presentation results and conclusion, and provide an idea of likely future direction. Students are also expected to summarize and critique a specific number of outside seminars presented by faculty from other universities.

GBIO-7111 THESIS COURSE To participate in the Master of Science in Bioscience program students must register for this course in each year of their program. Registration in this course indicates students are undertaking a thesis project in an area of biosciences under the supervision and guidance of a Faculty member. The thesis project must include actual research, experimental and/or theoretical, that is beyond a literature review or analysis of existing data. Permission to enroll is dependent on the availability of an Instructor in the student's field of interest and approval of the Biology Department Graduate Coordinator for the MSc Bioscience program and the Faculty of Graduate Studies at the University of Winnipeg. Registration in this course is mandatory during the student's residency in the program.

GBIO-7201(3) MOLECULAR BIOTECHNOLOGY This course equips Graduate students with theoretical and hands-on experience. Topics include, but are not limited to, techniques used for DNA, RNA and protein isolation, gel electrophoresis, molecular markers and DNA fingerprinting, Southern and Northern hybridization, the polymerase chain reaction (PCR), and DNA sequencing. The application of these techniques in diagnostics (e.g., DNA fingerprinting, pathogen typing, species identification) is emphasized.

PREREQUISITES: Consent of the Bioscience Graduate Program Chair.

GBIO-7304(3) CURRENT TOPICS IN GENETICS & GENOMICS The field of Genetics has experienced fast changes during the last years. Advances in molecular

techniques and computer sciences makes it feasible to address old questions and raise new ones. A consequence of this advancement is the birth of Genomics and the evolution of the field into structural, functional and comparative genomics. This course is a combination of readings, oral presentations and discussions that examine current topics in the field of genetics and genomics. A major aspect of the course will be student participation through presentations and discussion of the current literature.

PREREQUISITES: BIOL-2301; BIOL-3303 or equivalent. Consent of the Bioscience Graduate Program Chair.

GBIO-7402(3) CURRENT TOPICS IN ECOLOGY This course involves students in the current topics in ecology. The instructor presents a range of potential topics from which students can select those of interest. Students may also offer their own topics for presentation. Students will present seminars to the class on chosen topics, and their evaluation will be based upon class participation, and will involve peer assessment. This course is also open to 4th year Biology Honours students. Additional in-depth work is required to receive credit at the 7000 level.

PREREQUISITES: Consent of the Bioscience Graduate Program Chair.

GBIO-7102 (3) DIRECTED STUDIES IN BIOSCIENCE AND TECHNOLOGY This course allows students to learn more about critical technologies that relate to their research project in the Masters of Biosciences program. Under the guidance of their faculty supervisor, students will either participate in a specialized course of study in technologies important to the better understanding of their field of research or can develop a technology based project in conjunction with a faculty member. The supervisor and student must submit a proposed plan of study which must be approved by the Bioscience Graduate Program Chair prior to commencement of the course.

PREREQUISITES: Consent of the Bioscience Graduate Program Chair.

GBIO-7103 (3) BIOSCIENCE AND POLICY This course focuses on the relationship between government, industry and the academic sciences and the processes that shape science policy. Students gain a better understanding of the role of science policy in government and industry and where policy issues "fit" with respect to legislation and regulations, management planning and implementation, procedures and guidelines. Students analyze current science policy issues by discussing real world case studies e.g. medical, environmental, natural resource management, ethical etc. as they affect both basic and applied fields of bioscience research. Students acquire skills required for interacting effectively with policy makers and understand how scientists participate in the formulation of science policy.

PREREQUISITES: Consent of the Bioscience Graduate Program Chair.

ENV/GBIO 4617/7617(3) ECOLOGY AND MANAGEMENT OF SPECIES AT RISK This course examines current issues of controversy and public concern in environmental studies and environmental science. The content varies from year to year and students should consult the Environmental Studies department for a more detailed description of topic areas in terms in which the course is offered.

PREREQUISITES: Consent of the Bioscience Graduate Program Chair.

GBIO-7104(3) ANALYSIS OF BIOLOGICAL DATA This course provides a foundation for Bioscience graduate students in experimental design and methods to analyze their data sets using statistics and experimental design. The course covers practical tools needed to organize and summarize data generated by students in their Master's thesis research. Course content will consist of statistical distributions, model fitting, randomization tests, non-parametric statistics, and multivariate analysis. Students will be taught how to program and execute advanced statistical analysis in the open source statistical software program "R" using example data sets and their own research data.

EXPERIMENTAL COURSES

GBIO-7202 GEOGRAPHIC INFORMATION ANALYSIS (G.I.A.) This course deals with advanced theory and applications within Geographic Information Analysis (G.I.A.) with a specific focus on spatial statistics and spatial analysis. Laboratory instruction provides the students with enhanced skills through exposure to the higher-level functions of industry standard GIS software.

PREREQUISITES: Permission of the instructor or an introductory GIS class where you learned spatial data manipulation (e.g., visualizing, geometric operations, errors). Visualizing includes making good cartographic maps. Geometric operations include simple operations such as

calculating the total length of roads in a city or intersecting operations such as where is the closest water body to an ash stand. Errors include geocoding error (e.g., not having correct projection systems) and algorithm errors (e.g., calculating errors).

GBIO-7403 ADVANCED TOPICS IN CONSERVATION BIOLOGY (Adv Cons Bio) This course involves students in the topics of conservation biology and environmental studies. The instructor presents a range of potential topics related to organismal biology, population ecology, and conservation of animals in the Anthropocene. Students may also offer their own topics for presentation. Students will present seminars to the class on chosen topics, and their evaluation will be based upon class participation, and will involve peer assessment.

GBIO-7204 BIOINFORMATICS BIOTECHNOLOGY This course provides students with an introduction to the technologies behind and analysis of DNA, protein, and RNA transcriptomics data in the post-genomics era. Each three-hour class will be divided into lecture and *in silico* laboratory components. While, the content of the course may vary from year to year, emphasis will be given to phylogenetics and next generation sequencing (NGS) analyses. In the first half of the course, topics to be covered include methods for analyzing DNA sequence data such as homology and motif searches, multiple sequence alignments, identifying evidence of selection in DNA sequence data, synteny, DNA bar-coding, and phylogenetics. In the second part of the course, NGS technologies will be introduced, and students will learn how to walk through, step by step, the components of an NGS (e.g. RNAseq or CHIPseq) experiment. The course is intended to provide students with a foundation in the broad concepts underlying bioinformatics as well as an introduction to bioinformatics data analysis.