

Transfers from other Universities and Colleges

Students entering a program in the Division of Natural Sciences and Mathematics from another Canadian University or College, or from accredited international post-secondary institutions, will have their transcripts of grades examined individually for possible transfer credit against a Bishop's program's requirements. Please consult the Admission section of this Calendar or the Admissions Office, admissions@ubishops.ca for details.

Transfers from other programs at Bishop's University

Bishop's students wishing to transfer into a program offered by the Division of Natural Sciences and Mathematics normally require a cumulative average of 65% on all courses attempted at Bishop's. Students whose average is below 65% may still register in courses offered in the Division, subject to the normal regulations regarding course registration in the University. Program transfers are not normally permitted in a student's first semester of studies at Bishop's University.

Biochemistry

Faculty

Elizabeth Prusak,

M.Sc. Eng. (Tech. Univ., Poland);
Ph.D. (Polish Academy of Science);
Professor
Chair of the Department

Virginia L. Stroher,

B.Sc. (Montana State), Ph.D.
(University of Washington); Professor

Program Overview

The Biochemistry program at Bishop's is coordinated through an interdisciplinary committee of chemists, biochemists and biologists, providing students with a strong background in chemistry, biochemistry and biology. Students enrolling in the Biochemistry program will be able to follow a course of study that best meets their interests, strengths and future needs. This is accomplished through the offering of three program specializations – General, Molecular Biology, or Chemistry – any one of which the student will select to complete their Biochemistry program requirements. The goal of the General specialization is to provide a broad background in several relevant fields of biology, biochemistry and chemistry. The Molecular Biology specialization places greater emphasis on the molecular and cellular fields of study. The Chemistry specialization is more focused in chemistry and, by selecting the appropriate courses, can provide the student with the necessary academic requirements for membership in the Chemical Institute of Canada and accreditation by *l'Ordre des chimistes du Québec*.

The Biochemistry program offers both an Honours degree, which rigorously prepares students for graduate studies or professional schools, and a Major degree, which provides students more flexibility in their program. The program places strong emphasis on mastering the fundamentals of experimental biochemistry, and provides students with well-equipped laboratory facilities, first-hand experience with modern laboratory equipment, and close instructional contact with professors. As well, the Agriculture Canada Research Station in Lennoxville and the Université de Sherbrooke, with its associated medical research hospital, are easily accessible to students and provide additional opportunities and exposure for interested Honours students.

Programs

Biochemistry Honours (99 credits)

HONBCH

Students are not admitted to the Honours Biochemistry program until the end of their Y3 year.

To be eligible to enter the Honours Biochemistry program, a student must normally achieve:

- i) a minimum cumulative average of 75% by the end of the Y3 year, and
- ii) at least 75% in each 300-level and 400-level course required in the program.

To complete the Honours Biochemistry program, a student must:

- i) maintain a minimum cumulative average of 75% and
- ii) achieve at least 75% in each 300-level and 400-level course required in the program with a maximum permitted exemption of four credits and
- iii) achieve at least 75% in each of BCH 491 and BCH 492.

The Honours Biochemistry program includes a three credit scientific writing course and a six-credit honours research project that will be evaluated by at least three faculty from, or recognized by, the Biochemistry Program Committee. The scientific results of the honours research project must be presented in public, either through an oral seminar or poster presentation, and the scientific results submitted in a written thesis.

The Biochemistry Honours program is a four-year program that requires 40 three-credit courses, or their equivalent, for a total of 120 course credits, plus associated laboratory courses, the number of lab courses required depending on the specialization selected. The 120 course credits are divided as follows: 75 core required course credits, 24 specialization course credits, 18 free elective credits and 3 humanities or social sciences elective credits.

Core Required Courses (75 course credits)**Y1 Year**

BIO 196 / BIL 196 (Intro Cellular and Molecular Biology)
 CHM 191 / CHL 191 (General Chemistry I)
 PHY 193 / PHL 193 (General Physics I for Life Science)
 MAT 198 (Calculus I for Life Science)
 ELA 116 (Effective Writing)

CHM 192 / CHL 192 (General Chemistry II)
 PHY 194 / PHL 194 (General Physics II for Life Science)
 MAT 199 (Calculus II for Life Science)
 OPT
 OPT

Y2 Year

BIO 201 (Cellular and Molecular Biology)
 CHM 131 / CHL 131 (Physical Chemistry I)

 CHM 141 / CHL 141 (Analytical Chemistry)
 CHM 111 / CHL 111 (Organic Chemistry I)
 PHY 101 (Statistical Methods)

BIO 208 / BIL 208 (Genetics)
 BCH 210 (General Biochemistry)
 CHL 142 (Chromatography Laboratory)
 CHM 211 / CHL 211 (Organic Chemistry II)
 OPT
 OPT

Y3 Year

BIO 336 / BIL 336 (Animal Physiology I)
 BCH 311 (Proteins)
 CHM 341 / CHL 341 (Molecular Spectroscopy)
 OPT
 OPT

BCH 312 (Lipids & Biomembranes)
 BCH 313 / BCL 313 (Metabolism)
 OPT
 OPT
 OPT

Y4 Year

BCH 383 (Molecular Biology)
 BIO 386 (Scientific Writing)
 BCH 491 (Honours Research Project I)
 OPT
 OPT

BCH 492 (Honours Research Project II)
 OPT
 OPT
 OPT
 OPT

Specialization Courses (24 course credits)

- see below for individual specializations

Free Electives (18 course credits)**Humanities or Social Sciences Elective (3 course credits)**

Biochemistry Major (90 credits)

MAJBCH

The Biochemistry Major program is a four-year program that requires 40 three-credit courses, or their equivalent, for a total of 120 course credits, plus associated laboratory courses, the number of lab courses required depending on the specialization selected. The 120 course credits are divided as follows: 66 core required course credits, 24 specialization course credits, 27 free elective credits and 3 humanities or social sciences elective credits.

Core Required Courses (66 course credits):**Y1 Year**

BIO 196 / BIL 196 (Intro Cellular and Molecular Biology)	CHM 192 / CHL 192 (General Chemistry II)
CHM 191 / CHL 191 (General Chemistry I)	PHY 194 / PHL 194 (General Physics II for Life Science)
PHY 193 / PHL 193 (General Physics I for Life Science)	MAT 199 (Calculus II for Life Science)
MAT 198 (Calculus I for Life Science)	OPT
ELA 116 (Effective Writing)	OPT

Y2 Year

BIO 201 (Cellular and Molecular Biology)	BIO 208 / BIL 208 (Genetics)
CHM 131 / CHL 131 (Physical Chemistry I)	BCH 210 (General Biochemistry)
CHM 141 / CHL 141 (Analytical Chemistry)	CHL 142 (Chromatography Laboratory)
CHM 211 / CHL 211 (Organic Chemistry II)	
CHM 111 / CHL 111 (Organic Chemistry I)	OPT
PHY 101 (Statistical Methods)	OPT

Y3 Year

BIO 336 / BIL 336 (Animal Physiology I)	BCH 312 (Lipids & Biomembranes)
BCH 311 (Proteins)	BCH 313 / BCL 313 (Metabolism)
CHM 341 / CHL 341 (Molecular Spectroscopy)	OPT
OPT	OPT
OPT	OPT

Y4 Year

BCH 383 (Molecular Biology)	OPT
OPT	OPT
OPT	OPT
OPT	OPT

Specialization Courses (24 course credits)

- see below for individual specializations

Free Electives (27 course credits)**Humanities or Social Sciences Elective (3 course credits)**

Biochemistry Minor (24 credits) MINBCH

The program requires 8 three-credit one-semester courses, or their equivalent, for a total of 24 course credits, plus credits for associated laboratory courses.

Required Courses: (15 course credits)

BCH 311 (Proteins)
 BCH 312 (Lipids & Biomembranes)
 BCH 313 / BCL 313 (Metabolism)
 BIO 196 (Introductory Cellular & Molecular Biology)
 CHM 141 / CHL 141 (Analytical Chemistry)

Required Optional Courses (9 course credits from list):

Biochemistry:

BCH 381 (Immunology)
 BCH 383 (Molecular Biology)
 BCH 421 (Enzymology)

Biology:

BIO 208 / BIL 208 (Genetics)
 BIO 310 (Advanced Cell Biology)
 BIO 320 (Programmed Cell Death)
 BIO 336 / BIL 336 (Animal Physiology I)
 BIO 337 / BIL 337 (Animal Physiology II)
 BIO 352 / BIL 352 (Microbiology)
 BIO 394 (Biology of Cancer)
 BIO 442 (Bioethics)

Chemistry:

CHM 111 / CHL 111 (Organic Chemistry I)
 CHM 131 / CHL 131 (Physical Chemistry I)
 CHM 211 / CHL 211 (Organic Chemistry II)

Specializations (for Honours and Majors)

General Specialization

Specialization required courses (9 course credits):

BCH 381 (Immunology)
 BCH 421 (Enzymology)

and one of the courses below:

BIO 337 / BIL 337 (Animal Physiology II), or
 BIO 352 / BIL 352 (Microbiology)

Required Options (15 course credits from list):

Biochemistry:

BCH 382 (Environmental Biochemistry and Toxicology)
 BCH 422/BCL 422 (Biotechnology)

Biology:

BIO 310 (Advanced Cell Biology)
 BIO 320 (Programmed Cell Death)

Chemistry:

CHM 241 (Environmental Chemistry: Atmosphere and Energy)
 CHM 311 / CHL 311 (Organic Chemistry III)

Molecular Biology Specialization

Specialization required courses (9 course credits):

BCH 381 (Immunology)
 BIO 394 (Biology of Cancer)
 or

BIO 320 (Programmed Cell Death)
 BIO 352 / BIL 352 (Microbiology)

Required Options (15 course credits from list):

Biochemistry:

BCH 382 (Environmental Biochemistry and Toxicology)
 BCH 421 (Enzymology)
 BCH 422/BCL 422 (Biotechnology)

Biology:

BIO 337 / BIL 337 (Animal Physiology II)
 BIO 359 (Human Genetics)
 BIO 365 (Developmental Biology)
 BIO 394 (Biology of Cancer)

Chemistry Specialization

Specialization required courses (9 course credits):

CHM 121 (Structure and Bonding)
 CHM 221 / CHL 221 (Transition Metals and
 Bioinorganic Chemistry)
 CHM 231 / CHL 231 (Physical Chemistry II), or
 CHM 311 / CHL 311 (Organic Chemistry III)

Required Options (15 course credits from list):

Biochemistry:

BCH 381 (Immunology)
 BCH 382 (Environmental Biochemistry and Toxicology)
 BCH 421 (Enzymology)
 BCH 422 / BCL 422 (Biotechnology)

Chemistry:

CHM 241 (Environmental Chemistry: Atmosphere and Energy)
 CHM 242 / CHL 242 (Environmental Chemistry: Water and Soil)
 *CHM 331 / CHL 331 (Physical Chemistry III)
 CHM 411 (Advanced Topics in Organic Chemistry)

** This course must also be completed, along with the Specialization Required Courses listed above, in order to be eligible for accreditation by l'Ordre des Chimistes du Quebec .*

List of Courses

BCH 101 Introduction to Nutrition 3-3-0

This course is designed for students from any discipline (except Biochemistry, Biology and Chemistry). It will provide an introduction to basic concepts of nutrition and ways that good nutrition can be integrated into a healthy life style. Principles of digestion and absorption, the function of nutrients, disease prevention, diet modification and weight control will be discussed.

Prerequisites: None. However, secondary school Biology is strongly recommended.

Note: This course may not be taken for credit by students in Biology, Biochemistry or Chemistry programs.

BCH 210 General Biochemistry 3-1-0

An introduction to the structure and function of biomolecules with the emphasis on the central phenomena behind the behavior of biomolecules in the cellular environment.

Prerequisites: CHE 111 and BIO 201

BCH 311 Proteins 3-3-0

Protein structure and function, including protein purification, structure analysis, protein synthesis, distribution and degradation, as well as molecular visualization of protein structure.

Prerequisite: Chemistry 111 and BCH 210

BCH 312 Lipids and Biomembranes 3-3-0

Biomembranes structure and function, including study of cell membrane structure, and transport, trans-membrane signaling, hormones and secondary messengers.

Prerequisite: BCH 311

BCH 313 Metabolism 3-3-0

Introduction to the basic metabolic pathways of living cells. These include the central metabolic pathways associated with cellular energy generation, carbohydrate degradation and synthesis, fatty acid degradation and synthesis, lipid metabolism and nitrogen metabolism. Emphasis will be placed on the role and regulation of enzymes associated with these pathways.

Prerequisite: Chemistry 111 or BIO 155, and BIO 336

Co-requisite: BCL 313

BCL 313 Metabolism Laboratory 1-0-3

This course introduces the student to research approaches in metabolic enzymology and the study of enzyme kinetics. Environmental factors influencing enzyme activity as well as the effects of different inhibitory molecules will be examined. As well, protein isolation and analysis will be covered.

Co-requisite: BCH 313

BCH 371 Independent Studies in Biochemistry I 3-1-3

This course is not regularly offered and is only meant for final-year students who wish to pursue in-depth study of a particular area of biochemistry or who have a special need for a biochemistry course that would otherwise not be available during their final year of course work. This course can only be done in close collaboration with a faculty advisor from within the Biochemistry program, and may not be used as a supplement to a student's honours project. Requirements for this course will be agreed upon by at least three professors from within the Biochemistry Program.

Prerequisite: Consent of members of the Biochemistry Program.

BCH 372 Independent Studies in Biochemistry II 3-1-3

This course represents an additional semester of independent work, either a continuation of or a separate course from BCH 371, meant for final-year students who wish to pursue in-depth study of a particular area of biochemistry or who have a special need for a biochemistry course that would otherwise not be available during their final semester of course work. This course can only be done in close collaboration with a faculty advisor from within the Biochemistry Program, and may not be used as a supplement to a student's honours project. Requirements for this course will be agreed upon by at least three professors from within the Biochemistry Program.

Prerequisite: Consent of members of the Biochemistry Program.

BCH 381 Immunology 3-3-0

A comprehensive study of the fundamental principles of immunobiology. Intercellular recognition and self/non-self discrimination. Clonal selection theory and genetic basis of antibody diversity. Biochemistry of immunoglobulins. Regulation of immune response and tolerance.

Prerequisites: BIO 201 and BIO 208

BCH 382 Environmental Biochemistry and Toxicology 3-3-0

This course will examine the biochemical effects of environmental stresses on organisms, and adaptations that allow organisms to face these stresses. Emphasis is placed on biochemical responses to toxic compounds such as aromatics, halogenated aliphatics, drugs, and heavy metals. Other topics will include adaptations to stresses such as temperature extremes, pathogens, and ionizing radiation. Applications to related biotechnological processes may also be considered.

Prerequisite: BIO 201 and BIO 208

BCH 383 Molecular Biology 3-3-0

The molecular biology of nucleic acids and proteins, including DNA replication, mutation, and recombination; RNA transcription; and protein synthesis. Also covered will be protein/nucleic acid interactions and regulation of gene expression.

Prerequisite: BIO 201, BIO 208

BCH 421 Enzymology 3-3-0

Kinetics of enzyme reactions and mechanism of catalysis. Regulation by allosteric effectors and covalent modification. Protein targeting and degradation.

Prerequisites: BCH 311, BCH 312 and BCH 313

BCH 422 Biotechnology 3-3-0

This course will explore the technical approaches used in current research and biotechnology, emphasizing the applications of molecular strategies and processes studied in BCH 383. Both the theoretical and practical aspects of these molecular approaches will be discussed, as well as how these techniques are utilized and how they have changed modern research and medicine.

This course will be offered every second year.

Prerequisite: BCH 383 (may be taken concurrently)

Corequisite: BCL 422

BCL 422 Biotechnology Laboratory 1-0-3

Practical application of several of the techniques introduced in BCH 422.

Prerequisite: BCH 383 (may be taken concurrently)

Corequisite: BCH 422

BCH 491 Honours Research Project I 3-1-6

An introduction to the planning, execution and reporting of biological research. Each student is required to choose a research problem and, in consultation with a departmentally approved supervisor, draw up a formal research proposal of work to be undertaken. The final mark in this course will be based on the research proposal, preliminary research completed on the stated project, and presentation of a poster during the final week of classes. Satisfactory completion of BCH 491 with a minimum mark of 75% is required for enrolment in BCH 492.

Prerequisite: Permission of course coordinator. (Dr. Prusak or Dr. Stroher)

Co-requisite or prerequisite: BIO 386

BCH 492 Honours Research Project II 3-1-12

A continuation of BCH 491, in which the student will complete all research as outlined in the research proposal. The final mark in this course will be based on the quality and amount of research completed, presentation of a departmental seminar during the final week of classes, open to the public, based on research findings, and submission of a final written honours thesis. Enrolment in BCH 492 is conditional upon completing BCH 491 with a minimum mark of 75%.