Transfers from other Universities and Colleges

Students entering a program in the Faculty 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 Faculty 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 Faculty, 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.

Graduation "with Distinction"

The notation "with Distinction" will appear on the transcript of students who graduate with a cumulative average of 80% or more. It is only available for first degree students.

Department of Biology and Biochemistry

Faculty

Patrick Bergeron
B.Sc. (McGill University), Ph.D. (Université de Sherbrooke)
Professor
Research and Honours Project Coordinator

Marylène Boulet
B.Sc. (Université Laval), M.Sc. (Université Laval),
Ph.D. (McMaster University)
Senior Instructor

Estelle Chamoux
Ph.D. (Université de Sherbrooke)
Professor

Kerry Hull
B.Sc. (University of Alberta), Ph.D. (University of Alberta)
Professor

Elizabeth Prusak
M.Sc. Eng. (Tech. Univ., Poland),
Ph.D. (Polish Academy of Science)
Professor

Michael Richardson
B.Sc. (McGill University), M.Sc. (McGill University),
Ph.D. (McGill University)
Associate Professor

Jade Savage
B.Sc. (McGill University), Ph.D. (McGill University)
Professor

Ginny (Virginia) Stroeher
B.Sc. (Montana State University), Ph.D. (University of Washington)
Professor
Chair of the Department

Sarathi Weraduwage
B.Sc. (University of Colombo), Ph.D. (University of Guelph)
Associate Professor

Departmental Overview

Our programs cover a wide range of subjects, all with a focus on the components and processes that make up life. Whether it is studying biologically important molecules or entire ecosystems, our programs are designed to help students gain an understanding of one of the many fields within the life sciences and develop their own abilities to further explore subjects in these fields. Many of our graduates go on to professional and graduate studies in medicine, dentistry, veterinary science, forestry, wildlife biology, physiology, microbiology, and biotechnology; while others go into direct employment in the biotechnology sector, conservation, agriculture, education, or the allied health fields. The best attribute of our department is its teachers. Our faculty members are dedicated to undergraduate education and thrive on helping students develop their knowledge and skills both inside and outside the classroom. This dedication, coupled with a strong faculty culture of inquiry and research, encourages students to develop an analytical approach to investigating the world around them. This is further facilitated by a focus on hands-on learning in our modern

and well-equipped laboratory facilities. For those students interested in biochemistry or health sciences, our proximity and continued collaboration with the Université de Sherbrooke provides our students, both Francophone and Anglophone, access to some of the leading researchers in Canada in biochemistry, physiology, cellular and molecular biology, medicine, and microbiology. For those interested in ecology, the rural setting of Bishop's coupled with its proximity to many different natural habitats such as bogs, lakes, rivers, mountains, marshes, forests and meadows, provides exceptional opportunities for field study and research in biodiversity, ecology and conservation. Our varied facilities and opportunities allow a student to work in a modern biochemistry lab one afternoon and canoe a river the next.

Program Overviews

The Department of Biology and Biochemistry offers several degrees; a Bachelor of Science (B.Sc.) in Biochemistry, a Bachelor of Science (B.Sc.) in Biology, a Bachelor of Arts (B.A.) in Biology, and Minors in both Biochemistry and Biology. The B.Sc. and B.A. degrees in Biology offer two concentrations, a health sciences concentration and a biodiversity and ecology concentration. Below is a brief overview of the different degree programs offered, and details about the courses and requirements for each program follow. For information regarding the entrance requirements to any of these programs, please refer to the Natural Sciences Faculty page for information on *Faculty Requirements*.

B.Sc. Biochemistry Honours HONBCH

Students in the B.Sc. Biochemistry honours program may not enter this program until the start of their final year and after consultation with the Biology and Biochemistry honours project coordinator. To qualify for entrance a student must: (1) have a minimum cumulative average of 75% at the end of their Y3 year, and (2) have a mark of 75% or better in each 300- and 400-level Biology or Biochemistry course, with a maximum permitted exemption of four credits (one lecture and one laboratory course) that can be below 75%. Once in the program, students must: (1) maintain a minimum cumulative average of 75%, (2) achieve at least 75% in each 300- and 400-level Biology or Biochemistry course, including the maximum permitted exemption as noted above, and (3) achieve at least 75% in each of the honours research courses *(BCH 491 and BCH 492)*. Honours Biochemistry students must complete an additional *four courses: Scientific Writing (BIO 386), Honours Seminar (BIO 490), and the two honours research courses (BCH 491 and BCH 492)*. For more information, contact the research and honours project coordinator.

B.Sc. Biochemistry Major MAJBCH

*The B.Sc. Biochemistry major program provides students with a strong grounding in the core sciences (math and physics) as well as a broad foundation in chemistry, biochemistry and biology. Students graduating with a B.Sc. in Biochemistry will be ready to enter *graduate studies (M.Sc. or Ph.D.) or professional schools (e.g. medicine, dentistry, physiotherapy, or veterinary medicine).

Biochemistry Minor MINBCH

The Biochemistry Minor program consists of eight courses. Five of these courses are required, and three are optional. The minor allows students majoring in a different field to obtain a solid overview of modern biochemistry.

B.Sc. Biology Honours HONBIO

Students in the B.Sc. Biology honours program have the choice between one of two concentrations, Health Sciences or Biodiversity and Ecology. Students should declare their concentration no later than the end of the Y2 year. Students may not enter the honours program until the start of their final year and after consultation with the Biology and Biochemistry honours project coordinator. To qualify for entrance a student must: (1) have a minimum cumulative average of 75% at the end of their Y3 year, and (2) have a mark of 75% or better in each 300- and 400-level Biology or Biochemistry course, with a maximum permitted exemption of four credits (one lecture and one laboratory course) that can be below 75%. Once in the program, students must: (1) maintain a minimum cumulative average of 75%, (2) achieve at least 75% in each 300- and 400-level Biology or Biochemistry course, including the maximum permitted exemption as noted above, and (3) achieve at least 75% in each of the honours research courses (*BIO 492 and BIO 493*). Honours Biology students must complete an additional *four courses: Scientific Writing (BIO 386), Honours Seminar (BIO 490), and the two honours research courses (BIO 492 and BIO 493)*. For more information, contact the research and honours project coordinator.

B.Sc. Biology Major MAJBIO

The B.Sc. Biology major programs provide students with a strong grounding in the core sciences (math, physics, and chemistry) and a broad foundation in biology. Students graduating with a B.Sc. in Biology will be ready to enter graduate studies (M.Sc. or Ph.D.) or professional schools (e.g. medicine, dentistry, physiotherapy, or veterinary medicine). As with the Biology honours program, students must choose between one of two concentrations, Health Sciences or Biodiversity and Ecology. Students should declare their concentration no later than the end of the Y2 year.

B.A. Biology Major MAJBIO

The B.A. Biology major programs are designed with fewer required courses than the B.Sc. programs, allowing students to complete a second major in their 120-credit degree. This is ideal for students interested in pursuing a double major (such as Biology with a second degree in Psychology, Political Science, Business, or Environmental Studies.), while providing a solid foundation in the biological sciences. The B.A. Biology degree provides adequate preparation for some, but not all, professional and graduate programs. Students are advised to consult with officials of the specific post-graduate institution of interest. As with the Biology B.Sc. programs, students must choose between one of two concentrations, Health Sciences or Biodiversity and Ecology. Students should declare their concentration no later than the end of the Y2 year.

Biology Minor MINBIO

The Biology Minor program consists of eight courses in different areas of Biology. Five of these courses are required, and three are optional. The minor allows students majoring in a different field to obtain a solid overview of modern biology.

Program Details

Please note that many courses have associated labs featuring the same course number but a CHL/BCL/BIL code. Lab credits do not count towards the total credit requirements of the program, and the co-requisite lab must be passed to receive credit for the course.

B.Sc. Biochemistry Honours HONBCH

The Biochemistry B.Sc. Honours program requires 120 lecture credits (40 lecture courses) plus associated labs. The 120-credits are divided as follows: 78 required course credits (26 lecture courses), 21 required option course credits (7 lecture courses), 15 free option course credits (5 lecture courses, including 1 in the Y1 year), and 6 humanities credits (2 lecture courses). Please note that lab credits do not count towards the final 120 credits to complete a program, and no course can be counted in more than one category in a program (ex. required course, required option, or free option). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1. Y1 year (10 courses)

BIO 196/BIL 196	Introduction to Cellular and Molecular Biology
CHM 191/CHL 191	General Chemistry I
CHM 192/CHL 192	General Chemistry II
MAT 191	Calculus I
MAT 192	Calculus II
PHY 191/PHL 191	Introductory Physics I
PHY 192/PHL 192	Introductory Physics II

2 Humanities Option Courses *(one writing intensive course recommended)*
1 Free Option Course

2. Required Courses (15 courses)

BCH 210	General Biochemistry
BCH 311	Proteins
BCH 312	Lipids and Biomembranes
BCH 313/BCL 313	Metabolism
BCH 411	Molecular Biology
BIO 201	Cellular and Molecular Biology
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
CHM 111/CHL111	Organic Chemistry I: Introductory
CHM 135/CHL 135	Physical Chemistry – Thermal and Fluid Physics
CHM 141/CHL 141	Analytical Chemistry
CHM 211/CHL 211	Organic Chemistry II: Introductory
*CHM 245/CHL 245	Instrumental Analysis
*CHM 341/CHL 341	Principles and Practices of Chemical Spectroscopy and Mass Spectrometry
PHY 101	Statistical Methods in Experimental Science

** These courses are offered in alternate years*

3. Required Honours Courses (4 courses)

BIO 386	Scientific Writing
BIO 490	Honours Seminar
BCH 491	Honours Research Project I
BCH 492	Honours Research Project II

4. Required Option Courses (7 courses)

BCH 317 Plant Biochemistry for Human Health & Nutrition
BCH 342 Bioinformatics
BCH 380 Steroids and Their Essential Roles in Humans
BCH 381 Immunology
BCH 382 Principles of Toxicology
BCH 421 Enzymes in Health and Disease
BCH 422/BCL 422 Biotechnology
BCH 460 Plant Biotechnology for Crop Improvement
BIO 310 Cell Biology
BIO 311 Quantitative Methods
BIO 320 Programmed Cell Death
BIO 334 Epidemiology
BIO 337/BIL 337 Animal Physiology II
BIO 345 Plant Physiology
BIO 352/BIL 352 Microbiology
BIO 359 Human Genetics
BIO 365 Developmental Biology
BIO 391 Experiential Learning in Health Sciences & Biochemistry
BIO 394 Biology of Cancer
CHM 311 Organic Chemistry III
CHM 411 Organic Chemistry IV
PBI 380 Psychopharmacology

5. Free Options (4 courses)

B.Sc. Biochemistry Major MAJBCH

The Biochemistry B.Sc. Major program requires 120 lecture credits (40 lecture courses) plus associated labs. The 120-credits are divided as follows: 66 required course credits (22 lecture courses), 21 required option course credits (7 lecture courses), 27 free option course credits (9 lecture courses, including 1 in the Y1 year), and 6 humanities credits (2 lecture courses). Please note that lab credits do not count towards the final 120 credits to complete a program, and no course can be counted in more than one category in a program (ex. required course, required option, or free option). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1. Y1 year (10 courses)

BIO 196/BIL 196	Introduction to Cellular and Molecular Biology
CHM 191/CHL 191	General Chemistry I
CHM 192/CHL 192	General Chemistry II
MAT 191	Calculus I
MAT 192	Calculus II
PHY 191/PHL 191	Introductory Physics I
PHY 192/ PHL 192	Introductory Physics II

2 Humanities Option Courses *(one writing intensive course recommended)*
1 Free Option Course

2. Required Courses (15 courses)

BCH 210	General Biochemistry
BCH 311	Proteins
BCH 312	Lipids and Biomembranes
BCH 313/BCL 313	Metabolism
BCH 411	Molecular Biology
BIO 201	Cellular and Molecular Biology
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
CHM 111/CHL 111	Organic Chemistry I: Introductory
CHM 135/CHL 135	Physical Chemistry – Thermal and Fluid Physics
CHM 141/CHL 141	Analytical Chemistry
CHM 211/CHL 211	Organic Chemistry II: Introductory
*CHM 245/CHL 245	Instrumental Analysis
*CHM 341/CHL 341	Principles and Practices of Chemical Spectroscopy and Mass Spectrometry
PHY101	Statistical Methods in Experimental Science

** These courses are offered in alternate years.*

3. Required Option Courses (7 courses)

BCH 317 Plant Biochemistry for Human Health & Nutrition
BCH 342 Bioinformatics
BCH 380 Steroids and Their Essential Roles in Humans
BCH 381 Immunology
BCH 382 Principles of Toxicology
BCH 421 Enzymes in Health and Disease
BCH 422/BCL 422 Biotechnology
BCH 460 Plant Biotechnology for Crop Improvement
BIO 310 Cell Biology
BIO 311 Quantitative Methods
BIO 320 Programmed Cell Death
BIO 334 Epidemiology
BIO 337/BIL 337 Animal Physiology II
BIO 345 Plant Physiology
BIO 352/BIL 352 Microbiology
BIO 359 Human Genetics
BIO 365 Developmental Biology
BIO 386 Scientific Writing
BIO 391 Experiential Learning in Health Sciences & Biochemistry
BIO 394 Biology of Cancer
CHM 311 Organic Chemistry III
CHM 411 Organic Chemistry IV
PBI 380 Psychopharmacology

4. Free Option Courses (8 courses)

Biochemistry Minor

MINBCH

The Biochemistry Minor program requires 24 lecture credits (8 lecture courses) plus associated labs. The 24-credits are divided as follows: 15 required course credits (5 lecture courses) and 9 required option course credits (3 lecture courses). Please note that lab credits do not count towards the final 24 credits to complete the minor, and no course can be counted in more than one category in the program (ex. required course and required option course). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1. Required Courses: (5 courses)

BCH 311	Proteins
BCH 312	Lipids and Biomembranes
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
CHM 141/CHL 141	Analytical Chemistry

2. Required Option Courses (3 courses)

BCH 313/BCL 313	Metabolism
BCH 317	Plant Biochemistry for Human Health and Nutrition
BCH 381	Immunology
BCH 411	Molecular Biology
BCH 421	Enzymes in Health and Disease
BIO 310	Advanced Cell Biology
BIO 320	Programed Cell Death
BIO 337/BIL 337	Animal Physiology II
BIO 352/BIL 352	Microbiology
BIO 394	Biology of Cancer
CHM 211/CHL 211	Organic Chemistry II

B.Sc. Biology Honours: Health Sciences Concentration HONBHS

The Biology B.Sc. Honours program (Health Sciences) requires 120 lecture credits (40 lecture courses) plus associated labs. The 120-credits are divided as follows: 75 required course credits (25 lecture courses), 21 required concentration option course credits (7 lecture courses), 18 free option course credits (6 lecture courses, including 1 in the Y1 year), and 6 humanities credits (2 lecture courses). Please note that lab credits do not count towards the final 120 credits to complete a program, and no course can be counted in more than one category in a program (ex. required course, required option, or free option). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1. Y1 year (10 courses)

BIO 196/BIL 196	Introduction to Cellular and Molecular Biology
CHM 191/CHL 191	General Chemistry I
CHM 192/CHL 192	General Chemistry II
MAT 191	Calculus I
MAT 192	Calculus II
PHY 191/PHL 191	Introductory Physics I
PHY 192/PHL 192	Introductory Physics II

2 Humanities Option Courses *(one writing intensive course recommended)*
1 Free Option Course

2. Required core courses (7 courses)

BIO 201	Cellular and Molecular Biology
BIO 205/BIL 205	Animal Diversity
BIO 206	Plant Diversity
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
CHM 111/CHL 111	Organic Chemistry I: Introductory
PHY101	Statistical Methods in Experimental Science

3. Required Concentration Courses (7 courses)

BCH210	General Biochemistry
BCH 313/BCL 313	Metabolism
BIO 233	Human Anatomy
BIO 311	Quantitative Methods in Biology **or**
BCH 342	Bioinformatics (Principles and Practical Approaches)
BIO 337/BIL 337	Animal Physiology II
BIO 352/BIL 352	Microbiology **or**
BIO 334	Epidemiology
PSY 101	Introduction to Psychology I: Basic Processes

4. Required Honours Courses (4 courses)

BIO 386	Scientific Writing
BIO 490	Honours Seminar
BIO 492	Honours Research Project I
BIO 493	Honours Research Project II

5. Concentration Option Courses (7 courses, at least 5 BIO or BCH)

BIO 310 Advanced Cell Biology
BIO 311 Quantitative Methods in Biology
BIO 315 Frontiers of Biology, Past to Present
BIO 320 Programmed Cell Death
BIO 334 Epidemiology
BIO 341 Population Genetics and Evolution
BIO 349 Medical and Forensic Entomology
BIO 352/BIL 352 Microbiology
BIO 359 Human Genetics
BIO 365 Developmental Biology
BIO 391 Experiential Learning in Health Sciences & Biochemistry
BIO 394 Biology of Cancer
BIO 411 Seminars in Health Sciences
BIO 428 Advanced Physiology
BIO 520 Science Communication
BCH 311 Proteins
BCH 312 Lipids and Biomembranes
BCH 317 Plant Biochemistry for Human Health & Nutrition
BCH 342 Bioinformatics
BCH 380 Steroids and Their Essential Roles in Humans
BCH 381 Immunology
BCH 382 Principles of Toxicology
BCH 411 Molecular Biology
BCH 421 Enzymes in Health and Disease
BCH 422/BCL 422 Biotechnology
CHM 211/CHL 211 Organic Chemistry II
EXS 317 Biomechanics of Human Movement
PBI 379 Neuropsychology
PBI 380 Psychopharmacology

6. Free Options (5 courses)

Note: Students considering application to medical school may want to consider taking either CS 201/CSL 201 Foundations of Computer Science or CS 211/CSL 211 Introduction to Programming as one of their free option courses.

B.Sc. Biology Major: Health Sciences Concentration MAJBHS

The Biology B.Sc. Major program (Health Sciences) requires 120 lecture credits (40 lecture courses) plus associated labs. The 120-credits are divided as follows: 63 required course credits (21 lecture courses), 21 required concentration option course credits (7 lecture courses), 30 free option course credits (10 lecture courses, including 1 in the Y1 year), and 6 humanities credits (2 lecture courses). Please note that lab credits do not count towards the final 120 credits to complete a program, and no course can be counted in more than one category in a program (ex. required course, required option, or free option). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1. Y1 year (10 courses)

BIO 196/BIL 196	Introduction to Cellular and Molecular Biology
CHM 191/CHL 191	General Chemistry I
CHM 192/CHL 192	General Chemistry II
MAT 191	Calculus I
MAT 192	Calculus II
PHY 191/PHL 191	Introductory Physics I
PHY 192/ PHL 192	Introductory Physics II

2 Humanities Option Courses *(one writing intensive course recommended)*
1 Free Option Course

2. Required core courses (7 courses)

BIO 201	Cellular and Molecular Biology
BIO 205/BIL 205	Animal Diversity
BIO 206	Plant Diversity
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
CHM 111/CHL 111	Organic Chemistry I: Introductory
PHY 101	Statistical Methods in Experimental Science

3. Required Concentration Courses (7 courses)

BCH 210	General Biochemistry
BCH 313/BCL 313	Metabolism
BIO 233	Human Anatomy
BIO 311	Quantitative Methods in Biology **or**
BCH 342	Bioinformatics (Principles and Practical Approaches)
BIO 337/BIL 337	Animal Physiology II
BIO 352/BIL 352	Microbiology **or**
BIO 334	Epidemiology
PSY 101	Introduction to Psychology I: Basic Processes

4. Concentration Option Courses (7 courses, at least 5 BIO or BCH)

BIO 310 Advanced Cell Biology
BIO 311 Quantitative Methods in Biology
BIO 315 Frontiers of Biology, Past to Present
BIO 320 Programmed Cell Death
BIO 334 Epidemiology
BIO 341 Population Genetics and Evolution
BIO 349 Medical and Forensic Entomology
BIO 352/BIL 352 Microbiology
BIO 359 Human Genetics
BIO 365 Developmental Biology
BIO 386 Scientific Writing
BIO 391 Experiential Learning in Health Sciences & Biochemistry
BIO 394 Biology of Cancer
BIO 411 Seminars in Health Sciences
BIO 428 Advanced Physiology
BIO 520 Science Communication
BCH 311 Proteins
BCH 312 Lipids and Biomembranes
BCH 317 Plant Biochemistry for Human Health & Nutrition
BCH 342 Bioinformatics
BCH 380 Steroids and Their Essential Roles in Humans
BCH 381 Immunology
BCH 382 Principles of Toxicology
BCH 411 Molecular Biology
BCH 421 Enzymes in Health and Disease
BCH 422/BCL 422 Biotechnology
CHM 211/CHL 211 Organic Chemistry II
EXS 317 Biomechanics of Human Movement
PBI 379 Neuropsychology
PBI 380 Psychopharmacology

5. Free Options (9 courses)

Note: Students considering application to medical school may want to consider taking either *CS 201/CSL 201 Foundations of Computer Science* or *CS 211/CSL 211 Introduction to Programming* as one of their free option courses.

B.A. Biology Major: Health Studies Concentration MAJBHS

The Biology B.A. Major program (Health Sciences) requires 120 lecture credits (40 lecture courses) plus associated labs. The 120-credits are divided as follows: 33 required course credits (11 lecture courses), 18 required concentration option course credits (6 lecture courses), 63 free option course credits (21 lecture courses, including 7 in the Y1 year), and 6 humanities credits (2 lecture courses). Please note that lab credits do not count towards the final 120 credits to complete a program, and no course can be counted in more than one category in a program (ex. required course, required option, or free option). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1. Y1 year (10 courses)

BIO 196/BIL 196 Introduction to Cellular and Molecular Biology
2 Humanities Option Courses *(one writing intensive course recommended)*
Free Options (7 courses)

2. Required core courses (6 courses)

BIO 201	Cellular and Molecular Biology
BIO 205/BIL 205	Animal Diversity
BIO 206	Plant Diversity
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
PHY 101	Statistical Methods in Experimental Science

3. Required Concentration Courses (4 courses)

BIO 233	Human Anatomy
BIO 315	Frontiers of Biology, From Past to Present
BIO 337/BIL 337	Animal Physiology II
PSY 101	Introduction to Psychology I: Basic Processes

4. Concentration Option Courses (6 courses, at least 5 BIO or BCH)

BIO 310 Advanced Cell Biology
BIO 311 Quantitative Methods in Biology
BIO 320 Programmed Cell Death
BIO 334 Epidemiology
BIO 341 Population Genetics and Evolution
BIO 349 Medical and Forensic Entomology
BIO 352/BIL 352 Microbiology
BIO 359 Human Genetics
BIO 365 Developmental Biology
BIO 386 Scientific Writing
BIO 391 Experiential Learning in Health Sciences & Biochemistry
BIO 394 Biology of Cancer
BIO 411 Seminars in Health Sciences
BIO 428 Advanced Physiology
BIO 520 Science Communication
BCH 210 General Biochemistry
BCH 311 Proteins
BCH 312 Lipids and Biomembranes
BCH 317 Plant Biochemistry for Human Health & Nutrition
BCH 342 Bioinformatics
BCH 381 Immunology
BCH 382 Principles of Toxicology
BCH 411 Molecular Biology
BCH 421 Enzymes in Health and Disease
BCH 422/BCL 422 Biotechnology
EXS 317 Biomechanics of Human Movement
PBI 379 Neuropsychology
PBI 380 Psychopharmacology

5. Free Options (14 courses)

Note: Students considering application to medical school may want to consider taking either *CS 201/CSL 201 Foundations of Computer Science* or *CS 211/CSL 211 Introduction to Programming* as one of their free option courses.

B.Sc. Biology Honours: Biodiversity and Ecology Concentration HONBDE

The Biology B.Sc. Honours program (Biodiversity and Ecology) requires 120 lecture credits (40 lecture courses) plus associated labs. The 120-credits are divided as follows: 75 required course credits (25 lecture courses), 21 required concentration option course credits (7 lecture courses), 18 free option course credits (6 lecture courses, including 1 in the Y1 year), and 6 humanities credits (2 lecture courses). Please note that lab credits do not count towards the final 120 credits to complete a program, and no course can be counted in more than one category in a program (ex. required course, required option, or free option). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1.Y1 year (10 courses)

BIO 196/BIL 196	Introduction to Cellular and Molecular Biology
CHM 191/CHL 191	General Chemistry I
CHM 192/CHL 192	General Chemistry II
MAT 191	Calculus I
MAT 192	Calculus II
PHY 192/PHL 192	Introductory Physics I
PHY 191/PHL 191	Introductory Physics II

2 Humanities Option Courses *(one writing intensive course recommended)*
1 Free Option Course
Note: Students who attained >75% in BIO 196 may consider taking *BIO 207 Introduction to Evolution and Ecology* in their Y1 year

2. Required core courses (7 courses)

BIO 201	Cellular and Molecular Biology
BIO 205/BIL 205	Animal Diversity
BIO 206	Plant Diversity
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
CHM 111/CHL 111	Organic Chemistry I: Introductory
PHY 101	Statistical Methods in Experimental Science

3. Required Concentration Courses (7 courses)

BIO 207	Introduction to Evolution and Ecology
BIO 311	Quantitative Methods in Biology
BIO 327	Advanced Ecology
BIO 329/BIL 329	Invertebrate Biology
BIO 338	Vertebrate Life I: An Introduction to Ichthyology and Herpetology **or**
BIO 339	Vertebrate Life II: An Introduction to Ornithology and Mammalogy
BIO 345	Plant Physiology
ESG 127	Living in the Environment

4. Required Honours Courses (4 courses)

BIO 386	Scientific Writing
BIO 490	Honours Seminar
BIO 492	Honours Research Project I
BIO 493	Honours Research Project II

5. Concentration Option Courses (7 courses, at least 5 BIO or BCH)

BIO 209 Introduction to Animal Behaviour
BIO 219 Vertebrate Field Identification
BIO 315 Frontiers of Biology, Past to Present
BIO 331 Freshwater Biology
BIO 334 Epidemiology
BIO 337/BIL 337 Animal Physiology II
BIO 338 Vertebrate Life I
BIO 339 Vertebrate Life II
BIO 341 Population Genetics and Evolution
BIO 349 Medical and Forensic Entomology
BIO 352/BIL 352 Microbiology
BIO 354 Insect Biodiversity
BIO 358/BIL 358 Animal Behaviour
BIO 392 Experiential Learning in Biodiversity & Ecology
BIO 412 Seminars in Biodiversity and Ecology
BIO 520 Science Communication
BCH 313/BCL 313 Metabolism
BCH 342 Bioinformatics
BCH 382 Principles of Toxicology
BCH 460 Plant Biotechnology in Crop Improvement
ESG 262 Introduction to GIS

6. Free Option Courses (5 courses)

B.Sc. Biology Major: Biodiversity and Ecology Concentration MAJBDE

The Biology B.Sc. Major program (Biodiversity and Ecology) requires 120 lecture credits (40 lecture courses) plus associated labs. The 120-credits are divided as follows: 63 required course credits (21 lecture courses), 21 required concentration option course credits (7 lecture courses), 30 free option course credits (10 lecture courses, including 1 in the Y1 year), and 6 humanities credits (2 lecture courses). Please note that lab credits do not count towards the final 120 credits to complete a program, and no course can be counted in more than one category in a program (ex. required course, required option, or free option). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1. Y1 year (10 courses)

BIO 196/BIL 196	Introduction to Cellular and Molecular Biology
CHM 191/CHL 191	General Chemistry I
CHM 192/CHL 192	General Chemistry II
MAT 191	Calculus I
MAT 192	Calculus II
PHY 191/PHL 191	Introductory Physics I
PHY 192/PHL 192	Introductory Physics II

2 Humanities Option Courses *(one writing intensive course recommended)*
1 Free Option Course
Note: Students who attained >75% in BIO 196 may consider taking *BIO 207 Introduction to Evolution and Ecology* in their Y1 year.

2. Required core courses (7 courses)

BIO 201	Cellular and Molecular Biology
BIO 205/BIL 205	Animal Diversity
BIO 206	Plant Diversity
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
CHM 111/CHL 111	Organic Chemistry I: Introductory
PHY 101	Statistical Methods in Experimental Science

3. Required Concentration Courses (7 courses)

BIO 207	Introduction to Evolution and Ecology
BIO 311	Quantitative Methods in Biology
BIO 327	Advanced Ecology
BIO 329/BIL 329	Invertebrate Biology
BIO 338	Vertebrate Life I: An Introduction to Ichthyology and Herpetology **or**
BIO 339	Vertebrate Life II: An Introduction to Ornithology and Mammalogy
BIO 345	Plant Physiology
ESG 127	Living in the Environment

4. Concentration Option Courses (7 courses, at least 5 BIO or BCH)

BIO 209 Introduction to Animal Behaviour
BIO 219 Vertebrate Field Identification
BIO 315 Frontiers of Biology, Past to Present
BIO 331 Freshwater Biology
BIO 334 Epidemiology
BIO 337/BIL 337 Animal Physiology II
BIO 338 Vertebrate Life I
BIO 339 Vertebrate Life II
BIO 341 Population Genetics and Evolution
BIO 349 Medical and Forensic Entomology
BIO 352/BIL 352 Microbiology
BIO 354 Insect Biodiversity
BIO 358/BIL 358 Animal Behaviour
BIO 386 Scientific Writing
BIO 392 Experiential Learning in Biodiversity & Ecology
BIO 412 Seminars in Biodiversity and Ecology
BIO 520 Science Communication
BCH 313/BCH 313 Metabolism
BCH 342 Bioinformatics
BCH 382 Principles of Toxicology
BCH 460 Plant Biotechnology in Crop Improvement
ESG 262 Introduction to GIS

5. Free Options (9 courses)

B.A. Biology Major: Biodiversity and Ecology Concentration MAJBDE

The Biology B.A. Major program (Biodiversity and Ecology) requires 120 lecture credits (40 lecture courses) plus associated labs. The 120-credits are divided as follows: 33 required course credits (11 lecture courses), 18 required concentration option course credits (6 lecture courses), 63 free option course credits (21 lecture courses, including 7 in the Y1 year), and 6 humanities credits (2 lecture courses). Please note that lab credits do not count towards the final 120 credits to complete a program, and no course can be counted in more than one category in a program (ex. required course, required option, or free option). As well, if a co-requisite lab course is not offered in the semester that the lecture course is completed, the co-requisite is waived.

1. Y1 year (10 courses)

BIO 196/BIL 196 Introduction to Cellular and Molecular Biology
2 Humanities Option Courses *(one writing intensive course recommended)*
Free Options (7 courses)

2. Required core courses (6 courses)

BIO 201	Cellular and Molecular Biology
BIO 205/BIL 205	Animal Diversity
BIO 206	Plant Diversity
BIO 208/BIL 208	Genetics
BIO 336	Animal Physiology I
PHY 101	Statistical Methods in Experimental Science

3. Required Concentration Courses (4 courses)

BIO 207	Introduction to Evolution and Ecology
BIO 329/ BIL 329	Invertebrate Biology **or**
BIO 354	Insect Biodiversity
BIO 338	Vertebrate Life I: An Introduction to Ichthyology and Herpetology **or**
BIO 339	Vertebrate Life II: An Introduction to Ornithology and Mammalogy
ESG 127	Living in the Environment

4. Concentration Option Courses (6 courses, at least 5 BIO or BCH)

BIO 209 Introduction to Animal Behaviour
BIO 219 Vertebrate Field Identification
BIO 311 Quantitative Methods in Biology
BIO 315 Frontiers of Biology, Past to Present
BIO 327 Advanced Ecology
BIO 331 Freshwater Biology
BIO 334 Epidemiology
BIO 337/BIL 337 Animal Physiology II
BIO 338 Vertebrate Life I
BIO 339 Vertebrate Life II
BIO 341 Population Genetics and Evolution
BIO 345 Plant Physiology
BIO 349 Medical and Forensic Entomology
BIO 352/BIL 352 Microbiology
BIO 354 Insect Biodiversity
BIO 358/BIL 358 Animal Behaviour
BIO 386 Scientific Writing
BIO 392 Experiential Learning in Biodiversity & Ecology
BIO 412 Seminars in Biodiversity and Ecology
BIO 520 Science Communication
BCH 342 Bioinformatics
BCH 382 Principles of Toxicology
ESG 262 Introduction to GIS

5. Free Options (14 courses)

Biology Minor Requirements

The Biology Minor program requires 24 lecture credits (8 lecture courses) plus associated labs. The 24-credits are divided as follows: 15 required course credits (5 lecture courses) and 9 optional BIO credits (3 courses).

1. Required Courses: (5 courses)

BIO 196/BIL 196	Introduction to Cellular and Molecular Biology
BIO 205/BIL 205	Animal Diversity
BIO 206	Plant Diversity
BIO 207	Introduction to Evolution and Ecology
BIO 208/BIL 208	Genetics

2. Any Three (3) additional BIO courses

List of Courses in Biology and Biochemistry

PLEASE NOTE: The following list of courses represents those courses which are normally offered by the Department of Biology and Biochemistry. However, some courses alternate and thus are only available every second year. Courses offered on an occasional basis are indicated with an asterisk (*). Students should plan their schedules in advance, in consultation with their Academic advisor or Departmental Chair, to ensure that they complete all courses required for graduation. Co-requisite labs (BCL and BIL) must be completed by all students taking the corresponding lecture courses, regardless of major.

Biochemistry courses carry the code BCH (lecture) or BCL (lab)

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: CHM 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.
Prerequisites: CHM 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.
Prerequisites: CHM 111 and BCH 210
Co-requisite: BCL 313

BCL 313 Metabolism Laboratory 1-0-3
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.
Prerequisites: CHM 111 and BCH 210
Co-requisite: BCL 313

BCH 317 Plant Biochemistry for Human Health and Nutrition 3-3-0
This course covers the biochemistry of carbon assimilation and metabolism, and the major secondary metabolic pathways in plants. The significance of carbon assimilation for human nutrition, and the physiological function of secondary metabolites in plants and their impact on human health as vitamins, antioxidants, phytomedicines and nutraceuticals will be discussed in detail. The biochemistry of popular herbs as well as high value medicinal plants such as ginseng and artemisia will be reviewed. Students taking this course will gain a sound knowledge on Plant Biochemistry and the benefits of plant-based foods and other phytochemicals for humans.
Prerequisites: BCH 210, BIO 201 and BIO 208
Prerequisite or Co-requisite: BCH 313
Note: Students may take this course without BCH 313 with instructor's permission only.

BCH 342 Bioinformatics 3-3-0
This course will introduce students to Bioinformatics, which uses computer databases to store, retrieve and assist in understanding biological information.
Prerequisites: BCH 210 and BIO 208

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 a committee of professors from within the Biochemistry Program.
Prerequisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator
Co-requisite: BIO 490

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 a committee of professors from within the Biochemistry Program.
Prerequisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator
Co-requisite: BIO 490

BCH 380 Steroids and Their Essential Roles in Humans 3-3-0
This course will provide in-depth knowledge on the different types of steroids present in the human body including cholesterol, oxysteroids, bile acids, and steroid hormones (adrenal hormones such as cortisol, sex hormones), and vitamin D. The course will cover the synthesis and essential roles of these terpene-based lipids in human physiology ranging from cell signaling, modulation of growth, reproduction and aging. The use of anabolic steroids as performance-enhancing drugs and their effects on human health will be discussed.
Prerequisites: CHM 111, BCH 210 and BIO 201

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 Principles of 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.
Prerequisites: CHM 111, BCH 210, BIO 201, BIO 208

BCH 411 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.
Prerequisites: BCH 210, BIO 201 and BIO 208

BCH 421 Enzymes in Health and Disease 3-3-0
The course will focus on the theories of enzyme kinetics, the mechanisms of enzyme catalysis, and the mechanisms of enzyme regulation in the cell with the particular emphasis on the role of enzymes in human health and disease.
Prerequisite: 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.
Prerequisite or co-requisite: BCH 411
Co-requisite: BCL 422

BCL 422 Biotechnology Laboratory 1-0-3
Practical application of several of the techniques introduced in BCH 422.
Co-requisite: BCH 422

BCH 460 Plant Biotechnology for Crop Improvement 3-3-0
This course will cover in detail the principles, techniques and applications of Plant Biotechnology for crop improvement. Topics such as: the use of Plant Biotechnology tools in plant breeding, genetic engineering and plant transformation techniques, principles and techniques of micropropagation, practical applications of Plant Biotechnology and its significance for agriculture in terms of addressing climate change-mediated challenges on plant productivity, will be reviewed. The health and environmental concerns around genetically modified crops will also be discussed.
Prerequisites: BIO 201 and BIO 208
Prerequisite or Co-requisite: BCH 411
Note: Students may take this course without BCH 411 with instructor's permission only.

BCH 491 Honours Research Project I 3-1-6
An introduction to the planning, execution and reporting of biological research offered to students matching eligibility criteria. 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 overall mark of 75% with a minimal score of 70% in each graded component, is required for enrolment in BCH 492.
Prerequisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator
Co-requisite: BIO 490

BCH 492 Honours Research Project II 3-1-6
A continuation of BCH 491 offered to students matching eligibility criteria. 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%. Satisfactory completion of BIO 492 with a minimum overall mark of 75%, with a minimal score of 70% in each graded component, is required to complete the Honours program.
Prerequisite: BCH 491
Co-requisite: BIO 490

Biology courses carry the code BIO (lecture) or BIL (lab)

BIO 111 Organic Gardening 3-3-0
Our approach stems from the biological sciences. The course introduces, in an integrative manner, concepts and techniques of organic gardening, blending basic notions in soil science, cell biology, applied botany, zoology, and ecology. Students will learn how to sow seeds, grow vegetables through various techniques, and protect crops. The course includes lecture classes, as well as practical hands-on activities in the biology laboratory, greenhouse, and biology garden.
Note: This course is intended for non-science students and can count as science credits within the non-science programs. However, students in any of the science majors may take this course, but only as a free elective.
Note: This course cannot be taken for credit by anyone who already has credit for BIO 211.

BIO 131 The Human Body in Health and Disease 3-3-0
An introduction to human anatomy and physiology. This course will employ problem-based learning, virtual experiments, and traditional lectures to explain the relationship between the structure of the human body and its functions. These concepts will then be applied to the study of representative human diseases. This course is designed for students with minimal biology backgrounds, including arts students, teachers, coaches, and home-care workers. Students will acquire a working knowledge of human biology and the ability to communicate this knowledge to others.
Prerequisites: Secondary school Biology and/or Chemistry recommended
Note: This course cannot be taken for credit by students in Biology or Biochemistry or by students with credit for BIO 233.

Biology 138 The Genetics Revolution 3-3-0
This course is designed for non-science majors to examine the impact of recent genetic discoveries on medicine, agriculture and industry. It will begin with a brief introduction to the genetic organization of all living organisms, the structures of animal, plant and bacterial cells, and the molecular technologies used to alter the genomes of theses organisms for scientific and industrial purposes. The use of these technologies in the biotech industry to develop new drugs, diagnostic tests, alter agriculturally important plant species, and enhance forensic identification will be explored. As well, the potential benefits and possible problems associated with theses technologies to human society as well as ethical questions arising about the use of these new techniques will be discussed. This course cannot be taken for credit by students enrolled in programs in Biochemistry, Biology or Chemistry.

BIO 189 The Science of Covid-19 3-3-0
In 2020 the world experienced unprecedented times with the rapid spread of the first worldwide pandemic. In this course we will look at the Covid-19 pandemic from the very first discovery of a new virus to the most recent developments. Using the Sars-Cov-2 as our focus, we will explore concepts in genetics, cell biology, immunology, and human physiology. This will provide a gateway to understanding the scientific method, clinical studies and science publications. Taught at an introductory level for non-science majors, this course should leave students with a good background knowledge of biology and clinical research. This course should also help students to develop the type of critical thinking skills necessary to evaluate the credibility of information concerning medical research and public health.
Note: This course cannot be taken for credit by students in Biology or Biochemistry or by students with credit for BIO 289.

BIO 194 Introduction to the Biological Sciences 3-3-0
This course provides an introduction to biology for students with no previous science background. Starting with an introduction to the scientific method and a comparison of science and pseudoscience, this course will then give an overview of biology from the very small to the very large. Starting with biologically important macro-molecules, the course moves to basic cell anatomy and physiology, the origin of life, sexual vs asexual reproduction, mendelian genetics, evolutionary theory and natural selection, and finally ecology and ecosystems.
Note: This course cannot be taken for credit by science students without prior consent by the Chair of Biology and Biochemistry. This course may be used as a replacement for BIO196 only if a final mark of 75% or better is achieved. This course cannot be taken for credit by anyone who already has credit for collegial General Biology 2/00XU, BIO 193 or BIO 196.

BIO 196 Introduction to Cell & Molecular Biology 3-3-0
Topics covered include chemistry of life; structure and function of biomolecules; structure and organization of cells; structure and function of organelles, genetic replication and expression; gene mutation; cell signaling; regulation of the cell cycle. This course is intended for B.Sc. students and B.A. (Biology) students; other students are encouraged to take BIO 194.
Prerequisite: High School Biology and Chemistry
Co-requisite: BIL 196
Note: This course cannot be taken for credit by anyone who already has credit for collegial General Biology 2/00XU, BIO 193 or BIO 194.

BIL 196 Introduction to Cellular and Molecular Biology Laboratory 1-0-3
Practical exercises in microscopy, molecular and cellular biology, and histology.
Co-requisite: BIO 196

BIO 201 Cellular and Molecular Biology 3-3-0
Topics in modern cell biology. Examines aspects of eukaryotic cell structure and function. Includes, but not restricted to, areas such as intracellular signaling, cell cycling and cancer, cell-matrix interactions, endo/exocytosis, protein targeting and organelle biogenesis.
Prerequisite: BIO 196
Note: Students who have completed BIO 194 with a mark of 75% or better may take this course with prior consent by the Chair of Biology and Biochemistry.

BIO 205 Animal Diversity 3-3-0
This course complements Plant Diversity, a winter-term course with a focus on prokaryotic and non-animal eukaryotic life. The material in both courses is organized according to a modern phylogenetic framework. In this course students will learn how hypotheses of relationships and classifications are created, tested, and, when necessary, rejected. Focusing on major animal phyla, we will explore the forms, functions, and implications of key adaptations that have arisen throughout the evolutionary history of the group and the timeline for the appearance of major animal taxa will be presented. Selected topics such as high rates of contemporary extinction in certain groups and the relevance of zoology for other fields of study such as medicine, agriculture and engineering will also be discussed.
Prerequisite: BIO 196
Co-requisite: BIL 205
Note: Students who have completed BIO 194 with a mark of 75% or better may take this course with prior consent by the Chair of Biology and Biochemistry.

BIL 205 Animal Diversity Laboratory 1-0-3
The classification, identification, morphology and biology of the animals considered in BIO 205, with emphasis on nine important phyla (Porifera, Cnidaria, Platyhelminthes, Nematoda, Mollusca, Annelida, Arthropoda, Echinodermata, and Chordata). Science skills and competencies: observation; identification; fine manipulation; basic microscopy; basic dissection; introduction to phylogenetic analysis; relationships between form, function and habitat; comparison between taxa; lab safety; time-management; team-work.
Co-requisite: BIO 205

BIO 206 Plant Diversity 3-3-0
Broad evolutionary survey of green plant diversity, from green algae to land plants (bryophytes, ferns, gymnosperms, angiosperms) with emphasis on specific adaptations. Classes include a mixture of lecture and practical activities in lab or greenhouse. Science skills and competencies: observation; identification; basic microscopy; basic spectrophotometry; growing plants from seeds; relationships between form, function and habitat; comparison and trade-off; phylogenetic analysis (by computer); scientific curiosity.
Prerequisite: BIO 205

BIO 207 Introduction to Evolution and Ecology 3-3-0
This course will start by looking at the development of modern evolutionary theory before exploring natural selection and speciation. This course will then explore some of the basic principles of ecology, including species interactions such as predation and competition, and how these interactions help structure the complex web of life that helps form ecological communities and ecosystems. Although intended for Biology majors, students from other programs may also take this course with the instructor's permission.
Prerequisite: BIO 205 or prior consent by the Chair of Biology and Biochemistry
Note: This course cannot be taken for credit by anyone who already has credit for BIO 197.

BIO 208 Genetics 3-3-0
An introduction to the study of biologically inherited traits from three perspectives. (i) Mendelian Genetics: the rules of genetic transmission and heredity. (ii) Molecular Genetics: the biochemical and chromosomal basis of heredity. (iii) Population & Evolutionary Genetics: the variation in genes amongst individuals and populations, heritability, and changes in genes over time.
Prerequisite: BIO 201
Co-requisite: BIL 208
Note: Students who have completed BIO 194 with a mark of 75% or better may take this course with prior consent by the Chair of Biology and Biochemistry.

BIL 208 Genetics Laboratory 1-0-3
Various experiments and exercises in the field of genetics activities that are designed to complement topics discussed in BIO 208 and to learn or improve laboratory skills in the field of genetics.
Co-requisite: BIO 208

BIO 209 Introduction to Animal Behaviour 3-3-0
This course is an introduction to the science of animal behaviour. Subjects covered will include: a history of the discipline; natural selection and animal behaviour, a comparison of animal sensory and nervous systems; animal intelligence and learning; mating systems; predation and predator avoidance; and social behaviour and cooperation.
Prerequisites: BIO 194 or BIO 196
Antirequisites: Cannot be taken for credit if BIO 358 has already been taken

BIO 211 Sustainable Organic Agriculture 3-3-0
Our approach stems from the biological sciences. The course introduces, in an integrative manner, concepts and techniques of organic gardening, blending basic notions in soil science, cell biology, applied botany, zoology, and ecology. Students will learn how to sow seeds, grow vegetables through various techniques, and protect crops. The course includes lecture classes, as well as practical hands-on activities in the biology laboratory, greenhouse, and biology garden. This course has a co-requisite laboratory component (field projects completed in teams). Some experience in biology lab or field courses (university level) is required.
Prerequisites: BIO 205 and BIO 206 or permission of the instructor if the student can demonstrate a suitable background knowledge of the necessary material.
Co-requisite: BIL 211
Note: This course is intended for students in the science programs, such as biology and biochemistry, and counts as a science course in a science program.
Note: This course cannot be taken for credit by anyone who already has credit for BIO 111.

BIL 211 Sustainable Organic Agriculture Lab 1-0-3
This lab course requires students to work in small teams on a variety of projects around campus. Central to each project will be the integration of principles learned in the organic agriculture lecture. Examples of such projects might include the development of an ecologically friendly butterfly garden; integrated plantings to minimize crop damage; design and installation of a bioswale system; or monitoring and control of entomological pests on campus. Students should be aware that most of these projects will involve outdoor field work which includes working in all weather conditions, getting bitten or stung by insects, and in general getting dirty.
Co-requisite: BIO 211

BIO 219 Vertebrate Field Identification 3-3-0
This course will be focussed on vertebrate field techniques. Students should be prepared to work outside every week except for the last 2-3 weeks when we will move indoors to perform dissections and work with preserved material. To achieve the most from this course students are advised to take either BIO 338 Vertebrate Life I or BIO 339 Vertebrate Life II at the same time, however this is not mandatory. All students will need to provide their own binoculars, dissection kit, life vest, and waders.
Prerequisite: BIO 205
Antirequisite: Students may not take this course for credit if they have taken BIL 339

BIO 233 Human Anatomy 3-3-0
The anatomy of all of the major body systems will be discussed in the context of human health and disease. This course is designed for students interested in the biomedical sciences or health education. Students will develop their understanding of human anatomy and will acquire the ability to communicate scientific concepts to their patients or students.
Prerequisite: BIO 196 or EXS 127
Note: This course cannot be taken for credit by anyone who already has credit for BIO 131.

BIO 289 Biological Spotlight on Covid-19 3-3-0
In 2020 the world experienced unprecedented times with the rapid spread of the first worldwide pandemic. In this course we will look at the Covid-19 pandemic from the very first discovery of a new virus to the most recent developments. Using the Sars-Cov-2 as our focus, we will build on knowledge acquired from previous courses in cell biology and human physiology to understand the genetics, cell biology, immunology, and human physiology behind Covid-19. These topics will provide a gateway to understanding the scientific method, clinical studies and science publications. This course should help students synthesize information and create links between concepts taught in different courses. Students will also develop critical thinking skills necessary to evaluate the credibility of information concerning medical research and public health. Throughout this course, emphasis will be put on interactions between science and non-science students.
Prerequisites: BIO 201 and BIO 233
Note: This course cannot be taken for credit by anyone who already has credit for BIO 189.

BIO 310 Advanced Cell Biology 3-3-0
Advanced topics in modern cell biology. Examines aspects of eukaryotic cell structure and function. Using a hands-on approach and modern research methods, students will develop a deep understanding of intracellular protein trafficking, cell-cycle and cancer, cytoskeleton and extracellular matrix, gene expression, stem cells differentiation and organelle biogenesis.
Prerequisites: BIO 201 and BIO 208

BIO 311 Quantitative Methods in Biology 3-3-0
The main objective of this course is to teach how to use statistics to answer practical questions in the life and health sciences, focusing on real life datasets. We also pay particular attention to learning how to draw high quality statistical figures and to produce result summary tables. We critically assess study designs and cover data management methods. This course is in the computer lab and uses the free statistical software R.
Prerequisites: BIO 208 and PHY 101

BIO 315 Frontiers of Biology, From Past to Present 3-3-0
This course is for upper year biology students who already have a good understanding of complex concepts like human DNA sequencing, genomics, cell biology, and human anatomy and physiology. Topics covered include the history of genetics and human evolution, cell theory, chromosomes, mitosis and meiosis, human fertilization and heredity, recent advances in pharmacogenomics, genetic selection, and the CRISPR technology for DNA editing. The goal of this course is to broaden student's understanding on the development and acceptance of such discoveries and to ultimately understand that what they learnt in their first 2 or 3 years in biology is knowledge built from several non-linear steps that will likely go on evolving and developing in future years.
Prerequisites: BIO 205 and BIO 208

BIO 320 Programmed Cell Death 3-3-0
Programmed cell death, also called apoptosis, is a normal physiological process that takes place in every type of cell in the animal kingdom. It plays a critical role in embryo development, in selective processes (immune system), in degenerative diseases and in cancer. Since the early 90's, programed cell death is one of the fastest growing subject of research, with almost 15000 scientific publications in 2004. In this course, we will explore normal and impaired mechanisms involved in cell death, through examples taken in human medicine or in invertebrates' development.
Prerequisite: BIO 201

BIO 327 Advanced Ecology 3-3-0
Ecology is about finding the best data/modelling to test your theories and hypotheses. Great ideas, hiking boots and computers are all that are needed. This ecology course focuses on understanding the relationships between organisms and the strategies they use to survive, reproduce, and interact with their environment. This course will expand on the fundamental theories of ecology seen in BIO 207 with the application to real life data and analysis.
Prerequisite: BIO 207
Note: This course cannot be taken for credit by anyone who already has credit for BIO 217.

BIO 329 Invertebrate Biology 3-3-0
Morphology, physiology, embryology, evolution and classification of invertebrate animals.
Prerequisite: BIO 205
Co-requisite: BIL 329
Note: This course cannot be taken for credit by anyone who already has credit for BIO 248.

BIL 329 Invertebrate Biology Laboratory 1-0-3
The classification, identification, morphology and biology of the animals considered in BIO 329.
Co-requisite: BIO 329

BIO 331* Freshwater Biology 3-3-0
This course will expose students to the biological importance and diversity of freshwater systems. Emphasis will be placed on sampling in the field, and identification of aquatic invertebrates in the lab. Students should be prepared to go field sampling in their own time and must provide their own waders and life vest.
Prerequisite: BIO 205

BIO 334* Epidemiology 3-3-0
Epidemiology is the study of the distribution and determinants of diseases and health conditions among populations and the application of that study to control health problems. Concepts learned in this course will be applied to current health issues from different perspectives, such as pharma-economy, health care management, disease avoidance and food production.
Prerequisites: BIO 201 and BIO 208

BIO 336 Animal Physiology I 3-3-0
Basic mechanisms of homeostatic regulation. Topics include: Cell physiology, Nervous system, Muscular system, and the Cardiovascular system.
Prerequisite: BIO 201

BIO 337 Animal Physiology II 3-3-0
Mechanisms of functional operation of animal organisms. Topics include: renal, respiratory, gastrointestinal, and reproductive function.
Prerequisites: BIO 208 and BIO 336
Co-requisite: BIL 337

BIL 337 Animal Physiology II Laboratory 1-0-3
Experiments dealing with different aspects of animal physiology. Some experiments will be performed using computer simulations.
Co-requisite: BIO 337

BIO 338 Vertebrate Life I: An Introduction to Ichthyology and Herpetology 3-3-0
This is the first of two courses exploring the evolution and diversity of the vertebrates, and will focus on the fishes, amphibians, and reptiles. The first half of this course will explore the evolution of the earliest vertebrates and the myriad of types that we generally refer to as fishes. Part two of the course will look at the colonization of land by the first tetrapods, the rise of the amniotes, and will finish with an exploration of the extant groups of amphibians and reptiles.
Prerequisites: BIO 205 and BIO 207

BIO 339 Vertebrate Life II: An Introduction to Ornithology and Mammalogy 3-3-0
This course is the second of the series focusing on the evolutionary history and diversity of the vertebrates, and will focus on the mammals and birds. The course will start by looking at the ancestors of each group, before exploring their evolution and diversity. Particular attention will be paid to how these very different groups have solved similar evolutionary problems, and the groups still alive today. While it is better to take BIO 338 before BIO 339, it is not required, and this course may be taken without BIO 338 (Vertebrate Life I).
Prerequisites: BIO 205 and BIO 207

BIO 341 Population Genetics and Evolution 3-3-0
Understanding the processes by which selection and genetic variation allows species to adapt and evolve is an important aspect of biology. This course uses a wide spectrum of examples from animal and plant populations to outline the general principles in population and quantitative genetics that will then be applied to important issues in health sciences.
Prerequisites: BIO 208 and PHY 101

BIO 345 Plant Physiology 3-3-0
Nutrition, transport, growth and development in plants; the water relations of plants; mineral nutrition; growth regulators; tropisms; photoperiodism; vernalization and dormancy.
Prerequisite: BIO 206

BIO 349 Medical and Forensic Entomology 3-3-0
As one of the most important group of disease vectors, insects and other arthropods are involved in the transmission of numerous pathogens causing diseases such as the plague, malaria, West Nile fever, scabies, and Lyme disease. This course will introduce students to some of the basic concepts of medical entomology with a focus on selected diseases. Information on the life cycles of insect vectors and the pathogens they carry is presented, as well as symptoms, treatment and geographical distribution of selected arthropod-borne diseases. The relevance of entomological evidence in criminal investigations (such as the use of insects to determine post-mortem interval is also discussed.
Prerequisite: BIO 205

BIO 352 Microbiology 1-0-3
An introduction to prokaryotic microorganisms, eukaryotic microorganisms, and viruses; their ecology, growth characteristics, and host interactions. Examination of the environmental roles of microbes as well as their impact on the human world.
Prerequisites: BIO 201 and BIO 208
Co-requisite: BIL 352

BIL 352 Microbiology Laboratory 1-0-3
An introduction to common microbiological techniques used in medical, biological and biochemical research, including techniques in growth, staining and identification of bacteria and viruses. As well, the diversity of physiological and metabolic requirements of bacteria will be examined.
Co-requisite: BIO 352

BIO 354 Insect Biodiversity 3-3-0
The main goal of this course is to teach the students how to collect, preserve and identify insects, especially those found in eastern North America. In addition to using material housed in the Bishop's insect collection, material collected in the field by each student will be prepared in a fashion that will make the specimens museum worthy. Through the collecting and identification process, students will learn about insect taxonomy but they will also learn about where different taxa can be found and what their general ecological requirements are. Once they have completed the course, students should be able to identify most commonly encountered insects at least to the family level and recognize those that are beneficial or potentially harmful.
Prerequisite: BIO 205

BIO 358 Animal Behaviour 3-3-0
This course is an applied 3-credit course that explores concepts and themes covered in BIO 209 Introduction to Animal Behaviour. Students will be expected to design and implement a series of animal behaviour experiments, culminating in a final project that they will present to their peers.
Prerequisites: BIO 205, BIO 207 and PHY 101
Co-requisite: BIL 358

BIL 358 Animal Behaviour Lab 1-0-3
This course is an applied 3-credit course that explores concepts and themes covered in BIO 209 Introduction to Animal Behaviour. Students will be expected to design and implement a series of animal behaviour experiments, culminating in a final project that they will present to their peers.
Prerequisite: PHY 101
Pre- or Co-requisite: BIO 209

BIO 359 Human Genetics 3-3-0
Cytogenetics, biochemical genetics, Mendelian genetics, molecular genetics and quantitative genetics of humans; chromosome mapping; genetics and medicine.
Prerequisite: BIO 208

BIO 365 Developmental Biology 3-3-0
Examination of the molecular events involved in the development of vertebrates, invertebrates and plants, emphasizing common strategies used in these three systems. Topics will include establishment of body axes, origin of germ layers, and segmental pattern formation. The role of developmental genes, regulatory gene families, and maternal effect genes will be emphasized. Morphogenesis and early cell differentiation will also be studied.
Prerequisites: BIO 201 and BIO 208

BIO 386 Scientific Writing 3-3-0
The course is intended for students taking upper-level, research-based courses "BIO 492 - Honours Research Project I", "BIO 421 - Independent Studies in Biology I", or "BCH 491 - Honours Research Project I". The primary goal of this course is to instruct students in the writing process of research proposals, undergraduate theses, commentaries (critiques), and scientific manuscripts. In addition to written assignments and exercises, class activities will include oral presentations, self-editing, and peer-reviews. Biology or Biochemistry students in their 3rd or 4th year interested in pursuing a research path, but not registered in BIO 492, BIO 421, BCH 491, can take the course with permission from the course instructor. Research experience is an asset.

BIO 391 Experiential Learning in Health Sciences and Biochemistry 3-3-0
Students in the Health Sciences or Biochemistry program may receive credit for working under the tutelage of a mentor in a field directly related to their area of study. Students must secure both an internal supervisor (a fulltime faculty member) and a suitable mentor (i.e. external supervisor who will supervise the day to day activities of the student). Students must be actively involved in the daily work and should not be acting as menial labor.
Assessment of the student will be based largely on a mark assigned by the mentor directly responsible for the student and the submission of a journal outlining the daily objectives and actual work itself. Projects may be intensive in nature (i.e. 3 weeks during the summer), or may be more drawn out (i.e. 6-8 hours every week during the semester).
Prerequisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator
Note: This course is only eligible to students in good standing and if available positions are available. Students may not work for salary and may not work concurrently in an area directly related to their honors project. Students may only take one experiential learning course for credit (BIO 391 or BIO 392 or ELP 300).

BIO 392 Experiential Learning in Biodiversity & Ecology 3-3-0
Students in the Biodiversity & Ecology program may receive credit for working under the tutelage of a mentor in a field directly related to their area of study. Students must secure both an internal supervisor (a fulltime faculty member) and a suitable mentor (i.e. external supervisor who will supervise the day to day activities of the student). / Students must be actively involved in the daily work and should not be acting as menial labor.
Assessment of the student will be based largely on a mark assigned by the mentor directly responsible for the student and the submission of a journal outlining the daily objectives and actual work itself. Projects may be intensive in nature (i.e. 3 weeks during the summer), or may be more drawn out (i.e. 6-8 hours every week during the semester).
This course is only eligible to students in good standing and if available positions are available. Students may not work for salary and may not work concurrently in an area directly related to their honors project.
Prerequisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator
Note: This course is only eligible to students in good standing and if available positions are available. Students may not work for salary and may not work concurrently in an area directly related to their honors project. Students may only take one experiential learning course for credit (BIO 391 or BIO 392 or ELP 300).

BIO 394 Biology of Cancer 3-3-0
This course will review the broad subject of cancer development and treatment. In particular it will focus on taking concepts seen in cell biology and applying them to cancer cells. Among the topics reviewed will be: cancer types and staging, mutation rates and environmental contributions to genetic changes, oncogenes and tumor suppressors, cell proliferation/death balance, modification of cancer cells phenotypes and metastases formation, role of the immune system in the prevention of cancer spreading, strategies of cure, and a review of the body's physiological responses to several forms of cancer.
Prerequisite: BIO 201

BIO 411 Seminars in Health Sciences 3-3-0
An advanced course discussing current topics in the Health Sciences. Students will be expected to critically evaluate recent scientific literature, prepare and deliver oral and written presentations, participate in discussions, and analyze research questions.
Prerequisites: BIO 208 and BIO 336
Note: This course is restricted to students in year 3 or 4 (i.e. with less than 60 credits remaining of a B.Sc. Biology degree)

BIO 412* Seminars in Biodiversity & Ecology 3-3-0
This course will discuss recent developments in specific areas of ecology, conservation, and/or zoology. The course content will vary from year to year, depending on the instructor's area of expertise and the students' interests.
Prerequisites: BIO 205 and BIO 207

BIO 421 Independent Studies in Biology I 3-1-3
This course is intended for final-year students who wish to pursue in-depth study of a particular area of biology or who have a special need for a biology 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 Department of Biological Sciences and may not be used as a supplement to a student's honours project. Requirements for this course will be agreed upon by a committee of professors from within the Department of Biological Sciences.
Prerequisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator
Co-requisite: BIO 490

BIO 422 Independent Studies in Biology II 3-1-3
This course represents an additional semester of independent work, either a continuation of or a separate course from BIO 421, meant for final-year students who wish to pursue in-depth study of a particular area of biology or who have a special need for a biology 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 Department of Biological Sciences, and may not be used as a supplement to a student's honours project. Requirements for this course will be agreed upon by a committee of professors from within the Department of Biological Sciences.
Prerequisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator
Co-requisite: BIO 490

BIO 428 Advanced Physiology 3-3-0
This course will examine how animals adapt to environmental stresses such as extremes of temperature of altitude, hypoxia, water limitation and dietary changes. Short-term (acute), medium-term (acclimatory) and chronic (evolutionary) adaptations will be discussed.
Prerequisites or Co-requisites: BIO 336 and BIO 337

BIO 433 Advanced Exercise Science 3-3-0
This course examines selected topics in Exercise Physiology. Through traditional lectures, directed readings, seminars, and case studies, students will study short-term and long-term adaptations to exercise. We will also examine the scientific principles underlying sports-related topics such as optimizing exercise performance, injuries, and injury repair.
Prerequisite: BIO 336 or EXS 327
Note: See EXS 433.
Note: This course cannot be taken for credit by anyone who already has credit for EXS 433.

BIO 434 Teaching Assistant Internship in Biology and Biochemistry 3-3-0
Students enrolled in BIO 434 will work closely with a faculty member to work as a teaching assistant in a specific biology course they have already completed. Students will be expected to devote an average of 6-9 hours a week divided between deepening their knowledge of a specific field in biology, interacting with the students enrolled in the course, attending lectures on best practices in teaching biology, and maintaining a detailed journal of their work. This course should not be viewed as simply an unpaid TA for credit but rather as an opportunity to expand their knowledge of a specific biological discipline in their field of interest, and to learn about how best to help other undergraduates learn this material. Because this course requires a close working relationship with a teacher, students may only register by permission of the faculty teaching the course.

BIO 490 Honours Seminar 3-1.5-0
Students will analyze selected literature in the field of health sciences, biochemistry, and ecology to develop cross-disciplinary critical thinking. Guest speakers followed by group discussion will provide practical information about graduate studies and pathways to employment. Students will also get practical experience in literature reviews, scholarship applications and publication/peer review processes.
Co-requisites: BIO 492 or BIO 421, or Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator

BIO 492 Honours Research Project I 3-1-6
An introduction to the planning, execution and reporting of biological research offered to students matching eligibility criteria. 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 BIO 492 with a minimum mark of 75%, with a minimal score of 70% in each graded component, is required for enrolment in BIO 493.
Prerequisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator
Co-requisite: BIO 490

BIO 493 Honours Research Project II 3-1-6
A continuation of BIO 492 offered to students matching eligibility criteria. 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 BIO 493 is conditional upon completing BIO 493 with a minimum mark of 75%. Satisfactory component is required to complete the Honours program.
Prerequisite: BIO 492
Co-requisite: BIO 490

BIO 520 Science Communication 3-3-0
This course will focus on skill development, writing and online and print media communication strategies. At the end of the course, students will be able to evaluate scientific data critically and identify the most appropriate audience to make research results pertinent for users. We will identify and practice communication strategies, including infographics, podcasting, online blogs, and columns in local newspapers. Students will hone their skills in writing techniques, particularly in communicating complex scientific material to a broader audience.
Note: Students who take BIO 520 cannot take KMB 520 for credit.