

## 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](mailto: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.

## 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

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B.Sc. (McGill University), Ph.D. (Université de Sherbrooke)  
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Senior Instructor

#### Estelle Chamoux

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#### Kerry Hull

B.Sc. (University of Alberta), Ph.D. (University of Alberta)  
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#### 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) Strocher

B.Sc. (Montana State University), Ph.D. (University of Washington)  
Professor  
*Chair of Department*

#### Sarathi Weraduwege

B.Sc. (University of Colombo), Ph.D. (University of Guelph)  
Assistant 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 science 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 Division page for information on *Divisional 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 (*BCH491 and BCH492*). Honours Biochemistry students must complete an additional *four courses: Scientific Writing (BIO386), the two honours research courses (BCH491 and BCH492)*, and a fourth course pertinent to the students' honours research project to be determined by the internal supervisor. 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 Science 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 (*BIO492 and BIO493*). Honours Biology students must complete an additional *four courses: Scientific Writing (BIO386), the two honours research courses (BIO492 and BIO493)*, and a fourth course pertinent to the students' honours research project to be determined by the internal supervisor. 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 Science 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 at the specific post-graduate institution of interest. As with the Biology B.Sc. programs, students must choose between one of two concentrations, Health Science 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. Six of these courses are required, and two are optional. The minor allows students majoring in a different field to obtain a solid overview of modern biology.

## B.Sc. Pre-Medicine Double Major

MAJMED

Many students enrolled in the biology and biochemistry programs are interested in continuing their studies into medicine, and the B.Sc. Biochemistry and B.Sc. Biology (Health Sciences) programs include common prerequisite courses for application to medical schools in many areas of the world. However, students should be aware that specific entrance requirements can vary between medical schools, and can change from year to year. Therefore, it is recommended that students decide which schools they will apply to and research the particular requirements for that school. For those students unsure of where they will apply and who would like to cover as wide a set of potential prerequisite courses as possible, Bishop's offers an inter-disciplinary B.Sc. Pre-Medicine double major, which specifically addresses these concerns. See the *Pre-Medicine Double Major (B.Sc.)* section for more details. Students should note that graduating with a B.Sc. Pre-medicine major does not guarantee admission to medical school, but it does provide students with the courses necessary to apply to most of the major medical schools in Canada and the US, as well as many other countries.

## 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

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 corequisite lab course is not offered in the semester that the lecture course is completed, the corequisite is waived.

### 1. Y1 year (10 courses)

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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 193/PHL 193	Physics for the Life Science I
PHY 194/PHL 194	Physics for the Life Science II
2 Humanities Option Courses ( <i>one writing intensive course recommended</i> )	
1 Free Option Course	

### 2. Required Courses (15 courses)

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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 131/CHL131	Physical Chemistry I
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)

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BIO 386	Scientific Writing
BCH 491	Honours Research Project I
BCH 492	Honours Research Project II
One (1) course required by internal supervisor that is pertinent to student's honours project	

### 4. Required Option Courses (7 courses)

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BCH 317 Plant Biochemistry for Human Health & Nutrition	BIO 345 Plant Physiology
BCH 342 Bioinformatics	BIO 352/BIL 352 Microbiology
BCH 380 Steroids and their essential roles in humans	BIO 359 Human Genetics
BCH 381 Immunology	BIO 365 Developmental Biology
BCH 382 Principles of Toxicology	BIO 391 Experiential Learning in Health Science & Biochemistry
BCH 421 Enzymes in Health and Disease	BIO 394 Biology of Cancer
BCH 422/BCL 422 Biotechnology	CHM 231/CHL 231 Physical Chemistry
BCH 460 Plant Biotechnology for Crop Improvement	CHM 311/CHL 311 Organic Chemistry III
BIO 310 Cell Biology	CHM 411/CHL 411 Organic Chemistry IV
BIO 311 Quantitative Methods	PBI 380 Psychopharmacology
BIO 320 Programmed Cell Death	
BIO 334 Epidemiology	
BIO 337/BIL 337 Animal Physiology II	

### 5. Free Options (4 courses)

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## BSc Biochemistry Major

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 corequisite lab course is not offered in the semester that the lecture course is completed, the corequisite is waived.

### 1. Y1 year (10 courses)

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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 193/PHL 193	Physics for the Life Science I
PHY 194/PHL 194	Physics for the Life Science II
2 Humanities Option Courses ( <i>one writing intensive course recommended</i> )	
1 Free Option Course	

### 2. Required Courses (15 courses)

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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 131/CHL 131	Physical Chemistry I
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)

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BCH 317 Plant Biochemistry for Human Health & Nutrition	BIO 345 Plant Physiology
BCH 342 Bioinformatics	BIO 352/BIL 352 Microbiology
BCH 380 Steroids and their essential roles in humans	BIO 359 Human Genetics
BCH 381 Immunology	BIO 365 Developmental Biology
BCH 382 Principles of Toxicology	BIO 386 Scientific Writing
BCH 421 Enzymes in Health and Disease	BIO 391 Experiential Learning in Health Science & Biochemistry
BCH 422/BCL 422 Biotechnology	BIO 394 Biology of Cancer
BCH 460 Plant Biotechnology for Crop Improvement	CHM 231/CHL 231 Physical Chemistry II
BIO 310 Cell Biology	CHM 311/CHL 311 Organic Chemistry III
BIO 311 Quantitative Methods	CHM 411/CHL 411 Organic Chemistry IV
BIO 320 Programmed Cell Death	PBI 380 Psychopharmacology
BIO 334 Epidemiology	
BIO 337/BIL 337 Animal Physiology II	

### 4. Free Option Courses (8 courses)

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## Biochemistry Minor

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)

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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)

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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	Programmed Cell Death
BIO 337/BIL 337	Animal Physiology II
BIO 352/BIL 352	Microbiology
BIO 394	Biology of Cancer
CHM 131/CHL 131	Physical Chemistry I
CHM 211/CHL 211	Organic Chemistry II

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## B.Sc. Biology Honours: Health Sciences Concentration

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 corequisite lab course is not offered in the semester that the lecture course is completed, the corequisite is waived.

### 1. Y1 year (10 courses)

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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 193/PHL 193	Physics for the Life Science I
PHY 194/PHL 194	Physics for the Life Science II
2 Humanities Option Courses ( <i>one writing intensive course recommended</i> )	
1 Free Option Course	

### 2. Required core courses (7 courses)

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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)

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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. Required Honours Courses (4 courses)

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BIO 386	Scientific Writing
BIO 492	Honours Research Project I
BIO 493	Honours Research Project II
One (1) course required by internal supervisor that is pertinent to student's honours project	

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

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BIO 310 Advanced Cell Biology	BCH 311 Proteins
BIO 311 Quantitative Methods in Biology	BCH 312 Lipids and Biomembranes
BIO 315 Frontiers of Biology, Past to Present	BCH 317 Plant Biochemistry for Human Health & Nutrition
BIO 320 Programmed Cell Death	BCH 342 Bioinformatics
BIO 334 Epidemiology	BCH 380 Steroids and their essential roles in humans
BIO 340 Comparative Vertebrate Anatomy	BCH 381 Immunology
BIO 341 Population Genetics and Evolution	BCH 382 Principles of Toxicology
BIO 349 Medical and Forensic Entomology	BCH 411 Molecular Biology
BIO 352/BIL 352 Microbiology	BCH 421 Enzymes in Health and Disease
BIO 359 Human Genetics	BCH 422/BCL 422 Biotechnology
BIO 365 Developmental Biology	CHM 211/CHL 211 Organic Chemistry II
BIO 391 Experiential Learning in Health Sciences & Biochemistry	EXS 317 Biomechanics of Human Movement
BIO 394 Biology of Cancer	PBI 379 Neuropsychology
BIO 411 Seminars in Health Sciences	PBI380 Psychopharmacology
BIO 428 Advanced Physiology	

### 6. Free Options (5 courses)

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*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*

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## BSc Biology Major: Health Sciences Concentration

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 corequisite lab course is not offered in the semester that the lecture course is completed, the corequisite is waived.

### 1. Y1 year (10 courses)

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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 193/PHL 193	Physics for the Life Science I
PHY 194/PHL 194	Physics for the Life Science II
2 Humanities Option Courses ( <i>one writing intensive course recommended</i> )	
1 Free Option Course	

### 2. Required core courses (7 courses)

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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)

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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)

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BIO 310 Advanced Cell Biology	BCH 311 Proteins
BIO 311 Quantitative Methods in Biology	BCH 312 Lipids and Biomembranes
BIO 315 Frontiers of Biology, Past to Present	BCH 317 Plant Biochemistry for Human Health & Nutrition
BIO 320 Programmed Cell Death	BCH 342 Bioinformatics
BIO 334 Epidemiology	BCH 380 Steroids and their essential roles in humans
BIO 340 Comparative Vertebrate Anatomy	BCH 381 Immunology
BIO 341 Population Genetics and Evolution	BCH 382 Principles of Toxicology
BIO 349 Medical and Forensic Entomology	BCH 411 Molecular Biology
BIO 352/BIL 352 Microbiology	BCH 421 Enzymes in Health and Disease
BIO 359 Human Genetics	BCH 422/BCL 422 Biotechnology
BIO 365 Developmental Biology	CHM 211/CHL 211 Organic Chemistry II
BIO 386 Scientific Writing	EXS 317 Biomechanics of Human Movement
BIO 391 Experiential Learning in Health Sciences & Biochemistry	PBI 379 Neuropsychology
BIO 394 Biology of Cancer	PBI 380 Psychopharmacology
BIO 411 Seminars in Health Sciences	
BIO 428 Advanced Physiology	

### 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.*

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## BA Biology Major: Health Studies Concentration

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 corequisite lab course is not offered in the semester that the lecture course is completed, the corequisite is waived.

### 1. Y1 year (10 courses)

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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)

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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)

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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)

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BIO 310 Advanced Cell Biology	BCH 210 General Biochemistry
BIO 311 Quantitative Methods in Biology	BCH 311 Proteins
BIO 320 Programmed Cell Death	BCH 312 Lipids and Biomembranes
BIO 334 Epidemiology	BCH 317 Plant Biochemistry for Human Health & Nutrition
BIO 340 Comparative Vertebrate Anatomy	BCH 342 Bioinformatics
BIO 341 Population Genetics and Evolution	BCH 381 Immunology
BIO 349 Medical and Forensic Entomology	BCH 382 Principles of Toxicology
BIO 352/BIL 352 Microbiology	BCH 411 Molecular Biology
BIO 359 Human Genetics	BCH 421 Enzymes in Health and Disease
BIO 365 Developmental Biology	BCH 422/BCL 422 Biotechnology
BIO 386 Scientific Writing	EXS 317 Biomechanics of Human Movement
BIO 391 Experiential Learning in Health Sciences & Biochemistry	PBI 379 Neuropsychology
BIO 394 Biology of Cancer	PBI 380 Psychopharmacology
BIO 411 Seminars in Health Sciences	
BIO 428 Advanced Physiology	

### 5. Free Options (14 courses)

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*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

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 corequisite lab course is not offered in the semester that the lecture course is completed, the corequisite is waived.

### 1. Y1 year (10 courses)

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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 193/PHL 193	Physics for the Life Science I
PHY 194/PHL 194	Physics for the Life Science 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)

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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)

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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/BIL 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)

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

One (1) course required by internal supervisor that is pertinent to student's honours project

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

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BIO 315 Frontiers of Biology, Past to Present	BCH 313/BCH 313 Metabolism
BIO 331/BIL 331 Freshwater Biology	BCH 342 Bioinformatics
BIO 334 Epidemiology	BCH 382 Principles of Toxicology
BIO 337/BIL 337 Animal Physiology II	BCH 460 Plant Biotechnology in Crop Improvement
BIO 338 Vertebrate Life I	ESG 262 Introduction to GIS
BIO 339/BIL 339 Vertebrate Life II	BIO 340 Comparative Vertebrate Anatomy
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	

### 6. Free Option Courses (5 courses)

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## BSc Biology Major: Biodiversity and Ecology Concentration

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 corequisite lab course is not offered in the semester that the lecture course is completed, the corequisite is waived.

### 1. Y1 year (10 courses)

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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 193/PHL 193	Physics for the Life Science I
PHY 194/PHL 194	Physics for the Life Science II
2 Humanities Option Courses ( <i>one writing intensive course recommended</i> )	
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)

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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)

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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
BIO339/BIL339	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)

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BIO 315 Frontiers of Biology, Past to Present	BCH 313/BCH 313 Metabolism
BIO 331/BIL 331 Freshwater Biology	BCH 342 Bioinformatics
BIO 334 Epidemiology	BCH 382 Principles of Toxicology
BIO 337/BIL 337 Animal Physiology II	BCH 460 Plant Biotechnology in Crop Improvement
BIO 338 Vertebrate Life I	ESG 262 Introduction to GIS
BIO 339/BIL 339 Vertebrate Life II	BIO 340 Comparative Vertebrate Anatomy
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	

### 5. Free Options (9 courses)

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## BA Biology Major: Biodiversity and Ecology Concentration

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 corequisite lab course is not offered in the semester that the lecture course is completed, the corequisite is waived.

### 1. Y1 year (10 courses)

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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)

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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)

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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/BIL 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)

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BIO 311 Quantitative Methods in Biology

BCH 342 Bioinformatics

BIO 315 Frontiers of Biology, Past to Present

BCH 382 Principles of Toxicology

BIO 327 Advanced Ecology

ESG 262 Introduction to GIS

BIO 331/BIL 331 Freshwater Biology

BIO 334 Epidemiology

BIO 337/BIL 337 Animal Physiology II

BIO 338 Vertebrate Life I

BIO 339/BIL 339 Vertebrate Life II

BIO 340 Comparative Vertebrate Anatomy

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

### 5. Free Options (14 courses)

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## 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 lecture 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.

*Prerequisite: 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.

*Prerequisite: CHE 111, BCH 210 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 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, phytochemicals 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, BIO 208 and BCH 313*

#### **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: CHM 111, BCH 210 and BIO 336*

#### **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*

#### **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*

#### **BCH 380 Independent Studies in Biochemistry II 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.

*Prerequisite: BIO 201, BIO 208 and CHM 111*

**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.

*Prerequisite: 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.

*Prerequisites: 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 corequisite: BCH 411*

*Corequisite: BCL 422*

**BCL 422 Biotechnology Laboratory 1-0-3**

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

*Corequisite: 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.

*Prerequisite: BIO 201, BIO 208, and BCH 411*

**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*

**BCH 492 Honours Research Project II 3-1-12**

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*

**Biology courses carry the code BIO (lecture) or BIL (lab)****BIO 111 Organic Gardening 3-3-0**

This course is an introduction to organic and environment-friendly gardening, combining lectures and a hands-on-practicum. Principles of companionship, growth, water and mineral balance will be discussed. Students will learn how to recognize and treat diseases, pests or common physiological disorders with environmentally natural techniques. At the end of this course, students should be able to set-up and run a garden using environment-friendly techniques and know how to harvest, handle and store crops. Depending on the interests of the group, the course will either cover transformation strategies for year-long storage of vegetables grown in the summer (canning, freezing, fermentation, drying...), or make an introduction to entrepreneurship in organic farming (based on the instructor's own experience). In addition, several visits will be organized to locally run organic farms to present various models of environment-friendly productions of veggies, fruits and herbs.

*Note: This course is open to the general public and may be taken by non-DNS students for science credit. However, students in any of the science majors may only take this course as a free elective and may not count this course for science credit. It is offered in the spring semester.*

*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 and Biochemistry or by students with credit for BIO 233*

**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 discover 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, the study of life, and is designed for students with no previous science background. This course starts with an introduction to the scientific method and a comparison of science and pseudoscience. It then explores biology by starting with the small and moving to the large. Starting with biologically important macro-molecules, the course then moves to cell structure and metabolism, photosynthesis and respiration, the origin of life, a comparison of sexual vs asexual reproduction, genetics, the development of evolutionary theory and natural selection, and finally ecology and ecosystems. Throughout the course we explore these different aspects of biology from an applied human impact approach.

*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*  
*Corequisite: 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 Lab 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.  
*Prerequisites: 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*  
*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**  
Experiments in genetics designed to complement topics discussed in BIO 208.  
*Co-requisite: BIO 208*
- BIO 211 Sustainable Organic Agriculture 3-3-0**  
The objective of this course is to introduce students to the concepts and techniques of organic gardening through an integrated and sustainable approach. Subjects covered will include, applied botany, basic soil chemistry, weed control, crop rotation, tillage, ecologically responsible use of fertilizers, and drainage and irrigation practices. The course includes lecture classes as well as practical hands-on activities in biology laboratory JOH 320, JOH greenhouse and the biology outdoor garden, where students will be expected to apply some of the techniques discussed in class to real life situations.  
*Prerequisites: BIO205 and BIO206 or with permission of the instructor if the student can demonstrate a suitable background knowledge of the necessary material.*  
*Co-requisite BIL 211.*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIL 111.*  
*Note: BIO 211 is a science course based on biological principles and concepts. It is not equivalent to any AGR course.*
- 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 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 or Corequisite: BIO 196 or EXS 127*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIO131*
- 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. This course cannot be taken for credit by anyone who already has credit for BIO 189  
*Prerequisite: 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.  
*Prerequisite: 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 quantitative methods as a tool to answer practical problems in biological sciences. This course focuses on real life situations often encountered by scientists such as how to critically review studies, study design, and statistical output. This course will also cover the statistical and data management methods most often used in biological sciences.  
*Prerequisite: BIO208 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*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIO 319.*
- 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, programmed 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. Class material will look at both the biotic and abiotic components of aquatic systems as well as their interactions.  
*Prerequisite or Co-requisite: BIO 205 and BIO 207*  
*Co-requisite: BIL 331*
- BIL 331\* Freshwater Biology Lab 1-3-0**  
The lab section will focus on the different techniques necessary for sampling both lentic and lotic systems. Emphasis will be placed on practical first-hand experience using the appropriate equipment in the field. The process of data collection will culminate in the students performing a mini-research project on a local aquatic system of their choice and presenting these data to their peers.  
*Co-requisite: BIO 331*
- 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.  
*Prerequisite: 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.  
*Prerequisite: 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 course is the first of two exploring those animals with a cartilaginous or bony backbone, the vertebrates. Given their great diversity, two courses have been devoted to this group, Vertebrate Life 1 & 2; this is the first of those courses. Vertebrate Life 1 will focus on the fishes, amphibians, and reptiles and is divided into two sections. The first section 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 and the rise of the amniotes and will explore the extant groups of amphibians and reptiles.  
*Prerequisites: BIO 205, BIO 207 and PHY 101*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIO 332 and BIO 367.*
- 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. From the tiniest hummingbird to the mightiest whale, these two vertebrate groups represent separate evolutionary branches from within the amniote family tree. The course will start by looking at the ancestors of each group, before exploring their evolutionary diversification, and how these distantly related groups have solved similar evolutionary problems. Vertebrate Zoology II may be taken without previously taking Vertebrate Zoology I.  
*Prerequisites: BIO 205 and BIO 207*  
*Co-requisite: BIL 339*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIO 332.*
- BIL 339 Vertebrate Life II Lab 1-0-3**  
This is the co-requisite lab to the BIO 339 Vertebrate Life II. This course will help students develop basic skills in the identification of most of the common vertebrates in the region. Although focusing primarily on the subject matter of the co-requisite lecture, BIO 339 birds and mammals, all vertebrate groups will be explored including fishes, amphibians, and reptiles.  
*Co-requisite: BIO 339*
- BIO 340\* Comparative Vertebrate Anatomy 3-3-0**  
This course will use a comparative approach to help students understand vertebrate anatomy. Students will explore the evolution of major organ systems within the vertebrates, using both dissection and preserved material. Students should be prepared to both take lecture notes and dissect specimens every class.  
*Prerequisites: BIO 338 or BIO339*



**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.

*Prerequisite: 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**

The study of animal behaviour represents the oldest known form of biological study. Even from our earliest beginnings, humans had an intense interest in understanding how animals behave. This interest is still evident from our almost instinctive need to share our homes with various pets. This course will build on this most basic need to watch and understand animal behaviour, but will do so from a more scientific approach.

*Prerequisite: BIO 205, BIO 207, and PHY 101*

*Co-requisite: BIL 358*

**BIL 358 Animal Behaviour Lab 1-0-3**

This course is the co-requisite lab for BIO 358: Animal Behaviour. During the semester students will be expected to design and implement a series of animal behaviour experiments, culminating in a final project that they will then present to their peers in the form of a final scientific paper and oral presentation.

*Co-requisite: BIO 358*

**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.

*Prerequisite: BIO 201 and BIO 208*

**BIO 386 Scientific Writing 3-3-0**

The course is intended for students taking upper-level, research-based courses "Honours Biological Problems - BIO492", "Independent Studies in Biology 1 - BIO421", or "BCH 491 - Honours Research Project 1". 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 422, 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 Science 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 (BIO391 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).

*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 (BIO391 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.

*Prerequisites: BIO 201*

*Note: This course cannot be taken for credit by anyone who already has credit for BIO 224.*

- 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.  
*Pre-requisites: 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.  
*Prerequisite: BIO 205 and BIO 207*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIO 362.*
- 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.  
*Pre-requisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIO 371.*
- 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.  
*Pre-requisite: Permission of the Biology and Biochemistry Department Research and Honours Project Coordinator*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIO 372.*
- 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*  
*Note: This course cannot be taken for credit by anyone who already has credit for BIO 328.*
- 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. 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 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*
- 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*