

Transfers from other Universities and Colleges

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

Transfers from other programs at Bishop's University

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

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,

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Research and Honours Project Coordinator

Marylène Boulet,

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Estelle Chamoux,

Ph.D. (Sherbrooke); Professor

Kerry Hull,

B.Sc., Ph.D. (Alberta); Professor

Elizabeth Prusak,

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

Michael Richardson,

B.Sc., M.Sc., Ph.D. (McGill); Associate Professor
Administrative Chair of the Department

Jade Savage,

B.Sc., Ph.D. (McGill); Professor

Virginia Strocher,

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

Program Overview

Our programs cover a wide range of subjects, all with the central focus of the components and processes of life. Whether it is studying biologically important molecules or entire ecosystems, our courses are designed to help students gain an understanding of the content and to develop their own abilities to further explore the subject. Many of our graduates go on to professional and graduate studies in medicine, dentistry, veterinary school, forestry, wildlife biology, 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 an extensive 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 Francophones and Anglophones, 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 means that students can be working in a modern biochemistry lab one afternoon and canoeing a river the next.

Overview of Programs Available

Here is a brief overview of the programs offered by the Department of Biology and Biochemistry. See later in the document for more details about the courses and requirements for each program. 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 (99 credits)

HONBCH

Highly motivated students who may be considering graduate school, may choose to pursue an honours degree. Students may not enter the program until the start of their final year, and after consultation with the Biology and Biochemistry honours project coordinator. To qualify, students must: (1) maintain a cumulative average of at least 75%; (2) receive a mark lower than 75% in no more than four credits (1 lecture and 1 laboratory course) in any 300 or 400-level Biology or Biochemistry course. Once in the program, students must take an additional Scientific Writing Course (Bio386) and maintain an average 75% or higher in both the honours research courses, BCH491 and BCH492 (see course descriptions for more detail or contact the honours project coordinator).

B.Sc. Biochemistry Major (90 credits)

MAJBCH

The Biochemistry Major program is a four-year program that requires 40 three-credit courses, or their equivalent, for a total of 120 course credits, plus associated laboratory courses, the number of lab courses required depending on the specialization selected. The 120 course credits are divided as follows: 69 core required course credits, 21 required optional course credits, 27 free elective credits and 3 humanities or social sciences elective credits.

Biochemistry Minor (24 credits)

MINBCH

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

B.Sc. Biology Honours (102 credits)

HONBIO

Students in this program have the choice between one of two concentrations, Health Science, or Biodiversity and Ecology. The honours program in Biology follows the same rules as the Biochemistry Honours listed above, however biology honours students must also take an additional quantitative methods course

(Bio311) as well as Scientific Writing (Bio386) and both the honours research courses (Bio492 and Bio493).

B.Sc. Biology Major (90 credits)

MAJBIO

The B.Sc. programs are the best choice for students with a strong grounding in the core sciences (math, physics, and chemistry). Students graduating with a B.Sc. 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 honours program, students must decide between one of two concentrations, either Health Science, or Biodiversity and Ecology. See the tables below for the complete list of courses.

B.A. Biology Major (54 credits)

MAJBIO

The B.A. Biology program is designed with fewer required courses than the B.Sc. programs, so students may be able to complete a second major their 120-credit degree. This is therefore ideal for students interested in pursuing a double major (such as Biology with a second degree in Psychology, Political Science, Business, or Environmental Studies.), and provides a solid grounding 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 officials of the specific post-graduate institution of interest. Students must decide between one of two concentrations: either BA Health Studies, or BA Biodiversity and Ecology. Please see the Tables below for the complete list of courses required to complete this major.

Pre-Medicine Double Major

MAJMED

Many of our students enrolled in the biology and biochemistry program are interested in going to medical school, and the BSc Biochemistry, and BSc Biology (Health Sciences) programs includes common prerequisites for application to medical schools in many parts of the world. However, students should be aware that the entrance requirements can vary greatly between medical schools, and often change from year to year, therefore we recommend that students decide on which schools they are hoping to go to and then research what are the particular requirements of that school (the faculty can help you with this search). For those students unsure of where they would like to go and wishing to cover as wide a set of potential requirements as possible, BU also offers an inter-disciplinary Pre-Medicine double major, which specifically addresses these concerns. See the *Pre-Medicine Double Major* section for more details on how this program can be combined with a B.Sc. from this department. Students should note that graduating with Pre-medicine does not guarantee admission to medical school, but it does ensure that students take all the courses necessary to apply to most of the major medical schools in Canada and the US, as well as many other countries.

Biology Minor (24 credits)

MINBIO

The biology minor consists of eight courses in different areas of Biology. Six of these eight courses are required and two 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.

The tables below assumes students are taking a full course load of 5 lecture courses per semester. Students may decide to take fewer than 5 but should discuss this with their advisor before doing so.

BSc Biochemistry Honours

Y1 Year: Taken by all non-Cegep students.

1-BIO 196 / BIL 196 Intro Cellular and Molecular Biology	1-CHM 192 / CHL 192 General Chemistry II
2-CHM 191 / CHL 191 General Chemistry I	2-PHY 194 / PHL 194 General Physics II for Life Science
3-PHY 193 / PHL 193 General Physics I for Life Science	3-MAT 192 Calculus II
4-MAT 191 Calculus I	4-OPT
5-ENG 116 Effective Writing or other ENG	5-OPT

Y2 Year: Most Cegep Science students will start at this point.

1-BIO 201 Cellular and Molecular Biology	1-BIO 208 / BIL 208 Genetics
2-CHM 111 / CHL111 Organic Chemistry I	2-BCH 210 General Biochemistry
3-CHM 141 / CHL141 Analytical Chemistry	3-CHM 131 / CHL 131 Physical Chemistry I
4-PHY 101 Statistical Methods	4-CHM 211 / CHL 211 Organic Chemistry II
5-OPT	5-CHM 245 / CHL 245 Instrumental Analysis* OR CHM 341 / CHL 341 Molecular Spectroscopy*

Y3 Year:

1-BIO 336 Animal Physiology I	1-BCH 312 Lipids & Biomembranes
2-BCH 311 Proteins	2-BCH 313 / BCL 313 Metabolism
3-OPT	3-CHM 245 / CHL 245 Instrumental Analysis* OR CHM 341 / CHL 341 Molecular Spectroscopy*
4-OPT	4-OPT
5-OPT	5-OPT

Y4 Year:

1-BCH 411 Molecular Biology	1-BCH 492 Honours Research Project II
2-BIO 386 Scientific Writing	2-OPT
3-BCH 491 Honours Research Project I	3-OPT
4-OPT	4-OPT
5-OPT	5-OPT

* Course is offered in alternate years

OPT-these represents spaces in the student's timetable that should be filled with either a required optional course (choose 7 from the list below), one of the 6 free electives, or the Humanities or Social Science elective. It is incumbent on the student to ensure that they have completed all the degree requirements before applying to graduate.

Required Optional Courses (21 course credits from the list): Students must choose 7 courses from the list below:

BCH 381 Immunology
 BCH 382 Principles of Toxicology
 BCH 421 Enzymes in Health and Disease
 BCH 422 / BCL422 Biotechnology
 BIO 310 Advanced Cell Biology
 BIO 320 Programmed Cell Death
 BIO 337 / BIL 337 Animal Physiology II
 BIO 352 / BIL 352 Microbiology
 BIO 359 Human Genetics
 BIO 365 Developmental Biology
 BIO 394 Biology of Cancer
 CHM 231 / CHL 231 Physical Chemistry II
 CHM 311 / CHL 311 Organic Chemistry III
 PBI380 Psychopharmacology

Free Electives (18 course credits): Students must choose any six courses from across the university.

Humanities or Social Sciences Elective (3 course credits): Students must choose 1 course from the Humanities or Social Sciences.

BSc Biochemistry Major

Y1 Year: Taken by all non-Cegep students.

1-BIO 196 / BIL 196 Intro Cellular and Molecular Biology	1-CHM 192 / CHL 192 General Chemistry II
2-CHM 191 / CHL 191 General Chemistry I	2-PHY 194 / PHL 194 General Physics II for Life Science
3-PHY 193 / PHL 193 General Physics I for Life Science	3-MAT 192 Calculus II
4-MAT 191 Calculus I	4-OPT
5-ENG 116 Effective Writing or other ENG	5-OPT

Y2 Year: Most Cegep Science students will start at this point.

1-BIO 201 Cellular and Molecular Biology	1-BIO 208 / BIL208 Genetics
2-CHM 111 / CHL111 Organic Chemistry I	2-BCH 210 General Biochemistry
3-CHM 141 / CHL141 Analytical Chemistry	3-CHM 131 / CHL131 Physical Chemistry I
4-PHY 101 Statistical Methods	4-CHM 211 / CHL211 Organic Chemistry II
5-OPT	5-CHM 245 / CHL245 Instrumental Analysis* OR CHM 341 / CHL 341 Molecular Spectroscopy*

Y3 Year:

1-BIO 336 Animal Physiology I	1-BCH 312 Lipids & Biomembranes
2-BCH 311 Proteins	2-BCH 313 / BCL 313 Metabolism
3-OPT	3-CHM 245 / CHL 245 Instrumental Analysis* OR CHM 341 / CHL 341 Molecular Spectroscopy*
4-OPT	4-OPT
5-OPT	5-OPT

Y4 Year:

1-BCH 411 Molecular Biology	1-OPT
2-OPT	2-OPT
3-OPT	3-OPT
4-OPT	4-OPT
5-OPT	5-OPT

OPT-these represents spaces in the student's timetable that should be filled with either a required optional course (choose 7 from the list below), one of the 6 free electives, or the Humanities or Social Science elective. It is incumbent on the student to ensure that they have completed all the degree requirements before applying to graduate.

Required Optional Courses (21 course credits from the list): Students must choose 7 courses from the list below:

BCH 381 Immunology
 BCH 382 Principles of Toxicology
 BCH 421 Enzymes in Health and Disease
 BCH 422 / BCL 422 Biotechnology
 BIO 310 Advanced Cell Biology
 BIO 320 Programmed Cell Death
 BIO 337 / BIL 337 Animal Physiology II
 BIO 352 / BIL 352 Microbiology
 BIO 359 Human Genetics
 BIO 365 Developmental Biology
 BIO 394 Biology of Cancer
 CHM 231 / CHL 231 Physical Chemistry II
 CHM 311 / CHL 311 Organic Chemistry III
 PBI 380 Psychopharmacology

Free Electives (27 course credits): Students must choose any nine courses from across the university.

Humanities or Social Sciences Elective (3 course credits): Students must choose 1 course from the Humanities or Social Sciences.

Biochemistry Minor

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

Required Courses: (15 course credits):

- 1-BCH 311 Proteins
- 2-BCH 312 Lipids & Biomembranes
- 3-BIO 208 / BIL 208 Genetics
- 4-BIO 336 / BIL 336 Animal Physiology I
- 5-CHM 141 / CHL 141 Analytical Chemistry
- 6-A required optional course from the list below.
- 7-A required optional course from the list below.
- 8-A required optional course from the list below.

Required Optional Courses

(3 courses (9 course credits) from list):

- BCH 313 / BCL 313 Metabolism
 - 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 / BIL337 Animal Physiology II
 - BIO 352 / BIL352 Microbiology
 - BIO 394 Biology of Cancer
 - CHM 131 / CHL 131 Physical Chemistry I
 - CHM 211 / CHL 211 Organic Chemistry
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BSc Biology Majors and Honours

Concentrations Health Science or Biodiversity and Ecology.

All majors and honours in Biology must complete 120 credits to graduate, including a specific list of required courses. These courses are listed below and include a fixed set of departmental and concentration core courses, as well as a selection of concentration option courses that the student may select. Students should declare their concentration no later than the end of the Y2 year if the student wishes to graduate on time. Please note that many courses have associated labs, featuring the same course number but with the CHL/BCL/BIL code, and worth a single credit. These lab credits do not count towards the total credit requirements of the program and must be completed successfully to receive credits for the lecture course. The tables below assume students are taking a full course load of 5 lecture courses per semester. Students may decide to take fewer than 5 but should discuss this with their advisor before doing so.

BSc Biology Major: Health Sciences Concentration

Y1 Year: Taken by all non-Cegep students.

1-BIO 196 / BIL 196 Intro Cellular and Molecular Biology	1-CHM 192 / CHL 192 General Chemistry II
2-CHM 191 / CHL 191 General Chemistry I	2-PHY 194 / PHL 194 General Physics II for Life Science
3-PHY 193 / PHL 193 General Physics I for Life Science	3-MAT 192 Calculus II
4-MAT 191 Calculus I	4-Humanities Option (CLA, ENG, HIS, RSC, PHI or Lib. Arts)
5-ENG 116 Effective Writing (or other ENG)	5-*Free Elective.

*Free elective: Students may take any free elective. However, students wishing to take another biology course may want to consider *BIO 207 Introduction to Evolution and Ecology* or *BIO233 Human Anatomy*. Students should only consider these courses in their Y1 year if they achieved >70% in BIO 196, otherwise they should wait until their second year.

Y2 Year: Most Cegep Science students will start at this point.

1-BIO 201 Cellular and Molecular Biology	1-BIO 206 Plant Diversity
2-CHM 111 / CHL111 Organic Chemistry I	2-BIO 208 / BIL208 Genetics
3-PHY 101 Statistical Methods	3-BCH 210 General Biochemistry
4-BIO 205 / BIL205 Animal Diversity	4-**Concentration Option 1
5-***Science Option 1	5-*Free Option 1

Y3 Year:

1-BIO 336 Animal Physiology I	1-BIO 337 / BIL 337 Animal Physiology 2
2-PSY 101 Introductory Psychology	2-BCH 313 / BCL 313 Metabolism
3-BIO 352 / BIL352 Microbiology or BCH411 Molecular Biology	3-**Concentration Option 3
4-**Concentration Option 2	4-**Concentration Option 4
5-*Free Option 2	5-*Free Option 3

Y4 Year:

1-**Concentration Option 5	1-**Concentration Option 7
2-**Concentration Option 6	2-*Free Option 6
3-***Science Option 2	3-*Free Option 7
4-*Free Option 4	4-*Free Option 8
5-*Free Option 5	5-*Free Option 9

***Free Opt:** Indicates a free option course; any course from across the university including supplemental Biology or Biochemistry courses. Students often package these free electives together to take a minor in another discipline.

****Concentration Option:** Indicates one of seven courses to be selected from the list of “Health Science Concentrations Options”. At least 5 must be BIO or BCH courses.

*****Science Option:** Select any 2 courses from the Division of Natural Sciences and Mathematics (including Biology). All courses must be eligible for science credit by science students (see individual course descriptions). Students considering application to medical school might wish to consider taking CHM 211 Organic Chemistry II, or PHY 206 Waves and Optics.

NOTE: The sequence of the Free Options, Concentration Options, and Science Options courses is merely a suggestion. Students are free to take these options at any time or in any sequence during their degree, but they should be careful to ensure that they complete all the requirements if they wish to graduate on time.

BSc Biology Honours: Health Sciences Concentration

Highly motivated students may choose to pursue an honours degree. Students may not enter the program until the start of their final year, and after consultation with the Biology and Biochemistry honours project coordinator. To qualify, students must: (1) maintain a cumulative average of at least 75%; (2) receive a mark lower than 75% in no more than four credits (1 lecture and 1 laboratory course) in any 300 or 400-level Biology or Biochemistry course. The honours follows a similar course sequence to the Major but with the addition of 4 additional courses indicated by #. See below for details.

Y1 Year: Taken by all non-Cegep students.

1-BIO 196 / BIL 196 Intro Cellular and Molecular Biology	1-CHM 192 / CHL 192 General Chemistry II
2-CHM 191 / CHL 191 General Chemistry I	2-PHY 194 / PHL 194 General Physics II for Life Science
3-PHY 193 / PHL 193 General Physics I for Life Science	3-MAT 192 Calculus II
4-MAT 191 Calculus I	4-Humanities Option (CLA, ENG, HIS, RSC, PHI or Lib. Arts)
5-ENG 116 Effective Writing (or other ENG)	5-*Free Elective.

*Free elective: Students may take any free elective. However, students may want to consider taking *BIO 207 Introduction to Evolution and Ecology* or *BIO233 Human Anatomy*. Students who did not do well in BIO 196 (>70%) should not take the above courses until their second year when they are better prepared.

Y2 Year: Most Cegep Science students will start at this point.

1-BIO 201 Cellular and Molecular Biology	1-BIO 206 Plant Diversity
2-CHM 111 / CHL111 Organic Chemistry I	2-BIO 208 / BIL208 Genetics
3-PHY 101 Statistical Methods	3-BCH 210 General Biochemistry
4-BIO 205 / BIL205 Animal Diversity	4-Concentration Option 1
5-***Science Option 1	5-*Free Option 1

Y3 Year:

1-BIO 336 Animal Physiology I	1-BIO 337 / BIL 337 Animal Physiology 2
2-PSY 101 Introductory Psychology	2-BCH 313 / BCL 313 Metabolism
3-BIO 352 / BIL 352 Microbiology or BCH 411 Molecular Biology	3-**Concentration Option 3
4-**Concentration Option 2	4-**Concentration Option 4
5-*Free Option 2	5-#BIO 311 Quantitative Methods in Biology.

Y4 Year:

1-**Concentration Option 5	1-Concentration Option 7
2-**Concentration Option 6	2-#BIO 493 Honours Project 2
3-***Science Option 2	3-*Free Option 3
4-#BIO 386 Scientific Writing	4-*Free Option 4
5-#BIO 492 Honours Project 1	5-*Free Option 5

***Free Option:** Indicates a free option course; any course from across the university including supplemental Biology or Biochemistry courses. Students often package these free electives together to take a minor in another discipline.

****Concentration Option:** Indicates one of seven courses to be selected from the list of “Health Science Concentrations Options”. Students may not use their required honours courses (BIO 386, BIO 311, BIO 492, and BIO 493). At least 5 must be BIO or BCH courses.

*** **Science Option:** Select any 2 courses from the Division of Natural Sciences and Mathematics (including Biology). All courses must be eligible for science credit by science students (see individual course descriptions). Students considering application to medical school might wish to consider taking CHM 211 Organic Chemistry II, or PHY 206 Waves and Optics.

#: **Honours Requirement:** These courses indicated with a # are required for honours. These 4 courses may not be used as concentration options if enrolled in the honours. Students must complete these 4 courses by reducing the number of free options (OPT see above).

NOTE: The sequence of the Free Options, Concentration Options, and Science Options courses is merely a suggestion. Students are free to take these options at any time or in any sequence during their degree, but they should be careful to ensure that they complete all the requirements if they wish to graduate on time.

BA Biology Major: Health Studies Concentration

Y1 Year:

1-BIO 196 / BIL 196 Intro Cellular and Molecular Biology	1-Humanities Option (CLA, ENG, HIS, RSC, PHI or Lib. Arts)
2-ENG 116 Effective Writing (or other ENG)	2-*Free Option 4
3-*Free Option 1	3-*Free Option 5
4-*Free Option 2	4-*Free Option 6
5-*Free Option 3	5-*Free Option 7

Note: Students taking a double degree (ESG, POL, SPO, Etc) may wish to use some of these OPT slots to start taking the required courses for their second degree.

Y2 Year:

1-BIO 201 Cellular and Molecular Biology	1-BIO 206 Plant Diversity
2-BIO 205 / BIL 205 Animal Diversity	2-BIO 208 / BIL208 Genetics
3-PHY 101 Statistical Methods	3-**Concentration Option 1
4-***Science Option 1	4-*Free Option 9
5-*Free Option 8	5-*Free Option 10

Y3 Year:

1-BIO 336 Animal Physiology I	1-BIO 337 / BIL 337 Animal Physiology 2
2-PSY 101 Introductory Psychology	2-**Concentration Option 3
3-BIO 233 Human Anatomy	3-**Concentration Option 4
4-**Concentration Option 2	4-*Free Option 12
5-* Free Option 11	5-*Free Option 13

Y4 Year:

1-**Concentration Option 5	1-*Free Option 16
2-**Concentration Option 6	2-*Free Option 17
3-***Science Option 2	3-*Free Option 18
4-*Free Option 14	4-*Free Option 19
5-*Free Option 15	5-*Free Option 20

***Free Option:** Indicates a free option course; any course from across the university including supplemental Biology or Biochemistry courses. Students often package these free electives together to take a minor in another discipline.

****Concentration Option:** Indicates one of seven courses to be selected from the list of “Health Science Concentrations Options”. At least 5 must be BIO or BCH courses.

*****Science Option:** Select any 2 courses from the Division of Natural Sciences and Mathematics (including Biology). All courses must be eligible for science credit by science students (see individual course descriptions).

NOTE: The sequence of the Free Options, Concentration Options, and Science Options courses is merely a suggestion. Students are free to take these options at any time or in any sequence during their degree, but they should be careful to ensure that they complete all the requirements if they wish to graduate on time.

Health Sciences Concentration Options

Notes: BIO386, BIO311, BIO492, and BIO493 are requirements for honours and therefore cannot be used as Concentration options by students enrolled in Honours. BCH210 is a required course for the BSc programs and may not be double counted as a concentration option. It is only a concentration option for the BA degree:
 BIO 207 Introduction to Evolution and Ecology
 BIO 233 Human Anatomy
 BIO 311 Quantitative Methods in Biology
 BIO 315 Frontiers of Biology, From Past to Present
 BIO 320 Programmed Cell Death

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 Exp. Learning in Health Sciences and Biochemistry
 BIO 394 Biology of Cancer
 BIO 411 Seminar in Health Sciences
 BIO 428 Advanced Physiology
 BCH 210 General Biochemistry
 BCH 311 Proteins
 BCH 312 Lipids and Membranes
 BCH 381 Immunology
 BCH 382 Principles of Toxicology

BCH 411 Molecular Biology
 BCH 422 Biotechnology
 CHM 211 Organic Chemistry II
 EXS 317 Biomechanics of Human Movement
 PBI 379 Neuropsychology
 PBI 380 Psychopharmacology
 PSY 213 Research Methods

**Please note that many courses have associated labs, featuring the same course number and the BIL code, as indicated in the individual course descriptions. Lab credits do not count towards the total credit requirements of the program. The associated (co-requisite) lab must be completed to receive credit for the course.*

BSc Biology Major: Biodiversity and Ecology Concentration

Y1 Year: Taken by all non-Cegep students.

1-BIO 196 / BIL 196 Intro Cellular and Molecular Biology	1-CHM 192 / CHL 192 General Chemistry II
2-CHM 191 / CHL 191 General Chemistry I	2-PHY 194 / PHL 194 General Physics II for Life Science
3-PHY 193 / PHL 193 General Physics I for Life Science	3-MAT 192 Calculus II
4-MAT 192 Calculus I	4-Humanities Option (CLA, ENG, HIS, RSC, PHI or Lib. Arts)
5-ENG 116 Effective Writing (or other ENG)	5-*Free Elective.

*Free elective: Students may take any free elective. However, students may want to consider taking *BIO 207 Introduction to Evolution and Ecology* or *BIO233 Human Anatomy*. Students who did not do well in BIO 196 (>70%) should not take the above courses until their second year when they are better prepared.

Y2 Year: Most Cegep Science students will start at this point.

1-BIO 201 Cellular and Molecular Biology	1-BIO 206 Plant Diversity
2-CHM 111 / CHL111 Organic Chemistry I	2-BIO 208 / BIL208 Genetics
3-PHY 101 Statistical Methods	3-BIO 207 Evolution and Ecology
4-BIO 205 / BIL205 Animal Diversity	4-**Concentration Option 1
5-***Science Option 1	5-*Free Option 1

Y3 Year:

1-BIO 338 Vertebrate Zoology 1 or Bio 339 Vertebrate Zoo 2	1-BIO 327 Advanced Ecology
2-ESG 127 Introduction to Physical Geography	2-**Concentration Option 3
3-BIO 329 Invertebrate Biology	3-**Concentration Option 4
4-**Concentration Option 2	4-*Free Option 4
5-*Free Option 2	5-*Free Option 5

Y4 Year:

1-BIO 336 Animal Physiology I	1-**Concentration Option 7
2-**Concentration Option 5	2-*Free Option 7
3-**Concentration Option 6	3-*Free Option 8
4-***Science Option 2	4-*Free Option 19
5-*Free Option 6	5-*Free Option 10

***Free Option:** Indicates a free option course; any course from across the university including supplemental Biology or Biochemistry courses. Students often package these free options together to take a minor in another discipline.

****Concentration Option:** Indicates one of seven courses to be selected from the list of “Biodiversity and Ecology Concentrations Options”. At least 5 must be BIO or BCH courses.

*****Science Option:** Select any 2 courses from the Division of Natural Sciences and Mathematics (including Biology). All courses must be eligible for science credit by science students (see individual course descriptions). Students wishing to continue to graduate school may want to consider taking MAT 209 Linear Algebra, or MAT 310 Ordinary Differential Equations, as these will better prepare them for more advanced statistical courses later in their careers.

NOTE: The sequence of the Free Options, Concentration Options, and Science Options courses is merely a suggestion. Students are free to take these options at any time or in any sequence during their degree, but they should be careful to ensure that they complete all the requirements if they wish to graduate on time.

BSc Biology Honours: Biodiversity and Ecology Concentration

Highly motivated students may choose to pursue an honours degree. Students may not enter the program until the start of their final year, and after consultation with the Biology and Biochemistry honours project coordinator. To qualify, students must: (1) maintain a cumulative average of at least 75%; (2) receive a mark lower than 75% in no more than four credits (1 lecture and 1 laboratory course) in any 300 or 400-level Biology or Biochemistry course. The honours follows a similar course sequence to the Major but with the addition of 4 additional courses indicated by #. See below for details.

Y1 Year: Taken by all non-Cegep students.

1-BIO 196 / BIL 196 Intro Cellular and Molecular Biology	1-CHM 192 / CHL 192 General Chemistry II
2-CHM 191 / CHL 191 General Chemistry I	2-PHY 194 / PHL 194 General Physics II for Life Science
3-PHY 193 / PHL 193 General Physics I for Life Science	3-MAT 192 Calculus II
4-MAT 191 Calculus I	4-Humanities Option (CLA, ENG, HIS, RSC, PHI or Lib. Arts)
5-ENG 116 Effective Writing (or other ENG)	5-*Free Elective.

*Free elective: Students may take any free elective. However, students may want to consider taking *BIO 207 Introduction to Evolution and Ecology* or *BIO 233 Human Anatomy*. Students who did not do well in BIO 196 (>70%) should not take the above courses until their second year when they are better prepared.

Y2 Year: Most Cegep Science students will start at this point.

1-BIO 201 Cellular and Molecular Biology	1-BIO 206 Plant Diversity
2-CHM 111 / CHL111 Organic Chemistry I	2-BIO 208 / BIL208 Genetics
3-PHY 101 Statistical Methods	3-BIO 207 Evolution and Ecology
4-BIO 205 / BIL205 Animal Diversity	4-**Concentration Option 1
5-***Science Option 1	5-*Fee Option 1

Y3 Year:

1-BIO 338 Vertebrate Zoology 1 of Bio339 Vertebrate Zoo 2	1-BIO 327 Advanced Ecology
2-ESG127 Introduction to Physical Geography	2-**Concentration Option 3
3-BIO 329 Invertebrate Biology	3-**Concentration Option 4
4-**Concentration Option 2	4-*Free Option 3
5-*Free Option 2	5-*Free Option 4

Y4 Year:

1-BIO 336 Animal Physiology I	1-#BIO 492 Honours Project 2
2-**Concentration Option 5	2-**Concentration Option 6
3-***Science Option 2	3-**Concentration Option 74-#BIO 386 Scientific Writing
4-*Free Option 5	
5-#BIO 492 Honours Project 1	5-*Free Option 6

***Free Option:** Indicates a free option course; any course from across the university including supplemental Biology or Biochemistry courses. Students often package these free electives together to take a minor in another discipline.

****Concentration Option:** Indicates one of seven courses to be selected from the list of "Biodiversity and Ecology Concentrations Options". Students may not use their required honours courses (BIO 386, BIO 311, BIO 492, and BIO 493). At least 5 must be BIO or BCH courses.

*** **Science Option:** Select any 2 courses from the Division of Natural Sciences and Mathematics (including Biology). All courses must be eligible for science credit by science students (see individual course descriptions). Students wishing to continue to graduate school may want to consider taking MAT 209 Linear Algebra, or MAT 310 Ordinary Differential Equations, as these will better prepare them for more advanced statistical courses later in their careers.

#: **Honours Requirement:** These courses indicated with a # are required for honours. These 4 courses may not be used as concentration options if enrolled in the honours. Students must complete these 4 courses by reducing the number of free options (OPT see above).

NOTE: The sequence of the Free Options, Concentration Options, and Science Options courses is merely a suggestion. Students are free to take these options at any time or in any sequence during their degree, but they should be careful to ensure that they complete all the requirements if they wish to graduate on time.

BA Biology Major: Biodiversity and Ecology Concentration

Y1 Year:

1-BIO 196 / BIL 196 Intro Cellular and Molecular Biology	1-Humanities Option (CLA, ENG, HIS, RSC, PHI or Lib. Arts)
2-ENG 116 Effective Writing (or other ENG)	2-*Free Option 4
3-*Free Option 1	3-*Free Option 5
4-*Free Option 2	4-*Free Option 6
5-*Free Option 3	5-*Free Option 7

Note: Students taking a double degree (ESG, POL, SPO, Etc) may wish to use some of these OPT slots to start taking the required courses for their second degree.

Y2 Year: Most Cegep Science students will start at this point.

1-BIO 201 Cellular and Molecular Biology	1-BIO 206 Plant Diversity
2-BIO 205 / BIL205 Animal Diversity	2-BIO 208 / BIL208 Genetics
3-PHY 101 Statistical Methods	3-BIO 207 Evolution and Ecology
4-***Science Option 1	4-**Concentration Option 1
5-*Free Option 8	5-*Free option 9

Y3 Year:

1-BIO 338 Vertebrate Zoology 1 of BIO 339 Vertebrate Zoo 2	1-BIO 327 Advanced Ecology
2-ESG 127 Introduction to Physical Geography	2-**Concentration Option 3
3-BIO 329 Invertebrate Biology	3-**Concentration Option 4
4-**Concentration Option 2	4-*Free Option 11
5-*Free Option 10	5-*Free Option 12

Y4 Year:

1-BIO 336 Animal Physiology I	1-*Free Option 14
2-**Concentration Option 5	2-*Free Option 15
3-**Concentration Option 6	3-*Free Option 16
4-***Science Option 2	4-*Free Option 17
5-*Free Option 13	5-*Free Option 18

***Free Option:** Indicates a free option course; any course from across the university including supplemental Biology or Biochemistry courses. Students often package these free electives together to take a minor in another discipline.

****Concentration Option:** Indicates one of seven courses to be selected from the list of “Biodiversity and Ecology Concentrations Options”. At least 5 must be BIO or BCH courses.

*****Science Option:** Select any 2 courses from the Division of Natural Sciences and Mathematics (including Biology). All courses must be eligible for science credit by science students (see individual course descriptions).

NOTE: The sequence of the Free Options, Concentration Options, and Science Options courses is merely a suggestion. Students are free to take these options at any time or in any sequence during their degree, but they should be careful to ensure that they complete all the requirements if they wish to graduate on time.

Biodiversity and Ecology Concentration Options

Note: BIO 386, BIO 311, BIO 492, and BIO 493 are requirements for honours and therefore cannot be used as Concentration options by students enrolled in Honours:

BIO 311 Quantitative Methods in Biology

BIO 315 Frontiers of Biology, From Past to Present

BIO 331 Freshwater Biology

BIO 337 Animal Physiology 2

BIO 341 Population Genetics and Evolution

BIO 334 Epidemiology

BIO 338 Vertebrate Life 1

BIO 339 Vertebrate Life 2

BIO 349 Medical and Forensic Entomology

BIO 352 Microbiology

BIO 354 Insect Biodiversity

BIO 358 Animal Behaviour

BIO 386 Science Writing

BIO 392 Experiential Learning in Biodiversity & Ecology

BIO 412 Seminars in Biodiversity & Ecology

BCH 313 Metabolism

ESG 262 Introduction to GIS

ENV 337 Economics of the Environment

ENV 475 Ecological Economics

Biology Minor Requirements

Students must complete eight courses with the BIO prefix.

- 1-BIO196 Intro. to Cell & Molecular Biology
- 2-BIO 201 Cellular & Molecular Biology
- 3-BIO 205 Animal Diversity
- 4-BIO 206 Plant Diversity
- 5-BIO 207 Intro. to Evolution and Ecology
- 6-BIO 208 Genetics
- 7- Any Biology (BIO code) course
- 8- Any Biology (BIO code) course

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 Departmental Chair, to ensure that they register for all of the courses required for graduation.*

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 or BIO 155, and BIO 336
Co-requisite: BCL 313
- BCL 313 Metabolism Laboratory 1-0-3**
This course introduces the student to research approaches in metabolic enzymology and the study of enzyme kinetics. Environmental factors influencing enzyme activity as well as the effects of different inhibitory molecules will be examined. As well, protein isolation and analysis will be covered.
Co-requisite: BCH 313
- BCH 342 Bioinformatics (Principles and Practical Approaches) 3-1-3**
This course is designed to give students an introduction to the principles and techniques used in bioinformatics. In this combined lecture/lab class, students will learn how bioinformatics is used to integrate and analyse complex biological information. Students will gain knowledge and experience in using leading bioinformatics tools to analyse biological sequences (nucleotide and protein sequences) and answer important biological questions.
Prerequisite: BIO 201, BCH 210

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 Biochemistry Committee

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 Biochemistry Committee

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 and 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, 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.

This course will be offered every second year.

Prerequisite: BCH 383 (may be taken concurrently)

Corequisite: BCL 422

BCL 422 Biotechnology Laboratory 1-0-3

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

Prerequisite: BCH 383 (may be taken concurrently)

Corequisite: BCH 422

BCH 491 Honours Research Project I 3-1-6

An introduction to the planning, execution and reporting of biological research 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 Biochemistry Committee

Co-requisite or prerequisite: BIO 386

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.

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

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.

This course cannot be taken for credit by science students without prior consent by the Biology Chair. This course may be used as a replacement for Bio196 if a score of >75% is achieved. This course cannot be taken for credit by anyone who already has credit for collegial Biology NYA, BIO 191, BIO 193, BIO 196 or BIO 197

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
This course cannot be taken for credit by anyone who already has credit for collegial General Biology 2/00XU, BIO 191, BIO 193 or BIO 194.
Corequisite: BIL 196

BIL 196 Introduction to Cellular and Molecular Biology Laboratory 1-0-3
Practical exercises in microscopy, molecular and cellular biology, and histology.
Prerequisites: High School Biology and Chemistry; 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 or collegial general Biology 2/00XU or BIO 194 with a mark of 75% or better
This course may not be taken for credit by anyone who already has credit for Biology 110.

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 194 or BIO 196; Co-requisite: BIL205

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 194 or 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

Students with BIO 194 may enrol in this course with permission of the Chair of Students

Students with credit for BIO 118 cannot also receive credit for BIO 208.

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.

Pre or Co requisites: BIO205 and BIO206 or with permission of the instructor if the student can demonstrate a suitable background knowledge of the necessary material. Co-requisite BIL211. This course may not be taken for credit by students who have already completed BIL111.

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 208

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

This course cannot be taken for credit by anyone who already has credit for BIO131, BIO 132, or BIO 133

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

Biology 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

Students with credit for BIO 319 cannot receive credit for BIO 315.

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*
Students with credit for BIO 217 cannot receive credit for BIO 327.

BIO 329 Invertebrate Biology 3-3-0
Morphology, physiology, embryology, evolution and classification of invertebrate animals.

Prerequisite: BIO 205; Co-requisite: BIL 329

Students with credit for BIO 248 cannot also receive credit for BIO 329.

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

Students with credit for BIL 248 cannot also receive credit for BIL 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; 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.
Prerequisite or Co-requisite: BIO 205; BIO 207; 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
Students who have received credit for BIO 226 cannot also receive credit for BIO 336.

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
Students who have received credit for BIO 228 cannot also receive credit for BIO 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
Students who have received credit for BIL 228 cannot also receive credit for BIL 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. Students may not receive credit for this courses if they have already taken BIO 332 and BIO 367
Prerequisites: BIO 205, BIO 207, and PHY 101
- 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.
Co-requisite: BIL 339
Prerequisites: BIO 205 and BIO 207
Students may not receive credit for this course if they have already taken 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
Prerequisites: BIO 205 and BIO 207
Students may not receive credit for this course if they have already taken BIL 332
- 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 BIO 339
- 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 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
- 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 208 and BIO 201
- 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 BIO492, BIO 422, BCH491, can take the course with permission from the Departmental Chair or Instructor. Research experience is an asset.

BIO 391 Experimental 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).

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.

Note: Students may only take one experiential learning course for credit (i.e. BIO 391 or BIO 392 or ELP 300).

Coordinator: Professor Bergeron

BIO 392 Experimental 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.

Note: Students may only take one experiential learning course for credit (i.e. BIO 391, or BIO 392 or ELP 300).

Coordinator: Professor Bergeron

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: AND BIO 201

Offered in odd-numbered winters

Students with credit for BIO 224 cannot receive credit for BIO 394

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

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, BIO 207

Students with credit for BIO 362 cannot also receive credit for BIO 412.

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 committee

Students with credit for BIO 371 cannot also receive credit for BIO 421.

Coordinator: Professor Bergeron

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 committee

Students with credit for BIO 372 cannot also receive credit for BIO 422.

Coordinator: Professor Bergeron

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.

Pre-requisite: BIO 336; Pre-or Co-requisite: BIO 337

Offered in even-numbered winters

Students with credit for BIO 328 cannot also receive credit for BIO 428.

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

Students with credit for BIO 333 cannot also receive credit for BIO 433.

Note: See Exercise Science 433. Students may not take this course for credit if they have received 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 committee

Co-requisite or prerequisite: BIO 386

Students with credit for BIO 421 cannot also receive credit for BIO 492.

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: Permission of committee

Students with credit for BIO 422 cannot also receive credit for BIO 493.