

Minor Program Adjustment

Faculty: Science	Date: September 15 th , 2017
Program: Biological Science – Honours program including all specializations	
Undergraduate: <input checked="" type="checkbox"/>	Graduate: <input type="checkbox"/>

Minor Program Adjustments include: New required courses, Deletion of required courses, Other changes to degree requirements or program learning outcomes, New academic requirements or changes to existing requirements.

Motion: That CPRC approve the changes to the Biological Science program as presented.

Proposal Brief

Summary of the proposed change

a) **Introduction of a new required course BIOL1000U - Foundations in Bioscience**

We propose introducing a new first year course that aims to provide the foundational knowledge and skills for success in the biological science program. This will be a required course for all Biological Science students and will be offered in the first semester of their program.

b) **Replacement of MATH1010U and MATH 1020U with a new course MATH1015U - Mathematics for Bioscience**

We propose removing MATH1010U and 1020U from the curriculum of the Biological Science program (including all specializations) to be replaced with a course more relevant to the MATH skills required by students.

c) **Removal of BIOL 3051U and BIOL 3080U from the Biological Science program requirements, and removal of the “Complementary Studies” moniker.**

We propose to remove the term “Complementary Studies” from the comprehensive (no-specialization) Biological Science program option. The program will simply be referred to as the Biological Science program. We also propose removing BIOL3051U and BIOL 3080U from the unspecialized program course requirements. Students will still have to take the required number of BIOL and science electives, but these changes will provide more flexibility to students within the unspecialized Biological Science program.

Description of the ways in which the proposed change will enhance the program and/or opportunities for students.

a) **BIOL1000U - Foundations in Bioscience**

This course will have several benefits. Firstly, it will provide the opportunity for students to learn the practical skills that are not covered at a comprehensive level in their other courses. For example, this course will cover, in depth, areas such as the scientific method, basic principles of measurement and analysis, how to approach a laboratory experiment, time management for experiments, communication in biology, reading and writing scientific papers, data analysis and interpretation and problem solving. This course will also cover the skills needed to be successful

in learning the fundamental knowledge covered in the biological sciences program such as how to tackle course material and exams. Secondly, this course will have a strong emphasis on in-class individual and group work, instilling the importance of consistent attendance/work and time management, which should be translated to their other courses. Thirdly, this course aims to increase both student success and retention.

b) Removal of MATH 1010U and MATH 1020U, and the addition of MATH 1015U

MATH 1015U will provide the appropriate knowledge in Mathematics for students in the Biological Sciences program. Many key Math skills are required in subsequent Biology and Chemistry courses and because of short time frame students have for completion of regular lab and lecture material, there little time to spend on these numeracy skills (see course outline for the skills and topics covered). This new course will provide the appropriate depth needed for students to learn the application of math for the Biological Sciences. Students who wish to, will still be able to take MATH 1010U and MATH 1020U as science elective courses.

c) Removal of BIOL 3051U and BIOL 3080U from the Biological Sciences program, and removal of the “Complementary Studies” moniker.

The removal “Complementary Studies” indicator will help to clarify that Biological Science is the major program of study, as well as assist in emphasizing the distinct nature of the specializations within Biological Science program. The removal of BIOL 3051U and BIOL 3080U as core requirements of the unspecialized Biological Science program will bring our program more in line with other institutions which allow students in the comprehensive major option the flexibility in choosing their 3rd and 4th year courses. Students will still have the option to take both courses as electives.

Process of consultation with other units if the change(s) involves students, staff, and/or faculty from other programs or courses

There have been detailed discussions over the past year with the program director for Mathematics, Dr. Sean Bohun who designed the course template based of feedback from the Biology faculty. We have also tentatively chosen a textbook called Mathematics for the Biosciences, which includes all of the content that we deemed important for the Biology program.

The faculty in the biological sciences program supports all of the other changes proposed.

Analysis of financial and enrolment implications

The financial implications for the addition of BIOL 1000U and MATH 1015U is two potential sessional positions within the Faculty of Science. The associated costs have been discussed with the Dean. Costs associated with the tutorial sections for MATH 1015U will be offset by the cost savings from needing fewer tutorial sections in MATH 1010U and MATH 1020U. There are no other projected financial implications with regard to these changes.

We anticipate that these changes will have a positive impact on program enrolment, retention, and progression. Students will receive the necessary numerical knowledge and foundational skillset to be successful in a Biological Science program, while still having the option to expand their mathematical abilities through taking MATH 1010U and MATH 1020U as electives.

Similarly, students within the unspecialized Biological Science will have more flexibility to tailor their course selection to their interests and strengths.

Proposed Implementation Date (state term, e.g. Fall 2017)

Fall 2018.

Transition Plan (include a plan for all current students in the program, by year level)

- a) **The replacement of MATH 1000U/1010U and MATH 1020U, with MATH 1015U and BIOL 1000U.** It is recommended that current students in all Biological Science programs complete MATH 1000U/1010U and MATH 1020U as part of their existing program requirements. However, in consultation with the Science Advisors and the UPD, current Biological Science students who have been unable to pass MATH 1000U/1010U and/or MATH 1020U may be approved to take MATH 1015U and BIOL 1000U as substitutions. In this scenario, MATH 1015U and BIOL 1000U will only replace the program requirements of MATH 1000U/1010U and/or MATH 1020U. They will not replace the grade for any attempt at MATH 1000U/1010U or MATH 1020U within the student's GPA calculation.
- b) In general, MATH 1015U and BIOL 1000U will **not** be available to existing students as science electives. This is particularly true for students entering their 3rd and 4th year, as the implementation of these two courses is part of an overall program change, the outcomes of which are currently being met for these students in a different form. That being said, Biological Science students entering 2nd year who are struggling in their program may, in consultation with the Science Advisors and with approval from the UPD, be allowed to take BIOL 1000U and MATH 1015U concurrently with their second year courses. In this instance, these courses will apply as science electives.
- c) Current students in the unspecialized Biological Science program will not be required to complete BIOL 3051U and BIOL 3080U as part of their degree requirements, effective Fall 2018. The courses will remain as recommend BIOL electives for these students.

Calendar Copy and/or Program Maps (highlight revisions to existing curriculum)

Biological Science – Complementary Studies

General information

As students proceed through the Biological Science program, they will obtain a background in cell biology, genetics and molecular biology, physiology, biochemistry and developmental biology. Senior level courses such as Bioethics, Neuroscience, Functional Genomics and Proteomics, along with access to modern laboratories, computational tools, sophisticated equipment and state-of-the-art facilities will enable advanced research work and skills training in industry best practice and in research.

~~The Biological Science program offers specializations in Life Sciences, Environmental Toxicology and Pharmaceutical Biotechnology, as well as an unspecialized Biology degree (Complementary Studies).~~

Students can study through the Biological Science major, or choose to specialize in either Life Sciences, Environmental Toxicology, or Pharmaceutical Biotechnology.

Admission requirements

Admission is competitive. The specific average or standing required for admission varies from year to year. Students are selected by taking into consideration a wide range of criteria including school marks, distribution of subjects taken, and performance in subjects relevant to the academic program. Possession of the minimum requirements does not guarantee acceptance. Preference will be given to applicants with the best qualifications.

Current Ontario secondary school students must complete the Ontario Secondary School Diploma (OSSD) with six 4U or 4M credits including English (ENG4U), Advanced Functions (MHF4U), and two of Biology (SBI4U), Calculus and Vectors (MCV4U), Chemistry (SCH4U), or Physics (SPH4U). In addition, a combined minimum 70 per cent average in math and science courses is required. It is recommended that all four MCV4U, SBI4U, SCH4U and SPH4U be taken. All other applicants should refer to admissions for the requirements for their specific category of admission.

Program details and degree requirements

~~Students taking Complementary Studies will work with the science academic advisors to customize a Biological Science program to match their interests and career plans. The requirements for the regular four-year Biological Science — Complementary Studies program are detailed below.~~

~~In addition to the regular program, a co-op program is also available. Students in Complementary Studies wishing to follow the co-op program Biological Science — Complementary Studies — Co-operative Education should seek academic advising early in their second year.~~

Students taking Biological Science will work with the science academic advisors to customize a program map that matches their interests and career plans. The requirements for the regular four-year Honours Biological Science program are detailed below.

In addition to the regular program, a co-op program is also available. Students in Biological Science wishing to follow the co-op program should seek academic advising early in their second year.

Although reasonable efforts will be made to adhere to the following program details, course requirements and term offerings may change.

Students must successfully complete 120 credit hours according to the following requirements:

First-year required science courses – 27 credit hours

- BIOL 1000U – Foundations in Bioscience
- BIOL 1010U – Biology I: Molecular and Cellular Systems
- BIOL 1020U – Biology II: Diversity of Life and Principles of Ecology
- CHEM 1010U – Chemistry I
- CHEM 1020U – Chemistry II
- CSCI 1040U – Introduction to Programming for Scientists
- MATH 1015U – Mathematics for Bioscience ++
- ~~MATH 1000U – Introductory Calculus~~ ~~or~~ ~~MATH 1010U – Calculus I~~
- ~~MATH 1020U – Calculus II~~ +
- ~~PHY 1010U – Physics I~~ ~~or~~ PHY 1030U – Introductory Physics
- PHY 1040U – Physics for Biosciences ++

~~+All students who have completed Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U) should take MATH 1010U and PHY 1010U. Students without one of these high school courses or equivalent are directed to take MATH 1000U and PHY 1030U.~~

++Students who wish to take upper-year physics courses must take MATH 1000U or MATH 1010U, MATH 1020U, PHY 1010U or PHY 1030U, and PHY 1020U. However, students who achieve a B standing or higher in PHY 1040U will be permitted to proceed to higher-level physics courses. Students who wish to take upper-year mathematics courses must take MATH 1000U or MATH 1010U, and MATH 1020U.

Additional core courses –~~21~~ 15 credit hours in Biological Science

- BIOL 2010U – ~~Introductory Human~~ Physiology
- BIOL 2020U – Genetics and Molecular Biology
- BIOL 2030U – Cell Biology
- BIOL 2060U – Introduction to Microbiology and Immunology
- BIOL 2080U – Biochemistry I
- ~~BIOL 3051U – Developmental Biology~~
- ~~BIOL 3080U – Biochemistry II~~

Upper-year specialization –~~21~~ 27 credit hours in Biological Science

All students must successfully complete at least 21 27 credit hours in additional courses in biological science at the third- or fourth-year level, with a minimum of six of these credit hours at the fourth-year level.

Additional science courses – total of 27 credit hours

These science courses must include:

- BIOL 4080U – Bioethics
- CHEM 2020U – Introduction to Organic Chemistry
- STAT 2020U – Statistics and Probability for Biological Science
- Fourth-year science elective

Remaining 15 credit hours

The remaining 15 credit hours must be in courses offered by the Faculty of Science in the subject areas of:

- Biology
- Chemistry
- Computer Science
- Energy and Environment Science
- Forensic Science
- Mathematics
- Physics

Particular sets of science courses are designated as minor programs. Please consult Astronomy minor, Chemistry minor, Computational Science minor, Data Science minor, Mathematics minor or Physics minor for more information.

Liberal Studies and non-science courses – 12 credit hours

These courses must be in subjects not taught within the Faculty of Science.

General electives – 12 credit hours

These courses may be in science or in non-science subjects.

Notes:

The program must include 36 credit hours in science courses at the third- and fourth-year level; of these, at least 12 credit hours must be at the fourth-year level.

No more than 42 credit hours may be taken at the first-year level.

Biological Science – Environmental Toxicology specialization

General information

As students proceed through the Biological Science program, they will obtain a background in cell biology, genetics and molecular biology, physiology, biochemistry and developmental biology. Senior level courses such as Bioethics, Neuroscience, Functional Genomics and Proteomics, along with access to modern laboratories, computational tools, sophisticated equipment and state-of-the-art facilities will enable advanced research work and skills training in industry best practice and in research.

~~The Biological Science program offers specializations in Life Sciences, Environmental Toxicology and Pharmaceutical Biotechnology, as well as an unspecialized Biology degree (Complementary Studies).~~

Students can study through the Biological Science major, or choose to specialize in either Life Sciences, Environmental Toxicology, or Pharmaceutical Biotechnology.

Environmental Toxicology specialization

Environmental Toxicology is an interdisciplinary applied field, which focuses on the effects of contaminants on the environment and involves agriculture, health, industry, and urban development. It combines a strong base in biology and chemistry, with a focus on physiology, biochemistry, environmental science, and environmental chemistry.

In addition to the regular program, a co-op program is also available. Students in Environmental Toxicology interested in the co-op program, should contact the Faculty of Science Co-op Coordinator as early as the fall of their second year.

Admission requirements

Admission is competitive. The specific average or standing required for admission varies from year to year. Students are selected by taking into consideration a wide range of criteria including school marks, distribution of subjects taken, and performance in subjects relevant to the academic program. Possession of the minimum requirements does not guarantee acceptance. Preference will be given to applicants with the best qualifications.

Current Ontario secondary school students must complete the Ontario Secondary School Diploma (OSSD) with six 4U or 4M credits including English (ENG4U), Advanced Functions (MHF4U), and two of Biology (SBI4U), Calculus and Vectors (MCV4U), Chemistry (SCH4U), or Physics (SPH4U). In addition, a

combined minimum 70 per cent average in math and science courses is required. It is recommended that all four MCV4U, SBI4U, SCH4U and SPH4U be taken. All other applicants should refer to admissions for the requirements for their specific category of admission.

Program details and degree requirements

Although reasonable efforts will be made to adhere to the following program map, course requirements and term offerings may change.

Year 1

Semester 1 (15 credit hours)

- [BIOL 1000U – Foundations in Bioscience](#)
- BIOL 1010U – Biology I: Molecular and Cellular Systems
- CHEM 1010U – Chemistry I
- [MATH 1015U – Mathematics for Bioscience ++](#)
- [PHY 1030U – Introductory Physics ++](#)
- [CSCI 1040U – Introduction to Programming for Scientists](#)

One of:

- [MATH 1000U – Introductory Calculus + or](#)
- [MATH 1010U – Calculus I +](#)

One of:

- [PHY 1010U – Physics I + or](#)
- [PHY 1030U – Introductory Physics +](#)

Semester 2 (15 credit hours)

- Elective**
- BIOL 1020U – Biology II: Diversity of Life and Principles of Ecology
- CHEM 1020U – Chemistry II
- [CSCI 1040U – Introduction to Programming for Scientists](#)
- [MATH 1020U – Calculus II](#)
- PHY 1040U – Physics for Biosciences ++

~~+All students who have completed Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U) should take MATH 1010U and PHY 1010U. Students without one of these high school courses or equivalent are directed to take MATH 1000U and PHY 1030U~~

++Students who wish to take upper-year physics courses must take [MATH 1000U or MATH 1010U, MATH 1020U, PHY 1010U or PHY 1030U,](#) and PHY 1020U. However, students who achieve a B standing or higher in PHY 1040U will be permitted to proceed to higher-level physics courses. [Students who wish to take upper-year mathematics courses must take MATH 1000U or MATH 1010U, and MATH 1020U.](#)

Year 2

Semester 1 (15 credit hours)

- BIOL 2010U – ~~Introductory~~ [Human](#) Physiology
- BIOL 2030U – Cell Biology
- CHEM 2020U – Introduction to Organic Chemistry
- CHEM 2130U – Analytical Chemistry for Biosciences
- STAT 2020U – Statistics and Probability for Biological Science

Semester 2 (15 credit hours)

- Elective**
- BIOL 2020U – Genetics and Molecular Biology
- BIOL 2080U – Biochemistry I
- BIOL 2060U – Introduction to Microbiology and Immunology
- ENVS 1000U – Environmental Science

Year 3

Semester 1 (15 credit hours)

- Elective**
- BIOL 3020U – Principles of Pharmacology and Toxicology
- BIOL 3051U – Developmental Biology
- BIOL 3080U – Biochemistry II
- CHEM 3050U – Environmental Chemistry

Semester 2 (15 credit hours)

- Three electives**
- CHEM 3830U – Instrumental Analytical Chemistry
- STAT 3010U – Biostatistics

Year 4

Semester 1 (15 credit hours)

- Elective**
- BIOL 4010U – Introduction to Environmental Research Methods
- BIOL 4020U – Environmental Risk Characterization
- BIOL 4052U – Advanced Developmental Biology Laboratory

One of:

- BIOL 4410U – Biology Thesis Project I *** or
- Senior Biology elective**

Semester 2 (15 credit hours)

- Senior Biology elective**
- Elective**
- BIOL 4030U – Advanced Topics in Environmental Toxicology
- BIOL 4080U – Bioethics

One of:

- BIOL 4420U – Biology Thesis Project II *** or
- Senior Biology elective**

Notes:

No more than 42 credit hours may be taken at the first-year level.

**Electives and breadth requirements

All students must complete 27 elective credit hours including at least one senior biology elective. Students not accepted to take BIOL 4410U and BIOL 4420U must take an additional two senior biology electives for a total of 33 elective credit hours. A senior biology elective is defined as any 4000-level biology course not specified in the course map. At least 15 elective credit hours must be in courses

offered by the Faculty of Science including the 3 credit hours in a senior biology elective; the additional two senior Biology electives required for students who are not enrolled in thesis cannot be used to meet this requirement. In order to satisfy breadth requirements, no more than 9 elective credit hours may be in biology (BIOL) courses; at least 12 elective credit hours must be in courses outside the Faculty of Science.

***Thesis Project or Senior Biology electives

Students in clear academic standing who have completed 90 credit hours of their BIOL program and six third-year required courses may optionally apply to take a two-course sequence consisting of BIOL 4410U – Biology Thesis Project I and BIOL 4420U – Biology Thesis Project II. Students not accepted to take the thesis courses must complete two additional senior biology electives instead. A senior biology elective is defined as any 4000-level biology course not specified in the course map. A student meeting the above requirements who does not take BIOL 4410U and BIOL 4420U may optionally apply to take BIOL 4430U – Directed Studies in Biology as one of the required senior biology electives. Opportunities for the Thesis Project and Directed Studies options are limited; for either of these options, students must apply through Science Advising by March 30 following completion of the first three years of the program.

Biological Science – Life Sciences specialization

General information

As students proceed through the Biological Science program, they will obtain a background in cell biology, genetics and molecular biology, physiology, biochemistry and developmental biology. Senior level courses such as Bioethics, Neuroscience, Functional Genomics and Proteomics, along with access to modern laboratories, computational tools, sophisticated equipment and state-of-the-art facilities will enable advanced research work and skills training in industry best practice and in research.

~~The Biological Science program offers specializations in Life Sciences, Environmental Toxicology and Pharmaceutical Biotechnology, as well as an unspecialized Biology degree (Complementary Studies).~~

Students can study through the Biological Science major, or choose to specialize in either Life Sciences, Environmental Toxicology, or Pharmaceutical Biotechnology.

Life Sciences specialization

This specialization is well-suited for students interested in medical school and related medical and health science careers. The emphasis is on human aspects of biology, providing an integrated grounding in the life sciences with a particular focus on biology and chemistry and additional course work in neuroscience and human anatomy. ~~Students have priority access to all required courses for medical school applications.~~ Students in this program have priority access to all required courses for professional programs such as medicine, dentistry, or pharmacy. Some professional programs will have prerequisite courses required for admission. Students wishing to customize their degree should contact student advising early in their degree.

By means of its broad science foundation and its human biology focus, this program provides an excellent basis for writing the MCAT examinations and for satisfying course requirements for applying to medical school.

In addition to the regular program, a co-op program is also available. Students in Life Sciences interested in the co-op program, should contact the Faculty of Science Co-op Coordinator as early as the fall of their second year.

Admission requirements

Admission is competitive. The specific average or standing required for admission varies from year to year. Students are selected by taking into consideration a wide range of criteria including school marks, distribution of subjects taken, and performance in subjects relevant to the academic program. Possession of the minimum requirements does not guarantee acceptance. Preference will be given to applicants with the best qualifications.

Current Ontario secondary school students must complete the Ontario Secondary School Diploma (OSSD) with six 4U or 4M credits including English (ENG4U), Advanced Functions (MHF4U), and two of Biology (SBI4U), Calculus and Vectors (MCV4U), Chemistry (SCH4U), or Physics (SPH4U). In addition, a combined minimum 70 per cent average in math and science courses is required. It is recommended that all four MCV4U, SBI4U, SCH4U and SPH4U be taken. All other applicants should refer to admissions for the requirements for their specific category of admission.

Program details and degree requirements

Although reasonable efforts will be made to adhere to the following program map, course requirements and term offerings may change.

Year 1

Semester 1 (15 credit hours)

- ~~Elective** (recommend CSCI 1040U)~~
- ~~BIOL 1000U – Foundations in Bioscience~~
- BIOL 1010U – Biology I: Molecular and Cellular Systems
- CHEM 1010U – Chemistry I
- ~~MATH 1015U – Mathematics for Bioscience ++~~
- ~~PHY 1030U – Introductory Physics ++~~
- One of:
 - ~~MATH 1000U – Introductory Calculus + or~~
 - ~~MATH 1010U – Calculus I +~~
- One of:
 - ~~PHY 1010U – Physics I + or~~
 - ~~PHY 1030U – Introductory Physics +~~

Semester 2 (15 credit hours)

- ~~Elective** (recommend CSCI 1040U)~~
- BIOL 1020U – Biology II: Diversity of Life and Principles of Ecology
- CHEM 1020U – Chemistry II
- ~~MATH 1020U – Calculus II~~

- PHY 1040U – Physics for Biosciences ++
- PSYC 1000U – Introductory Psychology

~~+All students who have completed Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U) should take MATH 1010U and PHY 1010U. Students without one of these high school courses or equivalent are directed to take MATH 1000U and PHY 1030U.~~

++Students who wish to take upper-year physics courses must take MATH 1000U or MATH 1010U, MATH 1020U, PHY 1010U or PHY 1030U and PHY 1020U. However, students who achieve a B standing or higher in PHY 1040U will be permitted to proceed to higher-level physics courses. Students who wish to take upper-year mathematics courses must take MATH 1000U or MATH 1010U, and MATH 1020U.

Year 2

Semester 1 (15 credit hours)

- Elective**
- BIOL 2010U – ~~Introductory~~ Human Physiology
- BIOL 2030U – Cell Biology
- CHEM 2020U – Introduction to Organic Chemistry
- STAT 2020U – Statistics and Probability for Biological Science

Semester 2 (15 credit hours)

- BIOL 2020U – Genetics and Molecular Biology
- BIOL 2080U – Biochemistry I
- BIOL 2050U – Human Anatomy
- BIOL 2060U – Introduction to Microbiology and Immunology
- CHEM 2120U – Organic Chemistry

Year 3

Semester 1 (15 credit hours)

- Three electives**
- BIOL 3020U – Principles of Pharmacology and Toxicology
- BIOL 3080U – Biochemistry II

Semester 2 (15 credit hours)

- Two electives**
- BIOL 3040U – Animal Physiology
- BIOL 3060U – Fundamentals of Neuroscience
- BIOL 3650U – Fundamentals of Nutrition

Year 4

Semester 1 (15 credit hours)

- Senior Biology elective**
 - Three electives**
- One of:
- BIOL 4410U – Biology Thesis Project I *** or
 - Senior Biology elective**

Semester 2 (15 credit hours)

- Two electives**

- BIOL 4820U – Neuropharmacology

- BIOL 4080U – Bioethics

One of:

- BIOL 4420U – Biology Thesis Project II *** or

- Senior Biology elective**

Notes:

No more than 42 credit hours maybe taken at the first-year level.

**Electives and breadth requirements

All students must complete 39 elective credit hours. Students not accepted to take BIOL 4410U and BIOL 4420U must take an additional two senior biology electives for a total of 45 elective credit hours. A senior biology elective is defined as any 4000-level biology course not specified in the course map. At least 15 elective credit hours must be in courses offered by the Faculty of Science including at least 3 credit hours at the Senior Biology level; the additional two senior biology electives required for students who are not enrolled in thesis cannot be used to meet this requirement. In order to satisfy breadth requirements, no more than 12 elective credit hours may be in biology (BIOL) courses; at least 12 elective credit hours must be in courses outside the Faculty of Science. Students must take the remaining 12 elective credit hours in a general elective (offered by the Faculty of Science or outside the Faculty of Science).

***Thesis Project or Senior Biology electives

Students in clear academic standing who have completed 90 credit hours of their BIOL program and six third-year required courses may optionally apply to take a two-course sequence consisting of BIOL 4410U – Biology Thesis Project I and BIOL 4420U – Biology Thesis Project II. Students not accepted to take the thesis courses must complete two additional senior biology electives instead. A senior biology elective is defined as any 4000-level biology course not specified in the course map. A student meeting the above requirements who does not take BIOL 4410U and BIOL 4420U may optionally apply to take BIOL 4430U – Directed Studies in Biology as one of the required senior biology electives. Opportunities for the Thesis Project and Directed Studies options are limited; for either of these options, students must apply through Science Advising by March 30 following completion of the first three years of the program.

Biological Science – Pharmaceutical Biotechnology specialization

General information

As students proceed through the Biological Science program, they will obtain a background in cell biology, genetics and molecular biology, physiology, biochemistry and developmental biology. Senior level courses such as Bioethics, Neuroscience, Functional Genomics and Proteomics, along with access to modern laboratories, computational tools, sophisticated equipment and state-of-the-art facilities will enable advanced research work and skills training in industry best practice and in research.

~~The Biological Science program offers specializations in Life Sciences, Environmental Toxicology and Pharmaceutical Biotechnology, as well as an unspecialized Biology degree (Complementary Studies).~~

~~Students can study through the Biological Science major, or choose to specialize in either Life Sciences, Environmental Toxicology, or Pharmaceutical Biotechnology.~~

Pharmaceutical Biotechnology specialization

Biotechnology is a rapidly growing area with many applications in health, agriculture and industry. The Pharmaceutical Biotechnology specialization combines a primary emphasis on both biology and chemistry. Students gain a strong understanding of cell and molecular biology, microbiology, immunology, biochemistry and physiology. Students in this specialization also benefit from enhanced laboratory experience.

In addition to the regular program, a co-op program is also available. Students in Pharmaceutical Biotechnology interested in the co-op program, should contact the Faculty of Science Co-op Coordinator as early as the fall of their second year.

Admission requirements

Admission is competitive. The specific average or standing required for admission varies from year to year. Students are selected by taking into consideration a wide range of criteria including school marks, distribution of subjects taken, and performance in subjects relevant to the academic program. Possession of the minimum requirements does not guarantee acceptance. Preference will be given to applicants with the best qualifications.

Current Ontario secondary school students must complete the Ontario Secondary School Diploma (OSSD) with six 4U or 4M credits including English (ENG4U), Advanced Functions (MHF4U), and two of Biology (SBI4U), Calculus and Vectors (MCV4U), Chemistry (SCH4U), or Physics (SPH4U). In addition, a combined minimum 70 per cent average in math and science courses is required. It is recommended that all four MCV4U, SBI4U, SCH4U and SPH4U be taken. All other applicants should refer to admissions for the requirements for their specific category of admission.

Program details and degree requirements

Although reasonable efforts will be made to adhere to the following program map, course requirements and term offerings may change.

Year 1

Semester 1 (15 credit hours)

- [BIOL 1000U – Foundations in Bioscience](#)
 - BIOL 1010U – Biology I: Molecular and Cellular Systems
 - CHEM 1010U – Chemistry I
 - [CSCI 1040U – Introduction to Programming for Scientists](#)
 - [MATH 1015U – Mathematics for Bioscience ++](#)
 - [PHY 1030U – Introductory Physics ++](#)
- One of:
- [MATH 1000U – Introductory Calculus + or](#)

~~•MATH 1010U – Calculus I +~~

One of:

~~•PHY 1010U – Physics I + or~~

~~•PHY 1030U – Introductory Physics +~~

Semester 2 (15 credit hours)

- Elective**
- BIOL 1020U – Biology II: Diversity of Life and Principles of Ecology
- CHEM 1020U – Chemistry II
- CSCI 1040U – Introduction to Programming for Scientists
- ~~•MATH 1020U – Calculus II~~
- PHY 1040U – Physics for Biosciences ++

~~+All students who have completed Grade 12 Advanced Functions (MHF4U) and Calculus and Vectors (MCV4U) should take MATH 1010U and PHY 1010U. Students without one of these high school courses or equivalent are directed to take MATH 1000U and PHY 1030U~~

++Students who wish to take upper-year physics courses must take MATH 1000U or MATH 1010U, MATH 1020U, PHY 1010U or PHY 1030U and PHY 1020U. However, students who achieve a B standing or higher in PHY 1040U will be permitted to proceed to higher-level physics courses.

Students who wish to take upper-year mathematics courses must take MATH 1000U or MATH 1010U, and MATH 1020U.

Year 2

Semester 1 (15 credit hours)

- BIOL 2010U – ~~Introductory Human~~ Physiology
- BIOL 2030U – Cell Biology
- CHEM 2020U – Introduction to Organic Chemistry
- CHEM 2130U – Analytical Chemistry for Biosciences
- STAT 2020U – Statistics and Probability for Biological Science

Semester 2 (15 credit hours)

- Two electives**
- BIOL 2020U – Genetics and Molecular Biology
- BIOL 2080U – Biochemistry I
- BIOL 2060U – Introduction to Microbiology and Immunology

Year 3

Semester 1 (15 credit hours)

- Elective**
- BIOL 3020U – Principles of Pharmacology and Toxicology
- BIOL 3032U – Advanced Microbiology
- BIOL 3051U – Developmental Biology
- BIOL 3080U – Biochemistry II

Semester 2 (15 credit hours)

- ~~Two~~Three electives**
- ~~•BIOL 3010U – Laboratory Methods in Molecular Biology~~
- BIOL 3040U – Animal Physiology

- CHEM 3830U – Instrumental Analytical Chemistry

Year 4

Semester 1 (15 credit hours)

- Elective**
- BIOL 4040U – Applied Molecular Biology
- BIOL 4052U – Advanced Developmental Biology Laboratory
- BIOL 4070U – Advanced Biochemistry

One of:

- BIOL 4410U – Biology Thesis Project I *** or
- Senior Biology elective**

Semester 2 (15 credit hours)

- ~~Elective**~~
- BIOL 4041U – Laboratory Methods in Molecular Biology
- BIOL 4050U – Advanced Topics in Pharmaceutical Biotechnology
- BIOL 4060U – Functional Genomic and Proteomics
- BIOL 4080U – Bioethics

One of:

- BIOL 4420U – Biology Thesis Project II *** or
- Senior Biology elective**

Notes:

No more than 42 credit hours may be taken at the first-year level.

**Electives and breadth requirements

All students must complete 24 elective credit hours. Students not accepted to take BIOL 4410U and BIOL 4420U must take an additional two senior biology electives for a total of 30 elective credit hours. A senior biology elective is defined as any 4000-level biology course not specified in the course map. At least 12 elective credit hours must be in courses offered by the Faculty of Science; the additional two senior biology electives required for students who are not enrolled in thesis cannot be used to meet this requirement. In order to satisfy breadth requirements, no more than 9 elective credit hours may be in biology (BIOL) courses; at least 12 elective credit hours must be in courses outside the Faculty of Science.

***Thesis Project or Senior Biology elective courses

Students in clear academic standing who have completed 90 credit hours of their BIOL program and six third-year required courses may optionally apply to take a two-course sequence consisting of BIOL 4410U – Biology Thesis Project I and BIOL 4420U – Biology Thesis Project II. Students not accepted to take the thesis courses must complete two additional senior biology electives instead. A senior biology elective is defined as any 4000-level biology course not specified in the course map. A student meeting the above requirements who does not take BIOL 4410U and BIOL 4420U may optionally apply to take BIOL 4430U – Directed Studies in Biology as one of the required senior biology electives. Opportunities for the Thesis Project and Directed Studies options are limited; for either of these options, students must apply through Science Advising by March 30 following completion of the first three years of the program.

Biological Science – Advanced Entry

We recognize that these changes will affect the Biological Science - Advanced Entry program. We are waiting on additional information from Durham College concerning their Biotechnology program, so that we can correctly assess the impact on the Advance Entry program. The appropriate curriculum changes will follow.

Attachments

BIOL 1000U_New Course_Sept 2017

MATH 1015U_New Course_Sept 2017

APPROVAL DATES

Curriculum Committee approval	September 20 th , 2017
Faculty Council approval	October 4 th , 2017
CPRC Approval	19 January 2018
Submission to Academic Council	27 February 2018

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Science			
Full Course Title: Foundations in Bioscience			
Short Form Course Title (max 30 characters): Foundations in Bioscience			
Subject Code and Course number: BIOL 1000U	Cross-listings:	<input checked="" type="checkbox"/> Core <input type="checkbox"/> Elective	Credit weight: 3 cr. Hrs.
Contact hours (please indicate number of hours for each component):			
<input checked="" type="checkbox"/> Lecture 3hrs <input type="checkbox"/> Lab <input type="checkbox"/> Tutorial <input type="checkbox"/> Other			

PROGRAM(S) (if applicable, form should accompany a program adjustment/proposal)

Biological Science – Complementary Studies, Life Science, Environmental Toxicology, and Pharmaceutical Biotechnology
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CALENDAR DESCRIPTION

This course will provide an early introduction to the practical skills that are essential to the Biological Sciences program. Areas covered will include, basic principles of measurement and analysis, hypothesis testing and how to approach a laboratory experiment, communication in biology, reading and writing scientific papers, data analysis and interpretation and problem solving. This course will also cover the skills needed to be successful in learning the fundamental knowledge covered in the biological sciences program such as how to tackle course material and exams.

Prerequisites	Grade 12 Biology (SBI4U) (recommended)
Co-requisites	
Credit restrictions	
Credit exemptions	
Grading scheme	<input checked="" type="checkbox"/> letter grade <input type="checkbox"/> pass/fail

LEARNING OUTCOMES (this section is required)

1) Demonstrate an understanding of experimental measurement and analysis 2) Demonstrate an understanding of how to conduct, record and analyze results of a laboratory experiment 3) Present and interpret results of a scientific experiment 4) Develop the learning skills needed for success in the biological science program 5) Develop oral and written communication skills that will be built upon throughout the program

COURSE INSTRUCTIONAL METHOD

(check all that <u>may</u> apply) <input checked="" type="checkbox"/> CLS (in-class) <input type="checkbox"/> HYB (in-class and online) <input type="checkbox"/> IND (individual studies) <input type="checkbox"/> OFF (off-site) <input type="checkbox"/> WB1 (synchronous online delivery) <input type="checkbox"/> WEB (asynchronous online delivery)

TEACHING AND ASSESSMENT METHODS

Two midterms (30%), in-class assignments (30%), final exam (40%)

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

This course will require one new sessional position, the associated costs of which have been discussed and approved by the Dean of Science.

EFFECTIVE SEMESTER (Specify Term e.g. Fall 2017)

Fall 2018

APPROVAL DATES

Curriculum Committee approval	September 20 th , 2017
Faculty Council approval	October 4th, 2017
Submission to CPRC/GSC	19 January 2018

NEW COURSE TEMPLATE

For changes to existing courses see Course Change Template

Faculty: Science			
Full Course Title: Mathematics for Bioscience			
Short Form Course Title (max 30 characters): Mathematics for Bioscience			
Subject Code and Course number: MATH 1015U	Cross-listings:	<input checked="" type="checkbox"/> Core <input type="checkbox"/> Elective	Credit weight: 3 cr. Hrs.
Contact hours (please indicate number of hours for each component):			
<input checked="" type="checkbox"/> Lecture 3hrs <input type="checkbox"/> Lab <input checked="" type="checkbox"/> Tutorial 1.5hrs <input type="checkbox"/> Other			

PROGRAM(S) (if applicable, form should accompany a program adjustment/proposal)

Biological Science – Complementary Studies, Life Science, Environmental Toxicology, Pharmaceutical Biotechnology
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CALENDAR DESCRIPTION

Mathematics is a key tool for the biological sciences. This course emphasizes the mathematical applications that are used in the biological sciences rather than theory. Students begin with a review of pre-calculus topics, to ensure the necessary mathematical skills to succeed in the course, and before they are introduced to limits and continuity. Topics will include quantities and units; tables, graphs and functions; waves and trigonometry; differentiation and integration
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Prerequisites	MHF4U
Co-requisites	
Credit restrictions	
Credit exemptions	
Grading scheme	<input checked="" type="checkbox"/> letter grade <input type="checkbox"/> pass/fail

LEARNING OUTCOMES (this section is required)

- | |
|--|
| <ul style="list-style-type: none"> a) Familiarity and manipulation of physical quantities, numerical values and units b) Understanding conversion of units c) Understand arithmetic of fractions d) Understanding of powers, roots, ratios and percentages e) Order of precedence or sequence of operations f) Ability to use scientific notation g) Solve first-order, quadratic and simultaneous equations h) Understanding the concept of a function and inverse functions i) Graph simple functions including: powers, roots, exponentials, logarithms j) Understanding of basic trigonometric functions: sine and cosine k) Understanding sinusoidal oscillations: amplitude, frequency, phase l) Familiarity with the slope of a curve and differentiating simple functions m) Manipulation and proper use of derivatives: maximum and minimum points, points of inflection, sketching curves n) Ability to tangents and linear approximations |
|--|

- o) Understand integration of simple expressions
- p) Ability to compute the area under a curve and find the mean value of an expression

COURSE INSTRUCTIONAL METHOD

- (check all that may apply) CLS (in-class) HYB (in-class and online)
- IND (individual studies) OFF (off-site)
- WB1 (synchronous online delivery)
- WEB (asynchronous online delivery)

TEACHING AND ASSESSMENT METHODS

In-class assignments, Final Exam

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

This course will require one new sessional position, the associated costs of which have been discussed and approved by the Dean of Science. Cost of tutorials will be offset by savings in the reduction of tutorials required for MATH 1000/1010/1020.

EFFECTIVE SEMESTER (Specify Term e.g. Fall 2017)

Fall 2018

APPROVAL DATES

Curriculum Committee approval	September 20 th , 2017
Faculty Council approval	October 4th 2017
Submission to CPRC/GSC	January 19 2018