# 2011-2012 Undergraduate Calendar

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2011-2012 academic year, including the Summer Semester 2011, the Fall Semester 2011 and the Winter Semester 2012.

For your convenience the Undergraduate Calendar is available in PDF format.

If you wish to link to the Undergraduate Calendar please refer to the Linking Guidelines.

The University is a full member of:

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# Disclaimer

## University of Guelph 2011

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2011-2012 academic year, including the Summer Semester 2011, the Fall Semester 2011 and the Winter Semester 2012.

The University reserves the right to change without notice any information contained in this calendar, including fees, any rule or regulation pertaining to the standards for admission to, the requirements for the continuation of study in, and the requirements for the granting of degrees or diplomas in any or all of its programs. The publication of information in this calendar does not bind the University to the provision of courses, programs, schedules of studies, or facilities as listed herein.

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Published by: Undergraduate Program Services

# Introduction

## Collection, Use and Disclosure of Personal Information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/index.html. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes. Certain personal information is disclosed to external agencies, including the Ontario Universities Application Centre, the Ministry of Training, Colleges and Universities, and Statistics Canada, for statistical and planning purposes, and is disclosed to other individuals or organizations in accordance with the Office of Registrarial Services Departmental Policy on the Release of Student Information. For details on the use and disclosure of this information call the Office of Registrarial Services at the University at (519) 824-4120 or see http://www.uoguelph.ca/registrar/registrar/index.cfm?index.

## Statistics Canada - Notification of Disclosure

For further information, please see Statistics Canada's web site at http://www.statcan.ca and Section XIV Statistics Canada.

## Address for University Communication

Depending on the nature and timing of the communication, the University may use one of these addresses to communicate with students. Students are, therefore, responsible for checking all of the following on a regular basis:

### Email Address

The University issued email address is considered an official means of communication with the student and will be used for correspondence from the University. Students are responsible for monitoring their University-issued email account regularly. See Section I--Statement of Students' Academic Responsibilities for more information.

### Home Address

Students are responsible for maintaining a current mailing address with the University. Address changes can be made, in writing, through Undergraduate Program Services.

## Name Changes

The University of Guelph is committed to the integrity of its student records, therefore, each student is required to provide either on application for admission or on personal data forms required for registration, his/her complete, legal name. Any requests to change a name, by means of alteration, deletion, substitution or addition, must be accompanied by appropriate supporting documentation.

## Student Confidentiality and Release of Student Information Policy Excerpt

The University undertakes to protect the privacy of each student and the confidentiality of his or her record. To this end the University shall refuse to disclose personal information to any person other than the individual to whom the information relates where disclosure would constitute an unjustified invasion of the personal privacy of that person or of any other individual. All members of the University community must respect the confidential nature of the student information which they acquire in the course of their work.

Complete policy at http://www.uoguelph.ca/policies/pdf/ORSInfoReleasePolicy060610.pdf.

# Table of Contents

# Bachelor of Science (B.Sc.)

The University of Guelph offers general and honours programs leading to the B.Sc. degree. The general program consists of a minimum of 15.00 credits (usually 30 semester courses) involving normally 6 semesters of study. The requirements for the honours program is a minimum of 20.00 credits (usually 40 semester courses) which may be obtained over 8 semesters of study. Some majors may require more than 20.00 credits.

## The Three Semester System

Most of the B.Sc. programs operate on the three semester system. In this system each of the Fall, Winter and Summer semesters is of 12 weeks duration. Two semesters are equivalent to 1 academic year at a university on the traditional system. In the three semester system, students may vary their rate of progress towards graduation. However, since many science courses must be taken in a certain sequence and not all courses are offered each semester, most science students are required to proceed from semester to semester in restricted patterns. Furthermore, the advanced courses of the honours programs are offered only in the regular fall and winter semesters.

Additional information may be obtained from Admissions Services, Office of Registrarial Services. The three-semester system and the pass-by-course method of advancement allow considerable flexibility of program arrangement. In addition, a variety of program contents is available which the student may modify to meet individual requirements.

## Transfer from One B.Sc. Program to Another

On entrance to the B.Sc. program, the student may elect to follow an intended area of specialization or to postpone this decision until a later semester. The choice of a particular program of study may be most effectively made at the end of Semester 3 or 4. Judicious selection of courses in each and every semester will allow the easiest transfer between programs without incurring the need for additional semesters of study. The program counsellor of the particular college from which it is anticipated that the majority of science courses will be taken should be consulted for advice.

## Program Information

### General Program Requirements

The general B.Sc. degree requires the successful completion of 15.00 required credits. Normally 2.50 credits (usually 5 courses) are taken in each semester so that the degree may be completed in 6 semesters. The general science program is designed to give a broad general training in biological science, chemistry, physics and mathematical science. This is achieved by requiring each student to take a minimum of 1.00 credits in each of the above areas and an additional 0.50 credits in three of the four above areas. The courses to be taken in semesters 4 to 6 may be selected to allow a broad study of the sciences from the list of approved electives for B.Sc. students.

### Honours Program Requirements

In order to graduate in the honours program, students must fulfill all program requirements for the program and have achieved a 60%, or higher, cumulative average over all course attempts. Normally 2.50 credits (usually 5 courses) are taken in each semester so that the degree may be completed in generally 8 semesters. The following types of honours programs are offered:

### Honours Major Programs

Major in a subject

Major in a subject with a minor or a second major

### Honours Major

These programs permit a student to study science in greater depth than is permitted by the general program. The student is required to take a minimum of 1.00 credits (usually 2 courses) in each of biological science, chemistry, physics and mathematical science. In each of semesters 3 to 8, students select science credits so that the total program provides a broad science training with concentration in an area of physical science or biological science.

A major normally consists of certain prescribed courses (minimum of 8.00 credits) and a number of elective courses to complete the requirements for the degree. The composition of science courses selected must contain a sufficient number (minimum of 6.00 credits) of 3000 and 4000 level courses including a grouping (minimum of 2.00 credits) particularly at the 4000 level. A major program may be studied in conjunction with a minor in an area of science, humanities or social science.

### Honours Minor

A minor is a group of courses which provides for exposure to and mastery of the fundamental principles of a subject. A minor consists of a minimum of 5.00 credits (normally 10 courses). It may also require certain other courses from other areas to be taken along with the specified courses of the minor. A minor is taken in conjunction with a major.

Students should seek advice from the program counsellor of either the College of Biological Science or the College of Physical and Engineering Science dependent upon their primary area(s) of interest. Refer to B.Sc. Program Requirements: Regulation 6. Double-Counting of Credits.

### B.Sc. Program Requirements

**Regulations 1, 2, 3 and 4 apply to all B.Sc. students.**

#### 1. Entry Credits

In general, the 4U /grade 12 credit or its equivalent is required in a subject area to allow entrance to the initial university course. Students who lack this requirement can remedy the deficiency by successful completion of:

BIOL*1020 for students lacking biology
CHEM*1060 for students lacking chemistry
PHYS*1020 for students lacking physics
If more than one of the above courses is taken, students are required to complete additional credits beyond the minimum total required for the degree.

#### 2. Basic Science Core

In each of the first 2 semesters B.Sc. students must take one (1) of the specified courses in each of biology, chemistry, physics and mathematical science, and 1 other course which is normally an Arts or Social Science elective.

#### 3. 1000 Level Credits

If more than 7.00 credits at the 1000 level are completed, students are required to complete additional credits beyond the minimum total required for the degree.

#### 4. 3000 and 4000 Level Credits

There is a requirement for a minimum of 6.00 science credits at the 3000- and 4000-levels with a minimum of 2.00 credits at the 4000 level.

#### 5. Science Credits

A minimum of 16.00 science credits (usually 32 courses) is required for the honours major program. The inclusion of a minor in a non-science area involves the reduction to 14.00 science credits (usually 28 courses) with the approval of the program counsellors. Acceptable science courses in the following programs means "acceptable to the B.Sc. Program Committee". Lists of acceptable courses are available in the offices of the faculty advisors and the program counsellors and on the world wide web at the following address: http://www.bsc.uoguelph.ca/Approved_electives.shtml.

#### 6. Double-Counting of Credits

A maximum of 2.00 credits required in a major program may be applied to meet the requirements of a minor or an additional major.

For a completed minor in a non B.Sc. area, students can apply up to 1.00 credits, from their minor, at the 3000/4000 level towards the 6.00 credits a t the 3000/4000 level required for the degree.

#### 7. Continuation of Study

Students are advised to consult the regulations for continuation of study outlined in detail in Section VIII--Undergraduate Degree Regulations & Procedures.

## Doctor of Veterinary Medicine.

Students in the B.Sc. program who intend to apply for admission to the Doctor of Veterinary Medicine program should register for the Major Biological Science or Major Physical Science program, or the major of their choice. Prospective candidates for the D.V.M. program should consult the admission requirements for the program. Students may obtain assistance in selecting a program that will meet the requirements for the Doctor of Veterinary Program and for continuation in biological or physical science programs by consulting the appropriate Program Counsellor.

## General Program (BSCG)

### Continuation of Study

Students are advised to consult the regulations for continuation of study within the program which are outlined in detail in Section VIII--Undergraduate Degree Regulations & Procedures.

### Conditions for Graduation

In order to qualify for graduation from the general program the student is required to attain a passing grade in a minimum of 15.00 required credits as outlined in the Total Course Requirements for all students in the General Science Program and have achieved a minimum cumulative average of 50%.

### Total Course Requirements for all Students in the General Science Program

Total of 15.00 credits as follows:

1. 4.00 credits from the first year science core - 1.00 credits beyond the 4U/ grade 12 level in each of biological science, chemistry, mathematical science, physics. Note: A maximum of 7.00 credits at the 1000 level may be used towards the degree requirements.
2. An additional 0.50 credits from at least 3 of the following subject areas: biological science, biochemistry/chemistry, mathematical science, physics.
3. 6.50 additional credits selected from the list of approved sciences electives for the B.Sc. degree program of which 2.50 credits must be at the 3000 or 4000 level. Note: One of: BIOL*1020, CHEM*1060, PHYS*1020 may be counted towards the degree requirements, counting as 0.50 credits in science.

4. 2.00 credits - arts and/or social science electives approved for the B.Sc. degree program.
5. 1.00 credits in electives.

## Recommended Schedule for Students in Biological Science Areas

### Semester 1

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity * |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

One of:

| | | |
|---|---|---|
| CIS*1000 | [0.50] | Introduction to Computer Applications |
| CIS*1200 | [0.50] | Introduction to Computing |
| CIS*1500 | [0.50] | Introduction to Programming |
| STAT*2040 | [0.50] | Statistics I |
| MATH*2080 | [0.50] | Elements of Calculus II |

0.50 Arts or Social Science electives

* BIOL*1080 is a prerequisite for some courses in the biological sciences. Students are strongly recommended to also complete this course by the end of the third semester.

### Semester 3 to 6

A minimum of 2.50 credits in each semester, including at least 2.00 acceptable science credits per semester. For details consult 'Total Course Requirements'.

## Recommended Schedule for Students in Physical Science Areas

### Semester 1

| | | |
|---|---|---|
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

0.50 Arts or Social Science electives

### Semester 3 to 6

A minimum of 2.50 credits in each semester, including 2.00 acceptable science courses per semester. For details consult 'Total Course Requirements'.

# Honours Programs (BSCH)

## Honours Program Majors

The following honours majors are available:

### Biological Sciences:

20.00 credits -Animal Biology (ABIO)
20.25 credits -Biochemistry (BIOC)
20.00 credits -Biological Science (BIOS)
20.00 credits -Bio-Medical Science (BIOM)
20.00 credits - Human Kinetics (HK)
20.00 credits - Marine and Freshwater Biology (MFB)
20.00 credits - Microbiology (MICR)
20.00 credits - Molecular Biology and Genetics (MBG)
20.00 credits - Nutritional and Nutraceutical Sciences (NANS)
20.00 credits - Plant Science (PLSC)
20.00 credits - Wild Life Biology (WLB)
20.00 credits - Zoology (ZOO)

### Physical Sciences:

20.00 credits - Biological and Pharmaceutical Chemistry (BPCH)
21.25 credits - Biophysics (BIOP)
21.75 credits - Chemical Physics (CHPY)
20.25 credits - Chemistry (CHEM)
20.00 credits - Nanoscience (NANO)
20.00 credits -Physical Science (PSCI)
21.25 credits -Physics (PHYS)
21.25 credits -Theoretical Physics (THPY)

### Environmental Sciences:

20.00 credits - Ecology (ECOL)*
20.00 credits - Environmental Biology (ENVB)*
20.00 credits - Toxicology (TOX)
*also see B.SC.(ENV.)

### Computing Science, Mathematics, Statistics

20.00 credits - Mathematics (MATH)
20.00 credits - Statistics (STAT)

### Additional Disciplines:

20.00 credits - Food Science (FOOD)
20.00 credits - Psychology: Brain & Cognition (PBC)

### Co-operative Educational Programs:

20.00 credits - Applied Mathematics and Statistics (Co-op) (APMS:C)
20.25 credits - Biochemistry (Co-op) (BIOC:C)
21.25 credits - Biophysics (Co-op) (BIOP:C)
21.25 credits - Chemical Physics (Co-op) (CHPY:C)
20.25 credits - Chemistry (Co-op) (CHEM:C)
20.00 credits - Food Science (Co-op) (FOOD:C)
20.00 credits - Microbiology (Co-op) (MICR:C)
21.25 credits - Physics (Co-op) (PHYS:C)
20.00 credits - Toxicology (Co-op) (TOX:C)

## Honours Program Minors

Minors are available in the following science areas with the particular credit requirements being given (additional minors are available from the College of Arts and the College of Social and Applied Human Sciences). A minor may include additional prerequisites - consult with the appropriate faculty advisor.

### Biological Sciences:

5.00 credits - Biology (BIOL)
5.00 credits - Biochemistry (BIOC)
5.00 credits - Biotechnology (BIOT)
5.00 credits - Functional Foods and Nutraceuticals (FFAN)
5.25 credits - Microbiology (MICR)
5.00 credits - Molecular Biology and Genetics (MBG)
5.00 credits - Neuroscience (NEUR)
5.00 credits - Nutritional and Nutraceutical Sciences (NANS)
5.00 credits - Plant Science (PLSC)
5.00 credits - Zoology (ZOO)

### Physical Sciences:

5.00 credits - Chemistry (CHEM)
5.00 credits - Physics (PHYS)

### Environmental Sciences:

5.00 credits - Ecology (ECOL)
5.00 credits - Forest Systems (FSYS)
5.00 credits - Geographic Information Systems (GIS) and Environmental Analysis
5.00 credits - Geology (GEOL)

### Mathematical Sciences:

5.25 credits - Computing and Information Science (CIS)
5.00 credits - Mathematical Science (MSCI)
5.00 credits - Mathematics (MATH)
5.00 credits - Statistics (STAT)

### Additional Disciplines:

5.00 credits - Business Administration (BADM)
5.00 credits - Food Science (FOOD)
5.00 credits - Psychology: Brain & Cognition (PBC)

## Continuation of Study

Students are advised to consult the regulations for continuation of study within the program which are outlined in detail in Section VII--Undergraduate Degree Regulations & Procedures.

## Conditions for Graduation

### Schedules 1 and 2

In order to qualify for graduation from the honours program, the student must fulfill all program requirements and have achieved 60%, or higher, cumulative average in all course attempts.

**Note:** A student registered in an honours program who has successfully completed all required courses and the specified total number of credits for the program but does not have a cumulative average of 60%, or higher, may apply to graduate from the general program.

### Co-operative Education Program

Admission to the Co-operative Education program may be granted on entry to the University or by application normally before the conclusion of Semester 2. Application forms can be obtained from the appropriate faculty co-op advisor. In-course students will need to complete successfully an interview in the appropriate department. Students must be either a Canadian Citizen or Permanent Resident. A cumulative average of 70% is required in courses taken in Semesters 1 and 2 to permit continuation in the program.

#### Conditions for Graduation from the B.Sc. Co-operative Education Program

Conditions for graduation are the same as the corresponding regular B.Sc. program. In addition, all work reports and work performance evaluations must have a grade of satisfactory or better.

## Animal Biology (ABIO)

**Department of Animal and Poultry Science, Ontario Agricultural College**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor.

#### Semester 1

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

#### Semester 2

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

One of:

| | | |
|---|---|---|
| CIS*1000 | [0.50] | Introduction to Computer Applications |
| CIS*1200 | [0.50] | Introduction to Computing |
| CIS*1500 | [0.50] | Introduction to Programming |

0.50 Arts or Social Science electives

#### Semester 3

| | | |
|---|---|---|
| AGR*2350 | [0.50] | Animal Production Systems, Health and Industry |
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |

0.50 Arts or Social Science electives

0.50 electives or restricted electives

#### Semester 4

| | | |
|---|---|---|
| ANSC*2340 | [0.50] | Structure of Farm Animals |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |
| STAT*2040 | [0.50] | Statistics I |

0.50 electives or restricted electives

#### Semester 5

| | | |
|---|---|---|
| ANSC*3080 | [0.50] | Agricultural Animal Physiology |
| ANSC*3120 | [0.50] | Introduction to Animal Nutrition |

1.50 electives or restricted electives

#### Semester 6

| | | |
|---|---|---|
| ANSC*3210 | [0.50] | Principles of Animal Care and Welfare |
| ANSC*4650 | [0.50] | Comparative Immunology |
| MBG*3060 | [0.50] | Quantitative Genetics |

1.00 electives or restricted electives

#### Semester 7

2.50 electives or restricted electives

#### Semester 8

2.50 electives or restricted electives

#### Restricted Electives

Students must complete 2.00 credits from Arts or Social Science courses. ANSC*3210 is an Arts and Social Science 0.50 credit. 1.50 additional credits from Arts or Social Science are required.

0.50 credits is required from each of the following: Animal Nutrition, Animal Breeding & Genetics, and Animal Physiology & Behaviour. Students are encouraged to consult with the Faculty Advisor for help in tailoring their selection to meet personal and career interests.

**Note:** Students are required to complete 16.00 credits in science of which a minimum of 6.00 credits must be at the 3000, 4000 level and at least 2.00 credits of these must be 4000 level.

Animal Breeding & Genetics [0.50] Required

| | | |
|---|---|---|
| ANSC*4020 | [0.50] | Genetics of Companion Animals |
| ANSC*4050 | [0.50] | Biotechnology in Animal Science |
| MBG*3090 | [0.50] | Applied Animal Genetics |
| MBG*4030 | [0.50] | Animal Breeding Methods |

Animal Nutrition [0.50] Required

| | | |
|---|---|---|
| ANSC*3170 | [0.50] | Nutrition of Fish and Crustacea |
| ANSC*3180 | [0.50] | Wildlife Nutrition |
| ANSC*4260 | [0.50] | Beef Cattle Nutrition |
| ANSC*4270 | [0.50] | Dairy Cattle Nutrition |
| ANSC*4280 | [0.50] | Poultry Nutrition |
| ANSC*4290 | [0.50] | Swine Nutrition |
| ANSC*4560 | [0.50] | Pet Nutrition |
| EQN*4020 | [0.50] | Feeding the Performance Horse |

Animal Physiology & Behaviour [0.50] Required

| | | |
|---|---|---|
| ANSC*4090 | [0.50] | Applied Animal Behaviour |
| ANSC*4100 | [0.50] | Applied Environmental Physiology and Animal Housing |
| ANSC*4350 | [0.50] | Experiments in Animal Biology |
| ANSC*4470 | [0.50] | Animal Metabolism |
| ANSC*4490 | [0.50] | Applied Endocrinology |

An additional 3.00 credits must be obtained by selecting courses from the above lists and from the following:

| | | |
|---|---|---|
| ANSC*3050 | [0.50] | Aquaculture: Advanced Issues |
| ANSC*4610 | [0.50] | Critical Analysis in Animal Science |
| ANSC*4700 | [0.50] | Research in Animal Biology I |
| ANSC*4710 | [0.50] | Research in Animal Biology II |
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| EQN*3050 | [0.50] | Equine Exercise Physiology |
| MICR*3230 | [0.50] | Immunology |
| PATH*3610 | [0.50] | Principles of Disease |
| POPM*3240 | [0.50] | Epidemiology |
| POPM*4230 | [0.50] | Animal Health |

## Applied Mathematics and Statistics (Co-op) (APMS:C)

**Department of Mathematics and Statistics, College of Physical and Engineering Science**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum of 20.00 credits is required to complete this program which includes 5.00 credits in Mathematics, 2.50 credits in Statistics, an additional 2.00 credits in Mathematics or Statistics at the 3000 level, and an additional 2.00 credits in Mathematics or Statistics at the 4000 level, 1.00 credits in Computing and Information Science, and 1.00 credits in Arts or Social Sciences courses.

#### Semester 1 - Fall

| | | |
|---|---|---|
| CHEM*1040 | [0.50] | General Chemistry I |
| CIS*1500 | [0.50] | Introduction to Programming |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

#### Semester 2 - Winter

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| CIS*2500 | [0.50] | Intermediate Programming |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

#### Summer Semester

No study semester or work term.

#### Semester 3 - Fall

| | | |
|---|---|---|
| MATH*2000 | [0.50] | Set Theory |
| MATH*2160 | [0.50] | Linear Algebra I |
| MATH*2200 | [0.50] | Advanced Calculus I |

STAT*2040 [0.50] Statistics I
0.50 Arts or Social Science electives

**Winter Semester**

COOP*1000 [0.00] Co-op Work Term I
Note: Suggested course sequences are available in the departmental brochure. Please consult with the departmental advisor.

**Semester 4 - Summer**

MATH*2170 [0.50] Differential Equations I
STAT*2050 [0.50] Statistics II
0.50 Arts or Social Science electives
1.00 electives

**Fall Semester**

COOP*2000 [0.00] Co-op Work Term II

**Semester 5 - Winter**

MATH*2130 [0.50] Numerical Methods
MATH*2210 [0.50] Advanced Calculus II
0.50 credits in Mathematics or Statistics at the 3000 level or above
1.00 electives

**Summer Semester**

COOP*3000 [0.00] Co-op Work Term III

**Semester 6 - Fall**

STAT*3100 [0.50] Introductory Mathematical Statistics I
STAT*3240 [0.50] Applied Regression Analysis
At least 1.00 credits from:
- MATH*3100 [0.50] Differential Equations II
- MATH*3200 [0.50] Real Analysis
- MATH*3240 [0.50] Operations Research

0.50 electives

**Semester 7 - Winter**

STAT*3110 [0.50] Introductory Mathematical Statistics II
1.50 credits in Mathematics or Statistics at the 3000 level or above
0.50 electives

**Summer Semester**

COOP*4000 [0.00] Co-op Work Term IV

**Semester 8 - Fall**

2.00 credits in Mathematics or Statistics at the 4000 level
0.50 electives

**Electives must include:**

1.00 credits in Arts and Social Science courses
2.00 credits in Mathematics or Statistics at the 3000 level
2.00 credits in Mathematics or Statistics at the 4000 level

## Biochemistry (BIOC)

**Department of Molecular and Cellular Biology, College of Biological Science**

A B.Sc. in Biochemistry offers a multidisciplinary curriculum that gives students broad exposure to the life sciences with specific attention paid to the physical and chemical nature of biomolecular systems. The lab-intensive experience in this program prepares students to pursue post-graduate research opportunities in many different life science related fields. Graduates are also positioned to be successful in obtaining entrance to a number of professional programs, as well as employment in industry and government.

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. The major will require the completion of at least 20.25 credits as indicated below:

### Major (Honours Program)

**Semester 1**

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1040 [0.50] General Chemistry I
MATH*1200 [0.50] Calculus I
PHYS*1000 [0.50] An Introduction to Mechanics
0.50 Arts or Social Science electives
Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
CHEM*1050 [0.50] General Chemistry II
MATH*1210 [0.50] Calculus II
PHYS*1010 [0.50] Introductory Electricity and Magnetism

**Semester 3**

BIOC*2580 [0.50] Introduction to Biochemistry
CHEM*2060 [0.50] Structure and Bonding
CHEM*2880 [0.50] Physical Chemistry
MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
0.50 Arts or Social Science electives

**Semester 4**

BIOC*3560 [0.50] Structure and Function in Biochemistry
CHEM*2480 [0.50] Analytical Chemistry I
CHEM*2700 [0.50] Organic Chemistry I
MCB*2050 [0.50] Molecular Biology of the Cell
MICR*2420 [0.50] Introduction to Microbiology

**Semester 5**

BIOC*3570 [0.75] Analytical Biochemistry
CHEM*3750 [0.50] Organic Chemistry II
MICR*2430 [0.50] Microbiology Methods I
STAT*2040 [0.50] Statistics I
Minimum 0.25 electives or restricted electives*
***Note**: There are a limited number of 0.25 credit courses available. Students should consult their faculty advisor or program counsellor for additional information

**Semester 6**

MBG*3350 [0.75] Laboratory Methods in Molecular Biology I
PHYS*2030 [0.50] Biophysics of Excitable Cells
1.50 electives or restricted electives

**Semester 7**

2.50 electives or restricted electives

**Semester 8**

BIOC*4540 [0.75] Enzymology
1.75 electives or restricted electives

**Restricted Electives**

Students must take as part of their program: 3.5 credits from the following list, with at least 1.00 of these credits from BIOC*4520, BIOC*4580, MCB*4050

BIOC*4520 [0.50] Metabolic Processes
BIOC*4580 [0.50] Membrane Biochemistry
BIOM*3200 [1.00] Mammalian Physiology
MCB*4010 [0.50] Advanced Cell Biology
MCB*4050 [0.50] Protein and Nucleic Acid Structure
MCB*4500 [1.00] Research Project in Molecular & Cellular Biology I
MCB*4510 [1.00] Research Project in Molecular & Cellular Biology 2
MICR*3230 [0.50] Immunology
MICR*3330 [0.50] World of Viruses
MICR*4330 [0.50] Molecular Virology
MICR*4530 [0.50] Immunology II
PBIO*3110 [0.50] Crop Physiology
PBIO*4750 [0.50] Genetic Engineering of Plants
TOX*4590 [0.50] Biochemical Toxicology
One of:
- MBG*3080 [0.50] Bacterial Genetics
- MBG*4080 [0.50] Molecular Genetics

### Minor (Honours Program)

A minor in Biochemistry consists of at least 5.00 course credits. The following courses are required:

BIOC*3560 [0.50] Structure and Function in Biochemistry
BIOC*3570 [0.75] Analytical Biochemistry
BIOC*4540 [0.75] Enzymology
CHEM*2480 [0.50] Analytical Chemistry I
CHEM*2700 [0.50] Organic Chemistry I
One of:
- MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
- MICR*2420 [0.50] Introduction to Microbiology

In addition, at least 1.50 credits must be chosen from the following courses, with at least 1.00 credits from the first three courses listed:
BIOC*4520 [0.50] Metabolic Processes
BIOC*4580 [0.50] Membrane Biochemistry
MBG*3350 [0.75] Laboratory Methods in Molecular Biology I
MCB*4050 [0.50] Protein and Nucleic Acid Structure
MICR*3230 [0.50] Immunology
MICR*3330 [0.50] World of Viruses
TOX*4590 [0.50] Biochemical Toxicology

## Biochemistry (Co-op) (BIOC:C)

**Department of Molecular and Cellular Biology, College of Biological Science**

A B.Sc. in Biochemistry offers a multidisciplinary curriculum that gives students broad exposure to the life sciences with specific attention paid to the physical and chemical nature of biomolecular systems. The lab-intensive experience in this program prepares students to pursue post-graduate research opportunities in many different life science related fields. Graduates are also positioned to be successful in obtaining entrance to a number of professional programs, as well as employment in industry and government.

Two Streams are available. Stream A is different from Stream B in that Stream A has a double work term following academic semester 5. The course content of semesters 1-4 is the same as that listed above for the regular Honours Program Major. Students in the Co-op program must also take COOP*1100 in the second academic semester. The total program requirements, including the selection of electives are also the same.

Students will be expected to undertake their work terms after semester 3 and completion of course CHEM*2480. Since certain courses must be taken in a different semester from usual, consult your Faculty Co-op Advisor for assistance with course selection.

To graduate from the Co-op program a minimum of 4 successfully completed work terms is normally required.

This major requires the completion of 20.25 credits as indicated below.

## Stream A

### Semester 1 - Fall

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2 - Winter

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1050 | [0.50] | General Chemistry II |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

### Summer Semester

No academic semester or work term

### Semester 3 - Fall

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| CHEM*2060 | [0.50] | Structure and Bonding |
| CHEM*2480 | [0.50] | Analytical Chemistry I |
| CHEM*2880 | [0.50] | Physical Chemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |

### Winter Semester

| | | |
|---|---|---|
| COOP*1000 | [0.00] | Co-op Work Term I |

### Semester 4 - Summer

| | | |
|---|---|---|
| BIOC*3570 | [0.75] | Analytical Biochemistry |
| CHEM*2700 | [0.50] | Organic Chemistry I |
| MICR*2420 | [0.50] | Introduction to Microbiology |
| STAT*2040 | [0.50] | Statistics I |

0.50 Arts or Social Science electives

### Semester 5 - Fall

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| CHEM*3750 | [0.50] | Organic Chemistry II |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| MICR*2430 | [0.50] | Microbiology Methods I |

0.50 electives or restricted electives

### Winter Semester

| | | |
|---|---|---|
| COOP*2000 | [0.00] | Co-op Work Term II |

### Summer Semester

| | | |
|---|---|---|
| COOP*3000 | [0.00] | Co-op Work Term III |

### Semester 6 - Fall

| | | |
|---|---|---|
| MBG*3350 | [0.75] | Laboratory Methods in Molecular Biology I |

1.75 electives or restricted electives

### Semester 7 - Winter

| | | |
|---|---|---|
| BIOC*4540 | [0.75] | Enzymology |
| PHYS*2030 | [0.50] | Biophysics of Excitable Cells |

1.25 electives or restricted electives

### Summer Semester

| | | |
|---|---|---|
| COOP*4000 | [0.00] | Co-op Work Term IV |

### Semester 8 - Fall

2.50 electives or restricted electives

### Restricted Electives

Students must take as part of their program: 3.5 credits from the following list, with at least 1.00 of these credits from BIOC*4520, BIOC*4580, MCB*4050

| | | |
|---|---|---|
| BIOC*4520 | [0.50] | Metabolic Processes |
| BIOC*4580 | [0.50] | Membrane Biochemistry |
| BIOM*3200 | [1.00] | Mammalian Physiology |
| MCB*4010 | [0.50] | Advanced Cell Biology |
| MCB*4050 | [0.50] | Protein and Nucleic Acid Structure |
| MCB*4500 | [1.00] | Research Project in Molecular & Cellular Biology I |
| MCB*4510 | [1.00] | Research Project in Molecular & Cellular Biology 2 |
| MICR*3230 | [0.50] | Immunology |
| MICR*3330 | [0.50] | World of Viruses |
| MICR*4330 | [0.50] | Molecular Virology |
| MICR*4530 | [0.50] | Immunology II |
| PBIO*3110 | [0.50] | Crop Physiology |
| PBIO*4750 | [0.50] | Genetic Engineering of Plants |
| TOX*4590 | [0.50] | Biochemical Toxicology |

One of:

| | | |
|---|---|---|
| MBG*3080 | [0.50] | Bacterial Genetics |
| MBG*4080 | [0.50] | Molecular Genetics |

## Stream B

### Semester 1 - Fall

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2 - Winter

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1050 | [0.50] | General Chemistry II |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

### Summer Semester

No academic semester or work term

### Semester 3 - Fall

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| CHEM*2060 | [0.50] | Structure and Bonding |
| CHEM*2480 | [0.50] | Analytical Chemistry I |
| CHEM*2880 | [0.50] | Physical Chemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |

### Winter Semester

| | | |
|---|---|---|
| COOP*1000 | [0.00] | Co-op Work Term I |

### Semester 4 - Summer

| | | |
|---|---|---|
| BIOC*3570 | [0.75] | Analytical Biochemistry |
| CHEM*2700 | [0.50] | Organic Chemistry I |
| MICR*2420 | [0.50] | Introduction to Microbiology |
| STAT*2040 | [0.50] | Statistics I |

0.50 Arts or Social Science electives

### Fall Semester

| | | |
|---|---|---|
| COOP*2000 | [0.00] | Co-op Work Term II |

### Semester 5 - Winter

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| MICR*2430 | [0.50] | Microbiology Methods I |
| PHYS*2030 | [0.50] | Biophysics of Excitable Cells |

0.50 electives or restricted electives

### Summer Semester

| | | |
|---|---|---|
| COOP*3000 | [0.00] | Co-op Work Term III |

### Semester 6 - Fall

| | | |
|---|---|---|
| CHEM*3750 | [0.50] | Organic Chemistry II |

2.00 electives or restricted electives

### Semester 7 - Winter

| | | |
|---|---|---|
| BIOC*4540 | [0.75] | Enzymology |
| MBG*3350 | [0.75] | Laboratory Methods in Molecular Biology I |

1.00 electives or restricted electives

**Summer Semester**

COOP*4000 [0.00] Co-op Work Term IV

**Semester 8 - Fall**

2.50 electives or restricted electives

**Restricted Electives**

Students must take as part of their program: 3.5 credits from the following list, with at least 1.00 of these credits from BIOC*4520, BIOC*4580, MCB*4050

| | | |
|---|---|---|
| BIOC*4520 | [0.50] | Metabolic Processes |
| BIOC*4580 | [0.50] | Membrane Biochemistry |
| BIOM*3200 | [1.00] | Mammalian Physiology |
| MCB*4010 | [0.50] | Advanced Cell Biology |
| MCB*4050 | [0.50] | Protein and Nucleic Acid Structure |
| MCB*4500 | [1.00] | Research Project in Molecular & Cellular Biology I |
| MCB*4510 | [1.00] | Research Project in Molecular & Cellular Biology 2 |
| MICR*3230 | [0.50] | Immunology |
| MICR*3330 | [0.50] | World of Viruses |
| MICR*4330 | [0.50] | Molecular Virology |
| MICR*4530 | [0.50] | Immunology II |
| PBIO*3110 | [0.50] | Crop Physiology |
| PBIO*4750 | [0.50] | Genetic Engineering of Plants |
| TOX*4590 | [0.50] | Biochemical Toxicology |

One of:

| | | |
|---|---|---|
| MBG*3080 | [0.50] | Bacterial Genetics |
| MBG*4080 | [0.50] | Molecular Genetics |

## Biological and Pharmaceutical Chemistry (BPCH)

**Department of Chemistry, College of Physical and Engineering Science**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Chemistry Faculty Advisor. This major will require the completion of 20.00 credits as indicated below:

**Semester 1**

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |

0.50 Arts or Social Science electives

**Semester 3**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| CHEM*2060 | [0.50] | Structure and Bonding |
| CHEM*2400 | [0.75] | Analytical Chemistry I |
| CHEM*2880 | [0.50] | Physical Chemistry |

0.25 electives or restricted electives *

**Semester 4**

| | | |
|---|---|---|
| CHEM*2070 | [0.50] | Structure and Spectroscopy |
| CHEM*2700 | [0.50] | Organic Chemistry I |
| CHEM*3430 | [0.50] | Analytical Chemistry II: Instrumental Analysis |
| MICR*2420 | [0.50] | Introduction to Microbiology |
| STAT*2040 | [0.50] | Statistics I |

**Semester 5**

| | | |
|---|---|---|
| BIOC*3570 | [0.75] | Analytical Biochemistry |
| CHEM*3750 | [0.50] | Organic Chemistry II |

One of:

| | | |
|---|---|---|
| CHEM*3640 | [0.50] | Chemistry of the Elements I ** |

0.50 electives or restricted electives *

0.75 electives or restricted electives *

** CHEM*3640 is a prerequisite for CHEM*3650

**Semester 6**

Select either Option A or Option B

**Option A (at Guelph)**

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| CHEM*3650 | [0.50] | Chemistry of the Elements II |
| CHEM*3760 | [0.50] | Organic Chemistry III |

1.00 electives or restricted electives *

**Option B (at Seneca)**

2.50 credits from:

| | | |
|---|---|---|
| XSEN*3020 | [0.50] | Pharmaceutical Analysis |
| XSEN*3030 | [0.50] | Pharmacology and Applied Toxicology |
| XSEN*3040 | [0.50] | Occupational Health and Chemistry |
| XSEN*3060 | [0.50] | Pharmaceutical Analysis - Advanced |
| XSEN*3070 | [0.50] | Pharmaceutical Product Formulations |
| XSEN*3080 | [0.50] | Pharmaceutical Manufacturing |
| XSEN*3090 | [0.50] | Biopharmaceuticals |

Note: All XSEN courses are taught at the Seneca@York campus of Seneca College in Toronto. (For more information, go to: http://www.chemistry.uoguelph.ca/bpch/

**Semester 7**

One of:

| | | |
|---|---|---|
| CHEM*4730 | [0.50] | Synthetic Organic Chemistry |
| CHEM*4740 | [0.50] | Topics in Bio-Organic Chemistry |

2.00 electives or restricted electives *

**Semester 8**

2.50 electives or restricted electives *

*** Restricted Electives**

**Students are advised to pay particular attention to pre-requisite requirements when choosing individual courses, and seek advice as needed.

1. 1.00 credits from the following:

| | | |
|---|---|---|
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| TOX*2000 | [0.50] | Principles of Toxicology |

2. A minimum of 1.50 credits at the 4000 level and 2.50 credits at the 3000/4000 level from the following list:

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| BIOC*4520 | [0.50] | Metabolic Processes |
| BIOC*4540 | [0.75] | Enzymology ** |
| BIOC*4580 | [0.50] | Membrane Biochemistry |
| BIOM*3090 | [0.50] | Principles of Pharmacology ** |
| BIOM*3200 | [1.00] | Mammalian Physiology |
| BIOM*4090 | [0.50] | Pharmacology ** |
| CHEM*3360 | [0.50] | Environmental Chemistry and Toxicology |
| CHEM*3440 | [0.50] | Analytical Chemistry III: Analytical Instrumentation |
| CHEM*3640 | [0.50] | Chemistry of the Elements I |
| CHEM*3650 | [0.50] | Chemistry of the Elements II ** |
| CHEM*3760 | [0.50] | Organic Chemistry III |
| CHEM*4010 | [0.50] | Chemistry and Industry |
| CHEM*4400 | [0.50] | Advanced Topics in Analytical Chemistry |
| CHEM*4630 | [0.50] | Bioinorganic Chemistry ** |
| CHEM*4720 | [0.50] | Organic Reactivity ** |
| CHEM*4730 | [0.50] | Synthetic Organic Chemistry ** |
| CHEM*4740 | [0.50] | Topics in Bio-Organic Chemistry |
| CHEM*4900 | [1.00] | Chemistry Research Project I ** |
| CHEM*4910 | [1.00] | Chemistry Research Project II ** |
| MBG*3350 | [0.75] | Laboratory Methods in Molecular Biology I ** |
| MCB*4050 | [0.50] | Protein and Nucleic Acid Structure ** |
| MICR*3230 | [0.50] | Immunology |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |
| PATH*3610 | [0.50] | Principles of Disease |
| TOX*4590 | [0.50] | Biochemical Toxicology ** |

## Biological and Pharmaceutical Chemistry (Co-op) (BPCH:C)

**Department of Chemistry, College of Physical and Engineering Science**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Chemistry Faculty Advisor. This major will require the completion of 20.00 credits as indicated below:

**Semester 1 - Fall**

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |

0.50 Arts or Social Science electives

**Semester 3 - Fall**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| CHEM*2060 | [0.50] | Structure and Bonding |
| CHEM*2400 | [0.75] | Analytical Chemistry I |
| CHEM*2880 | [0.50] | Physical Chemistry |

0.25 electives or restricted electives *

**Winter Semester**

| | | |
|---|---|---|
| COOP*1000 | [0.00] | Co-op Work Term I |

**Semester 4 - Summer**

| | | |
|---|---|---|
| CHEM*2070 | [0.50] | Structure and Spectroscopy |
| CHEM*2700 | [0.50] | Organic Chemistry I |
| CHEM*3430 | [0.50] | Analytical Chemistry II: Instrumental Analysis |
| STAT*2040 | [0.50] | Statistics I |

0.50 electives or restricted electives *

**Semester 5 - Fall**

| | | |
|---|---|---|
| BIOC*3570 | [0.75] | Analytical Biochemistry |
| CHEM*3750 | [0.50] | Organic Chemistry II |

One of:

| | | |
|---|---|---|
| CHEM*3640 | [0.50] | Chemistry of the Elements I ** |

0.50 electives or restricted electives *

0.75 electives or restricted electives *

** CHEM*3640 is a prerequisite for CHEM*3650

**Semester 6 - Winter**

Select either Option A or Option B

**Option A (at Guelph)**

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| CHEM*3650 | [0.50] | Chemistry of the Elements II |
| CHEM*3760 | [0.50] | Organic Chemistry III |

1.00 electives or restricted electives *

**Option B (at Seneca)**

2.50 credits from:

| | | |
|---|---|---|
| XSEN*3020 | [0.50] | Pharmaceutical Analysis |
| XSEN*3030 | [0.50] | Pharmacology and Applied Toxicology |
| XSEN*3040 | [0.50] | Occupational Health and Chemistry |
| XSEN*3060 | [0.50] | Pharmaceutical Analysis - Advanced |
| XSEN*3070 | [0.50] | Pharmaceutical Product Formulations |
| XSEN*3080 | [0.50] | Pharmaceutical Manufacturing |
| XSEN*3090 | [0.50] | Biopharmaceuticals |

Note: All XSEN courses are taught at the Seneca@York campus of Seneca College in Toronto. (For more information, go to: http://www.chemistry.uoguelph.ca/bpch/

**Summer Semester**

| | | |
|---|---|---|
| COOP*2000 | [0.00] | Co-op Work Term II |

**Fall Semester**

| | | |
|---|---|---|
| COOP*3000 | [0.00] | Co-op Work Term III |

**Semester 7 - Winter**

2.50 electives or restricted electives *

**Summer Semester**

| | | |
|---|---|---|
| COOP*4000 | [0.00] | Co-op Work Term IV |

**Semester 8 - Fall**

One of:

| | | |
|---|---|---|
| CHEM*4730 | [0.50] | Synthetic Organic Chemistry |
| CHEM*4740 | [0.50] | Topics in Bio-Organic Chemistry |

2.00 electives or restricted electives *

*** Restricted Electives**

**Students are advised to pay particular attention to pre-requisite requirements when choosing individual courses, and seek advice as needed.

1. MICR*2420 [0.50] Introduction to Microbiology
2. 1.00 credits from the following:

| | | |
|---|---|---|
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| TOX*2000 | [0.50] | Principles of Toxicology |

3. A minimum of 1.50 credits at the 4000 level and 2.50 credits at the 3000/4000 level from the following list:

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| BIOC*4520 | [0.50] | Metabolic Processes |
| BIOC*4540 | [0.75] | Enzymology ** |
| BIOC*4580 | [0.50] | Membrane Biochemistry |
| BIOM*3090 | [0.50] | Principles of Pharmacology ** |
| BIOM*3200 | [1.00] | Mammalian Physiology |
| BIOM*4090 | [0.50] | Pharmacology ** |
| CHEM*3360 | [0.50] | Environmental Chemistry and Toxicology |
| CHEM*3440 | [0.50] | Analytical Chemistry III: Analytical Instrumentation |
| CHEM*3640 | [0.50] | Chemistry of the Elements I |
| CHEM*3650 | [0.50] | Chemistry of the Elements II ** |
| CHEM*3760 | [0.50] | Organic Chemistry III |
| CHEM*4010 | [0.50] | Chemistry and Industry |
| CHEM*4400 | [0.50] | Advanced Topics in Analytical Chemistry |
| CHEM*4630 | [0.50] | Bioinorganic Chemistry ** |
| CHEM*4720 | [0.50] | Organic Reactivity ** |
| CHEM*4730 | [0.50] | Synthetic Organic Chemistry ** |
| CHEM*4740 | [0.50] | Topics in Bio-Organic Chemistry |
| CHEM*4900 | [1.00] | Chemistry Research Project I ** |
| CHEM*4910 | [1.00] | Chemistry Research Project II ** |
| MBG*3350 | [0.75] | Laboratory Methods in Molecular Biology I ** |
| MBG*4080 | [0.50] | Molecular Genetics ** |
| MCB*4050 | [0.50] | Protein and Nucleic Acid Structure ** |
| MICR*3230 | [0.50] | Immunology |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |
| PATH*3610 | [0.50] | Principles of Disease |
| TOX*4590 | [0.50] | Biochemical Toxicology ** |

## Biological Science (BIOS)

**College of Biological Science**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. This major will require the completion of 20.00 credits as indicated below:

### Schedule of Studies

**Semester 1**

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 Arts or Social Science electives

**Semester 3**

One of:

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |

1.50 electives or restricted electives *

0.50 Arts or Social Science elective

**Semester 4**

| | | |
|---|---|---|
| STAT*2040 | [0.50] | Statistics I |

One of:

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |

1.00 electives or restricted electives *

0.50 Arts or Social Science elective

**Semester 5 to 8**

2.50 in each semester*

*** Restricted Electives**

1. Ecology Elective - 0.50 credits:

| | | |
|---|---|---|
| BIOL*2060 | [0.50] | Ecology |
| BIOL*3110 | [0.50] | Population Ecology |
| BOT*3050 | [0.50] | Plant Functional Ecology |

2. Mathematical or Computational Science Elective - 0.50 credits:

| | | |
|---|---|---|
| BIOL*2250 | [0.50] | Biostatistics and the Life Sciences |

| | | |
|---|---|---|
| CIS*1000 | [0.50] | Introduction to Computer Applications |
| CIS*1200 | [0.50] | Introduction to Computing |
| MATH*2080 | [0.50] | Elements of Calculus II |
| STAT*2050 | [0.50] | Statistics II |
| STAT*2250 | [0.50] | Biostatistics and the Life Sciences |

3. Physiology Elective - 0.50 credits:

| | | |
|---|---|---|
| BIOM*3200 | [1.00] | Mammalian Physiology |
| BOT*2100 | [0.50] | Life Strategies of Plants |
| HK*3940 | [1.25] | Human Physiology |
| ZOO*3200 | [0.50] | Comparative Animal Physiology I |

4. 6.00 additional Biological Science credits of which 4.00 must be at the 3000 or 4000 level. The list of approved science electives is posted at http://www.bsc.uoguelph.ca/ .

### Credit Summary (20.00 credits)

4.00 - First year science core

3.00 - Required science courses semesters 3 - 8

6.00 - Approved Biological Science electives of which 4.00 must be 3000/4000 level

3.00 - Approved Science electives of which 2.00 must be 3000/4000 level* May include 1 of BIOL*1020, CHEM*1060, PHYS*1020

2.00 - Approved Arts or Social Science electives

2.00 - Electives

*2.00 science credits must be at the 4000 level.

## Biology (BIOL)

**College of Biological Science**

### Minor (Honours Program)

A minor in Biology consists of a minimum of 5.00 credits including the following courses:

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |

One of:

| | | |
|---|---|---|
| BIOL*2060 | [0.50] | Ecology |
| BIOL*3110 | [0.50] | Population Ecology |
| BOT*3050 | [0.50] | Plant Functional Ecology |

Of the additional 3.00 credits approved science electives, students must complete a minimum of 1.50 credits at the 3000 or 4000 level, from courses offered by the following departments: Human Health and Nutritional Sciences , Integrative Biology and Molecular and Cellular Biology. BIOL*1080 is a prerequisite for some CBS courses. This minor is restricted to students registered in B.Sc. majors in the Physical Sciences, B.A.S., and the B.A. degree programs.

## Bio-Medical Science (BIOM)

**Department of Biomedical Sciences and Department of Human Health and Nutritional Sciences**

This joint program of the Department of Human Health and Nutritional Sciences and the Department of Biomedical Sciences focuses on the maintenance and promotion of human and animal health through the study of function (biochemistry and physiology), structure (anatomy and histology), and the basic medical sciences (epidemiology and pharmacology). It will permit graduates to contribute to society in the area of health maintenance. The program is a good preparation for students intending to develop professional or research careers in the medical and biological sciences. Through the use of electives, students may structure a program emphasizing either nutritional sciences or principles of health and disease prevention. For more information on recommended electives contact the Faculty Advisor of the major.

This program is designed to partially meet the current requirements for an entry into medical schools in Ontario (a student interested in meeting these requirements should check the present admission requirements for the medical schools); as well as entry into the DVM program of the Ontario Veterinary College.

Live animals and/or animal tissues are used for teaching purposes in some courses in the Bio-Medical Science Major. This must be accepted by students admitted to the program. All animals are protected under the Animals for Research Act of Ontario (1980), the Guidelines for the Care and Use of Experimental Animals (Canadian Council on Animal Care), and the Animal Care Policies of the University of Guelph.

Students who are admitted into the Bio-Medical Science major from high school must meet additional requirements to continue in the major. Continuation after first year is based on the cumulative average in the first two full-time semesters (5.00 credits), including the eight core courses as prescribed by the Schedule of Studies (see below). Students with a minimum average of 75% average will be guaranteed continuation in this major. For students with a 70-74.9% average, continuation will be competitive based on available spaces. Students with an average below 70% will be changed to the Biological Science major. Students may subsequently change to another B.Sc. major of their choice.

B.Sc. students who were not admitted into the Bio-Medical Science major from high school and wish to declare the specialization at the end of first year must apply directly to the Department of Biomedical Sciences by the last day of classes in the winter semester and meet the additional requirements specified above.

B.Sc. students beyond first year who wish to declare the specialization must apply directly to the Department of Biomedical Sciences by the last day of classes in the winter semester. Admission to the major will be based on the cumulative average in the previous two full-time semesters (5.00 credits). Acceptance will be competitive based on available spaces. Students with an average below 70% will not be considered for admission to the major.

All decisions will be made at the end of June.

### Major (Honours Program)

A minimum of 20.00 credits is required.

Note: Students are required to complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level.

#### Semester 1

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 electives or restricted electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

#### Semester 2

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 electives or restricted electives

#### Semester 3 (see admission statement above)

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| STAT*2040 | [0.50] | Statistics I |

1.00 electives or restricted electives

#### Semester 4

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |

1.00 electives or restricted electives

#### Semester 5

| | | |
|---|---|---|
| POPM*3240 | [0.50] | Epidemiology |

One of:

| | | |
|---|---|---|
| BIOM*3200 | [1.00] | Mammalian Physiology |
| HK*3940 | [1.25] | Human Physiology |

Electives or restricted electives to a maximum of 2.75 total credits in this semester.

#### Semester 6

| | | |
|---|---|---|
| BIOM*3040 | [0.75] | Medical Embryology |
| BIOM*3090 | [0.50] | Principles of Pharmacology |

Electives or restricted electives to a maximum of 2.75 total credits in this semester.

#### Semester 7

2.50 electives or restricted electives

#### Semester 8

| | | |
|---|---|---|
| PATH*3610 | [0.50] | Principles of Disease |

2.00 electives or restricted electives*

#### Restricted Electives

1. Anatomy Elective - 1 of BIOM*3010, HK*3401/2, HK*3501/2, ZOO*2090
2. Histology Elective - BIOM*4070 or ZOO*3000
3. Immunology Elective - ANSC*4650 or MICR*3230
4. Advance Study Electives - 2.00 credits from BIOM*4030, BIOM*4050, BIOM*4090, BIOM*4110, BIOM*4150, BIOM*4180, BIOM*4210, BIOM*4220, BIOM*4420, BIOM*4500, BIOM*4510, BIOM*4521/2, HK*4070, HK*4230, HK*4360, HK*4371/2, HK*4441/2, HK*4460, NUTR*4320, NUTR*4350, NUTR*4360, NUTR*4510.
5. Arts and Social Science Electives - 2.00 credits (1.00 credits must be from: PHIL*2030, PHIL*2070, PHIL*2100, PHIL*2120, PHIL*2180, PSYC*XXXX, SOC*XXXX)

## Biophysics (BIOP)

**Department of Physics, College of Physical and Engineering Science**

## Major (Honours Program)

The program emphasizes the physics of biological systems. It provides an excellent background for careers in the expanding interdisciplinary research laboratories of Government and Industry. Completion of the program at an appropriate level will qualify a student to pursue post-graduate studies in biophysics and certain areas of physics.

Since some of the required courses are not offered every semester, students entering the Major in Biophysics should plan their program in consultation with the Department of Physics Departmental Advisor.

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. This major requires the completion of 21.25 credits as indicated below. At least 1.00 credits must be from Arts and/or Social Science courses.

### Semester 1

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1040 [0.50] General Chemistry I
CIS*1500 [0.50] Introduction to Programming
One of (MATH*1200 recommended):
- MATH*1080 [0.50] Elements of Calculus I
- MATH*1200 [0.50] Calculus I

One of (PHYS*1000 recommended):
- PHYS*1000 [0.50] An Introduction to Mechanics
- PHYS*1070 [0.50] Introductory Physics for Life Sciences
- PHYS*1080 [0.50] Physics for Life Sciences

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2

CHEM*1050 [0.50] General Chemistry II
One of (PHYS*1010 recommended):
- PHYS*1010 [0.50] Introductory Electricity and Magnetism
- PHYS*1080 [0.50] Physics for Life Sciences
- PHYS*1130 [0.50] Physics with Applications

One of:
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health

One of (MATH*1210 recommended):
- MATH*1210 [0.50] Calculus II
- MATH*2080 [0.50] Elements of Calculus II

0.50 Arts or Social Science electives

### Semester 3

MATH*2160 [0.50] Linear Algebra I
MATH*2200 [0.50] Advanced Calculus I
MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
PHYS*2440 [0.75] Mechanics I
PHYS*2460 [0.75] Electricity and Magnetism I

### Semester 4

MATH*2170 [0.50] Differential Equations I
PHYS*2030 [0.50] Biophysics of Excitable Cells
PHYS*2260 [0.50] Quantum Physics
PHYS*2450 [0.75] Mechanics II
PHYS*2470 [0.75] Electricity and Magnetism II

### Semester 5

BIOC*2580 [0.50] Introduction to Biochemistry
MATH*3100 [0.50] Differential Equations II
PHYS*3100 [0.75] Electronics
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3240 [0.50] Statistical Physics I

### Semester 6

BIOC*3560 [0.50] Structure and Function in Biochemistry
PHYS*3220 [0.50] Waves and Optics
PHYS*3510 [0.50] Intermediate Laboratory
PHYS*4040 [0.50] Quantum Mechanics II
PHYS*4540 [0.50] Molecular Biophysics

### Semester 7

MCB*4050 [0.50] Protein and Nucleic Acid Structure
PHYS*4240 [0.50] Statistical Physics II
PHYS*4560 [0.50] Biophysical Methods
Two of:
- PHYS*4001 [0.50] Research in Physics
- PHYS*4120 [0.50] Atomic and Molecular Physics
- PHYS*4500 [0.50] Advanced Physics Laboratory
- 0.50 electives
- 0.50 electives

Note: At least one of PHYS*4120 in semester 7 or PHYS*4150 in semester 8 must be taken. Either PHYS*4001/2 in semesters 7 and 8 or PHYS*4300 in semester 8 must be taken.

### Semester 8

BIOC*4580 [0.50] Membrane Biochemistry
One of:
- PHYS*4002 [0.50] Research in Physics
- PHYS*4300 [0.50] Inquiry in Physics

One of:
- PHYS*4150 [0.50] Solid State Physics
- 0.50 electives

0.50 Arts or Social Science electives
0.50 electives
Note: At least one of PHYS*4120 in semester 7 or PHYS*4150 in semester 8 must be taken. Either PHYS*4001/2 in semesters 7 and 8 or PHYS*4300 in semester 8 must be taken.
Note: PHYS*4001/2 will be projects in biophysics, some of which may be in biological areas outside the Department of Physics.

# Biophysics (Co-op) (BIOP:C)

**Department of Physics, College of Physical and Engineering Science**

## Major (Honours Program)

Since some of the required courses are not offered every semester, students entering the Major in Biophysics (Co-op) should plan their program in consultation with the Department of Physics Faculty Advisor.

To graduate from the Co-op program a minimum of 4 successfully completed work terms is normally required.

This major requires the completion of 21.25 credits as indicated below:

### Semester 1 - Fall

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1040 [0.50] General Chemistry I
CIS*1500 [0.50] Introduction to Programming
One of (MATH*1200 recommended):
- MATH*1080 [0.50] Elements of Calculus I
- MATH*1200 [0.50] Calculus I

One of (PHYS*1000 recommended):
- PHYS*1000 [0.50] An Introduction to Mechanics
- PHYS*1070 [0.50] Introductory Physics for Life Sciences
- PHYS*1080 [0.50] Physics for Life Sciences

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2 - Winter

CHEM*1050 [0.50] General Chemistry II
One of:
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health

One of (MATH*1210 recommended):
- MATH*1210 [0.50] Calculus II
- MATH*2080 [0.50] Elements of Calculus II

One of (PHYS*1010 recommended):
- PHYS*1010 [0.50] Introductory Electricity and Magnetism
- PHYS*1080 [0.50] Physics for Life Sciences
- PHYS*1130 [0.50] Physics with Applications

0.50 Arts or Social Science electives

### Semester 3 - Fall

BIOC*2580 [0.50] Introduction to Biochemistry
COOP*1100 [0.00] Introduction to Co-operative Education
MATH*2160 [0.50] Linear Algebra I
MATH*2200 [0.50] Advanced Calculus I
PHYS*2440 [0.75] Mechanics I
PHYS*2460 [0.75] Electricity and Magnetism I

### Semester 4 - Winter

MATH*2170 [0.50] Differential Equations I
PHYS*2030 [0.50] Biophysics of Excitable Cells
PHYS*2260 [0.50] Quantum Physics
PHYS*2450 [0.75] Mechanics II
PHYS*2470 [0.75] Electricity and Magnetism II

### Summer Semester

COOP*1000 [0.00] Co-op Work Term I ++

### Semester 5 - Fall

BIOC*3560 [0.50] Structure and Function in Biochemistry
MATH*3100 [0.50] Differential Equations II

PHYS*3100 [0.75] Electronics
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3240 [0.50] Statistical Physics I

**Winter Semester**

COOP*2000 [0.00] Co-op Work Term II ++

**Summer Semester**

COOP*3000 [0.00] Co-op Work Term III ++

**Semester 6 - Fall**

MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
MCB*4050 [0.50] Protein and Nucleic Acid Structure
PHYS*4240 [0.50] Statistical Physics II
PHYS*4560 [0.50] Biophysical Methods
0.50 electives *

**Semester 7 - Winter**

BIOC*4580 [0.50] Membrane Biochemistry
PHYS*3220 [0.50] Waves and Optics
PHYS*3510 [0.50] Intermediate Laboratory
PHYS*4040 [0.50] Quantum Mechanics II
0.50 electives *

**Summer Semester**

COOP*4000 [0.00] Co-op Work Term IV ++

**Fall Semester**

COOP*5000 [0.00] Co-op Work Term V ++

**Semester 8 - Winter**

PHYS*4540 [0.50] Molecular Biophysics
One of:
- PHYS*4150 [0.50] Solid State Physics
- 0.50 electives *

One of:
- PHYS*4300 [0.50] Inquiry in Physics
- 0.50 electives *

One of:
- PHYS*4500 [0.50] Advanced Physics Laboratory
- 0.50 electives *

0.50 electives

*A minimum of 1.00 credits of Arts/Social Sciences electives is required for completion of this program.

++Four work terms are required for the completion of the co-op degree. It is also necessary that there be at least one work term in each of Fall, Winter and Summer semesters. Therefore, one of the summer work terms could be missed and the student would still graduate successfully. Whether the student completes four or five work terms, a report is required for each work term completed. Contact the co-op faculty advisor for further details.

## Biotechnology (BIOT)

Department of Molecular and Cellular Biology, College of Biological Science

### Minor (Honours Program)

A minimum of 5.00 credits is required.

BIOC*3560 [0.50] Structure and Function in Biochemistry
MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
MICR*2420 [0.50] Introduction to Microbiology
MICR*2430 [0.50] Microbiology Methods I
One of:
- ENGG*2660 [0.50] Biological Engineering Systems I
- ENGG*3830 [0.50] Bio-Process Engineering
- FOOD*2620 [0.50] Food Engineering Principles

Two of:
- ECON*1050 [0.50] Introductory Microeconomics
- ECON*1100 [0.50] Introductory Macroeconomics
- ECON*2100 [0.50] Economic Growth and Environmental Quality
- ECON*2310 [0.50] Intermediate Microeconomics
- ECON*2410 [0.50] Intermediate Macroeconomics
- MCS*1000 [0.50] Introductory Marketing

Three of:
- ANSC*4050 [0.50] Biotechnology in Animal Science
- FOOD*3260 [0.50] Industrial Microbiology
- MBG*4240 [0.50] Applied Molecular Genetics
- MICR*3230 [0.50] Immunology
- MICR*4180 [0.50] Microbial Processes in Environmental Management
- PBIO*3750 [0.50] Plant Tissue Culture

## Business Administration (BADM)

**Department of Economics and Finance, College of Management and Economics**

### Minor (Honours Program)

A minimum of 5.00 credits is required.

ACCT*2220 [0.50] Financial Accounting
ACCT*2230 [0.50] Management Accounting
ECON*1050 [0.50] Introductory Microeconomics
ECON*1100 [0.50] Introductory Macroeconomics
ECON*2310 [0.50] Intermediate Microeconomics
ECON*2410 [0.50] Intermediate Macroeconomics
ECON*2560 [0.50] Theory of Finance
MCS*1000 [0.50] Introductory Marketing
MCS*3040 [0.50] Business and Consumer Law
One of:
- BUS*2090 [0.50] Individuals and Groups in Organizations
- FARE*3310 [0.50] Operations Management

Students wishing to acquire further depth in Business Administration should consider taking electives from the schedules of study listed under Economics in the B.A. degree, Economics and Mathematical Economics in the B.A.H. degree and Management Economics Industry and Finance in the B.Comm. degree.

## Chemical Physics (CHPY)

**Administered by the Office of the Dean, College of Physical and Engineering Science on behalf of the Department of Chemistry and the Department of Physics**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum of 21.75 credits is required. At least 1.00 credits must be from Arts and/or Social Science courses.

**Semester 1**

CHEM*1040 [0.50] General Chemistry I
CIS*1500 [0.50] Introduction to Programming
MATH*1200 [0.50] Calculus I
PHYS*1000 [0.50] An Introduction to Mechanics
One of
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health
- BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

CHEM*1050 [0.50] General Chemistry II
MATH*1210 [0.50] Calculus II
PHYS*1010 [0.50] Introductory Electricity and Magnetism
One of
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health
- BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology

0.50 Arts or Social Science electives

**Semester 3**

CHEM*2060 [0.50] Structure and Bonding
MATH*2160 [0.50] Linear Algebra I
MATH*2200 [0.50] Advanced Calculus I
PHYS*2440 [0.75] Mechanics I
PHYS*2460 [0.75] Electricity and Magnetism I

**Semester 4**

CHEM*2070 [0.50] Structure and Spectroscopy
CHEM*2480 [0.50] Analytical Chemistry I
MATH*2170 [0.50] Differential Equations I
PHYS*2450 [0.75] Mechanics II
PHYS*2470 [0.75] Electricity and Magnetism II

**Semester 5**

CHEM*2820 [0.50] Thermodynamics and Kinetics
CHEM*3860 [0.50] Quantum Chemistry
PHYS*3100 [0.75] Electronics
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3240 [0.50] Statistical Physics I

**Semester 6**

CHEM*3430 [0.50] Analytical Chemistry II: Instrumental Analysis
PHYS*3220 [0.50] Waves and Optics
PHYS*4040 [0.50] Quantum Mechanics II
One of:
- CHEM*2700 [0.50] Organic Chemistry I
- 0.50 Arts or Social Science electives

One of:

CHEM*3870 [0.50] Molecular Spectroscopy
CHEM*4880 [0.50] Topics in Advanced Physical Chemistry

**Semester 7**

CHEM*3440 [0.50] Analytical Chemistry III: Analytical Instrumentation
IPS*4001 [0.75] Chemical Physics Research Project
MATH*3100 [0.50] Differential Equations II
PHYS*4120 [0.50] Atomic and Molecular Physics
PHYS*4240 [0.50] Statistical Physics II

**Semester 8**

IPS*4002 [0.75] Chemical Physics Research Project
One of:
CHEM*3870 [0.50] Molecular Spectroscopy
CHEM*4880 [0.50] Topics in Advanced Physical Chemistry
1.50 electives

## Chemical Physics (Co-op) (CHPY:C)

**Administered by the Office of the Dean, College of Physical and Engineering Science on behalf of the Department of Chemistry and the Department of Physics**

### Major (Honours Program)

A minimum of 21.25 credits is required. At least 1.00 credits must be from Arts and/or Social Science courses.

**Semester 1 - Fall**

CHEM*1040 [0.50] General Chemistry I
CIS*1500 [0.50] Introduction to Programming
MATH*1200 [0.50] Calculus I
PHYS*1000 [0.50] An Introduction to Mechanics
One of
BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

CHEM*1050 [0.50] General Chemistry II
MATH*1210 [0.50] Calculus II
PHYS*1010 [0.50] Introductory Electricity and Magnetism
One of
BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
One of:
CIS*2500 [0.50] Intermediate Programming
0.50 Arts or Social Science electives

**Semester 3 - Fall**

CHEM*2060 [0.50] Structure and Bonding
COOP*1100 [0.00] Introduction to Co-operative Education
MATH*2160 [0.50] Linear Algebra I
MATH*2200 [0.50] Advanced Calculus I
PHYS*2440 [0.75] Mechanics I
PHYS*2460 [0.75] Electricity and Magnetism I

**Semester 4 - Winter**

CHEM*2070 [0.50] Structure and Spectroscopy
CHEM*2480 [0.50] Analytical Chemistry I
MATH*2170 [0.50] Differential Equations I
PHYS*2450 [0.75] Mechanics II
PHYS*2470 [0.75] Electricity and Magnetism II

**Summer Semester**

COOP*1000 [0.00] Co-op Work Term I ++

**Fall Semester**

COOP*2000 [0.00] Co-op Work Term II ++

**Semester 5 - Winter**

CHEM*3430 [0.50] Analytical Chemistry II: Instrumental Analysis
PHYS*3220 [0.50] Waves and Optics
One of:
CHEM*2700 [0.50] Organic Chemistry I
0.50 electives *
One of:
CHEM*3870 [0.50] Molecular Spectroscopy +
0.50 electives *
0.50 electives *

**Summer Semester**

COOP*3000 [0.00] Co-op Work Term III ++

**Semester 6 - Fall**

CHEM*2820 [0.50] Thermodynamics and Kinetics
CHEM*3860 [0.50] Quantum Chemistry
MATH*3100 [0.50] Differential Equations II
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3240 [0.50] Statistical Physics I

**Winter Semester**

COOP*4000 [0.00] Co-op Work Term IV ++

**Summer Semester**

COOP*5000 [0.00] Co-op Work Term V ++

**Semester 7** - Fall**

CHEM*3440 [0.50] Analytical Chemistry III: Analytical Instrumentation
PHYS*3100 [0.75] Electronics
PHYS*4240 [0.50] Statistical Physics II
One of:
CHEM*3640 [0.50] Chemistry of the Elements I
CHEM*3750 [0.50] Organic Chemistry II
0.50 electives *
0.50 electives *

**Semester 8** - Winter**

PHYS*4040 [0.50] Quantum Mechanics II
One of:
CHEM*3760 [0.50] Organic Chemistry III
0.50 electives *
One of:
CHEM*3870 [0.50] Molecular Spectroscopy +
CHEM*4880 [0.50] Topics in Advanced Physical Chemistry +
0.50 electives *
One of:
PHYS*4300 [0.50] Inquiry in Physics
0.50 electives *
0.50 electives *

* A minimum of 1.00 credits of Arts/Social Sciences electives is required for completion of this program.

** A minimum of 2.00 credits in science courses at the 4000 level is required for graduation.

+ One of CHEM*3870 or CHEM*4880 is required for graduation.

++ Four work terms are required for the completion of the co-op degree. It is also necessary that there be at least one work term in each of Fall, Winter and Summer semesters. Therefore, one of the summer work terms could be missed and the student would still graduate successfully. Whether the student completes four or five work terms, a report is required for each work term completed. Contact the co-op faculty advisor for further details.

## Chemistry (CHEM)

**Department of Chemistry, College of Physical and Engineering Science**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. The major will require the completion of 20.25 credits as indicated below:

**Semester 1**

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1040 [0.50] General Chemistry I
MATH*1200 [0.50] Calculus I
PHYS*1000 [0.50] An Introduction to Mechanics
0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

CHEM*1050 [0.50] General Chemistry II
MATH*1210 [0.50] Calculus II
PHYS*1010 [0.50] Introductory Electricity and Magnetism
One of
BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
0.50 electives

**Semester 3**

BIOC*2580 [0.50] Introduction to Biochemistry
CHEM*2060 [0.50] Structure and Bonding
CHEM*2400 [0.75] Analytical Chemistry I
MATH*2150 [0.50] Applied Matrix Algebra
0.50 electives*

**Semester 4**

| | | |
|---|---|---|
| CHEM*2070 | [0.50] | Structure and Spectroscopy |
| CHEM*2700 | [0.50] | Organic Chemistry I |
| CHEM*3430 | [0.50] | Analytical Chemistry II: Instrumental Analysis |
| MATH*2170 | [0.50] | Differential Equations I |
| PHYS*2260 | [0.50] | Quantum Physics |

**Semester 5**

| | | |
|---|---|---|
| CHEM*2820 | [0.50] | Thermodynamics and Kinetics |
| CHEM*3640 | [0.50] | Chemistry of the Elements I |
| CHEM*3750 | [0.50] | Organic Chemistry II |
| CHEM*3860 | [0.50] | Quantum Chemistry |

0.50 electives*

**Semester 6**

| | | |
|---|---|---|
| CHEM*3650 | [0.50] | Chemistry of the Elements II |
| CHEM*3760 | [0.50] | Organic Chemistry III |

1.50 electives* or restricted electives**

**Semester 7 and 8**

| | | |
|---|---|---|
| CHEM*3440 | [0.50] | Analytical Chemistry III: Analytical Instrumentation |

3.00 Chemistry or Biochemistry**
1.50 electives*

*selection of electives is subject to the following:

1. At least 1.00 credits must be in the Arts & Social Sciences.
2. Approval of the Faculty Advisor must be obtained for the selection of courses not listed as restrictive electives.
3. Options for an "Area of Focus" or a minor are available. Subject areas include Biochemistry, Computing and Information Science, Earth Sciences, Environmental Sciences, Mathematical Sciences, and Physics. Please consult with your Faculty Advisor for more detail.

**3.00 credits from the 3000/4000 level as follows:

1. 1.50 comprising of (CHEM*3870 or CHEM*4880), (CHEM*4620 or CHEM*4630), (CHEM*4720 or CHEM*4730)
2. 1.50 chosen from CHEM*3870, CHEM*4010, CHEM*4400, BIOC*4520, BIOC*4540,BIOC*4580, CHEM*4620, CHEM*4630, CHEM*4720, CHEM*4730, CHEM*4740, CHEM*4880, CHEM*4900, CHEM*4910, MCB*4050, MCB*4080 , TOX*4590

**Note:**

1. Some of these courses may have to be taken in Semester 6.
2. Some of these courses are offered only in alternate years, and some have additional prerequisites for which the student must plan ahead, with the assistance of the faculty advisor.

## Minor (Honours Program)

A minor in Chemistry consists of at least 5.00 credits in Chemistry courses (CHEM) at the 2000 level or above including a minimum of 2.50 credits at the 3000 or 4000 level. Exclusions: CHEM*2300 and CHEM*3360 cannot be counted toward this specialization

# Chemistry (Co-op) (CHEM:C)

**Department of Chemistry, College of Physical and Engineering Science**

## Major (Honours Program)

The major will require the completion of 20.25 credits as indicated below.

The course content of semesters 1 to 3 is the same as listed in the regular Honours Program Major.

To graduate from the Co-op program a minimum of 4 successfully completed work terms is normally required. These can be taken as four single work terms (Stream A), or as a double work term between two single work terms (Stream B).

**Stream A:** single work term option

**Semester 1 - Fall**

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |

0.50 electives

**Semester 3 - Fall**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| CHEM*2060 | [0.50] | Structure and Bonding |
| CHEM*2400 | [0.75] | Analytical Chemistry I |
| MATH*2150 | [0.50] | Applied Matrix Algebra |

0.50 electives*

**Winter Semester**

| | | |
|---|---|---|
| COOP*1000 | [0.00] | Co-op Work Term I |

**Semester 4 - Summer**

| | | |
|---|---|---|
| CHEM*2070 | [0.50] | Structure and Spectroscopy |
| CHEM*2700 | [0.50] | Organic Chemistry I |
| CHEM*3430 | [0.50] | Analytical Chemistry II: Instrumental Analysis |
| MATH*2170 | [0.50] | Differential Equations I |
| PHYS*2260 | [0.50] | Quantum Physics |

**Semester 5 - Fall**

| | | |
|---|---|---|
| CHEM*2820 | [0.50] | Thermodynamics and Kinetics |
| CHEM*3440 | [0.50] | Analytical Chemistry III: Analytical Instrumentation |
| CHEM*3640 | [0.50] | Chemistry of the Elements I |
| CHEM*3860 | [0.50] | Quantum Chemistry |

0.50 electives*

**Winter Semester**

| | | |
|---|---|---|
| COOP*2000 | [0.00] | Co-op Work Term II |

**Semester 6 - Summer**

| | | |
|---|---|---|
| CHEM*3750 | [0.50] | Organic Chemistry II |

0.50 electives*
1.50 electives* or restricted electives**

**Fall Semester**

| | | |
|---|---|---|
| COOP*3000 | [0.00] | Co-op Work Term III |

**Semester 7 - Winter**

| | | |
|---|---|---|
| CHEM*3650 | [0.50] | Chemistry of the Elements II |
| CHEM*3760 | [0.50] | Organic Chemistry III |

1.50 electives* or restricted electives**

**Summer Semester**

| | | |
|---|---|---|
| COOP*4000 | [0.00] | Co-op Work Term IV |

**Semester 8 - Fall**

2.50 electives* or restricted electives**

* selection of electives is subject to the following:

1. At least 1.00 credits must be in the Arts & Social Sciences.
2. Approval of the Faculty Advisor must be obtained for the selection of courses not listed as restrictive electives.
3. Options for an "Area of Focus" or a minor are available. Subject areas include Biochemistry, Computing and Information Science, Earth Sciences, Environmental Sciences, Mathematical Sciences, and Physics. Please consult with your Faculty Advisor for more detail.

** 3.00 credits from the 3000/4000 level as follows:

1. 1.50 comprising of (CHEM*3870 or CHEM*4880), (CHEM*4620 or CHEM*4630), (CHEM*4720 or CHEM*4730)
2. 1.50 chosen from CHEM*3870, CHEM*4010, CHEM*4400, BIOC*4520, BIOC*4540, BIOC*4580, CHEM*4620, CHEM*4630, CHEM*4720, CHEM*4730, CHEM*4740, CHEM*4880, CHEM*4900, CHEM*4910, MCB*4050, MCB*4080 , TOX*4590

**Note:**

Some of these courses are offered only in alternate years, and some have additional prerequisites for which the student must plan ahead, with the assistance of the faculty advisor.

**Stream B:** double work term option

**Semester 1 - Fall**

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| MATH*1210 | [0.50] | Calculus II |

PHYS*1010 [0.50] Introductory Electricity and Magnetism
One of
BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
0.50 electives

**Semester 3 - Fall**

BIOC*2580 [0.50] Introduction to Biochemistry
CHEM*2060 [0.50] Structure and Bonding
CHEM*2400 [0.75] Analytical Chemistry I
MATH*2150 [0.50] Applied Matrix Algebra
0.50 electives*

**Winter Semester**

COOP*1000 [0.00] Co-op Work Term I

**Semester 4 - Summer**

CHEM*2070 [0.50] Structure and Spectroscopy
CHEM*2700 [0.50] Organic Chemistry I
CHEM*3430 [0.50] Analytical Chemistry II: Instrumental Analysis
MATH*2170 [0.50] Differential Equations I
PHYS*2260 [0.50] Quantum Physics

**Semester 5 - Fall**

CHEM*2820 [0.50] Thermodynamics and Kinetics
CHEM*3640 [0.50] Chemistry of the Elements I
CHEM*3750 [0.50] Organic Chemistry II
CHEM*3860 [0.50] Quantum Chemistry
0.50 electives*

**Semester 6 - Winter**

CHEM*3650 [0.50] Chemistry of the Elements II
CHEM*3760 [0.50] Organic Chemistry III
0.50 electives*
1.00 electives* or restricted electives*

**Summer Semester**

COOP*2000 [0.00] Co-op Work Term II

**Fall Semester**

COOP*3000 [0.00] Co-op Work Term III

**Semester 7 - Winter**

2.50 electives* or restricted electives**

**Summer Semester**

COOP*4000 [0.00] Co-op Work Term IV

**Semester 8 - Fall**

CHEM*3440 [0.50] Analytical Chemistry III: Analytical Instrumentation
2.00 electives* or restricted electives**

* selection of electives is subject to the following:

1. At least 1.00 credits must be in the Arts & Social Sciences.
2. Approval of the Faculty Advisor must be obtained for the selection of courses not listed as restrictive electives.
3. Options for an "Area of Focus" or a minor are available. Subject areas include Biochemistry, Computing and Information Science, Earth Sciences, Environmental Sciences, Mathematical Sciences, and Physics. Please consult with your Faculty Advisor for more detail.

** 3.00 credits from the 3000/4000 level as follows:

1. 1.50 comprising of (CHEM*3870 or CHEM*4880), (CHEM*4620 or CHEM*4630), (CHEM*4720 or CHEM*4730)
2. 1.50 chosen from CHEM*3870, CHEM*4010, CHEM*4400, BIOC*4520, BIOC*4540, BIOC*4580, CHEM*4620, CHEM*4630, CHEM*4720, CHEM*4730, CHEM*4740, CHEM*4880, CHEM*4900, CHEM*4910, MCB*4050, MCB*4080 , TOX*4590

**Note:**

Some of these courses are offered only in alternate years, and some have additional prerequisites for which the student must plan ahead, with the assistance of the faculty advisor.

## Computing and Information Science (CIS)

**Department of Computing and Information Science, College of Physical and Engineering Science**

A knowledge of Computing is a complement to most areas of study. The Minor in Computing and Information Science is directed towards students who wish to supplement their studies in another area with some experience in Computing. Students interested in pursuing a Major in Computing can do so through the Bachelor of Computing Degree Program.

### Minor (Honours Program)

CIS*1500 [0.50] Introduction to Programming
CIS*1910 [0.50] Discrete Structures in Computing I
CIS*2430 [0.50] Object Oriented Programming
CIS*2500 [0.50] Intermediate Programming
CIS*2520 [0.50] Data Structures
CIS*2750 [0.75] Software Systems Development and Integration
CIS*2910 [0.50] Discrete Structures in Computing II
CIS*3530 [0.50] Data Base Systems and Concepts
1.00 additional credits from CIS or STAT courses at the 2000 level or above

## Ecology (ECOL)

**Department of Integrative Biology, College of Biological Science**

The program provides a solid foundation in the principles of ecology, and further training in both pure and applied aspects of ecology. After the fourth semester, the student may choose to enter one (1) of three (3) areas of emphasis, or to design a course package that meets his/her own specific ecological interests (General Ecology). The program offers preparation for careers in conservation, resource management, ecological consulting, or nature interpretation; or for graduate training and research in fundamental ecology and evolutionary biology. This major qualifies students for post-graduate work in the environmental sciences, and provides a sound science background for students wishing to pursue careers in teaching, government service or the private sector.

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum total of 20.00 credits is required to complete the major.

**Semester 1**

BIOL*1070 [0.50] Discovering Biodiversity
CHEM*1040 [0.50] General Chemistry I
MATH*1080 [0.50] Elements of Calculus I
PHYS*1070 [0.50] Introductory Physics for Life Sciences
0.50 Arts or Social Science electives
Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

BIOL*1080 [0.50] Biological Concepts of Health
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1050 [0.50] General Chemistry II
PHYS*1080 [0.50] Physics for Life Sciences
0.50 Arts or Social Science electives

**Semester 3**

MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
STAT*2040 [0.50] Statistics I
One of:
GEOG*1300 [0.50] Introduction to the Biophysical Environment
GEOL*1050 [0.50] Geology and the Environment
1.00 electives or restricted electives*

**Semester 4**

BIOC*2580 [0.50] Introduction to Biochemistry
BIOL*3110 [0.50] Population Ecology
One of:
BIOL*2250 [0.50] Biostatistics and the Life Sciences
STAT*2050 [0.50] Statistics II
STAT*2250 [0.50] Biostatistics and the Life Sciences
1.00 electives*

**Semester 5**

BIOL*3010 [0.50] Laboratory and Field Work in Ecology
One of:
BOT*2100 [0.50] Life Strategies of Plants
ZOO*3200 [0.50] Comparative Animal Physiology I
One of:
BIOL*3020 [0.50] Population Genetics
BIOL*3400 [0.50] Evolution
1.00 electives

**Semester 6**

BIOL*3120 [0.50] Community Ecology
2.00 electives

**Semester 7**

BIOL*4110 [0.75] Ecological Methods
1.75 electives

**Semester 8**

BIOL*4120 [0.50] Evolutionary Ecology
2.00 electives

* Restricted Electives

One of:

| | | |
|---|---|---|
| ZOO*2090 | [0.50] | Vertebrate Structure and Function |
| ZOO*2700 | [0.50] | Invertebrate Morphology & Evolution |

## Areas of Emphasis

### General Ecology (GECO)

A minimum of 3.00 credits from the area-of-emphasis-specific credits, plus 1.50 additional science credits. Of the 4.50 credits, at least 3.50 must be at the 3000 or 4000 level.

### Experimental Ecology (EECO)

| | | |
|---|---|---|
| ZOO*4070 | [0.50] | Animal Behaviour |
| ZOO*4170 | [0.50] | Experimental Comparative Animal Physiology |

0.75 credits from:

| | | |
|---|---|---|
| BIOL*4410 | [0.75] | Field Ecology |
| BIOL*4600 | [0.75] | Tropical Ecology |
| BIOL*4610 | [0.75] | Arctic Ecology |
| BIOL*4700 | [0.50] | Field Biology |
| BIOL*4710 | [0.25] | Field Biology |
| BIOL*4800 | [0.50] | Field Biology |
| BIOL*4810 | [0.25] | Field Biology |
| IBIO*4500 | [0.75] | Research in Integrative Biology I |

One of the following not already successfully completed in Semester 6:

| | | |
|---|---|---|
| BIOL*3020 | [0.50] | Population Genetics |
| BIOL*3400 | [0.50] | Evolution |

1.75 additional science credits, at least 1.50 of which are at the 3000 or 4000 level

### Interpretive Ecology (IE)

| | | |
|---|---|---|
| ENVB*3000 | [0.50] | Nature Interpretation |
| ZOO*4070 | [0.50] | Animal Behaviour |
| ZOO*4910 | [0.50] | Integrative Vertebrate Biology |

0.75 credits from:

| | | |
|---|---|---|
| BIOL*4410 | [0.75] | Field Ecology |
| BIOL*4600 | [0.75] | Tropical Ecology |
| BIOL*4610 | [0.75] | Arctic Ecology |
| BIOL*4700 | [0.50] | Field Biology |
| BIOL*4710 | [0.25] | Field Biology |
| BIOL*4800 | [0.50] | Field Biology |
| BIOL*4810 | [0.25] | Field Biology |

At least 0.75 additional science credits at the 3000 or 4000 level

One of:

| | | |
|---|---|---|
| BIOL*3050 | [0.50] | Mycology |
| BOT*3710 | [0.50] | Plant Diversity and Evolution |

One of:

| | | |
|---|---|---|
| ZOO*4920 | [0.25] | Lab Studies in Ornithology |
| ZOO*4930 | [0.25] | Lab Studies in Ichthyology |
| ZOO*4940 | [0.25] | Lab Studies in Herpetology |
| ZOO*4950 | [0.25] | Lab Studies in Mammalogy |

One of:

| | | |
|---|---|---|
| BIOL*3450 | [0.50] | Introduction to Aquatic Environments |
| ENVB*3090 | [0.50] | Insect Diversity and Biology |

Recommended:

| | | |
|---|---|---|
| CHEM*3360 | [0.50] | Environmental Chemistry and Toxicology |
| ENVB*3040 | [0.50] | Natural Chemicals in the Environment |
| ENVB*4040 | [0.50] | Behaviour of Insects |
| MICR*4140 | [0.50] | Soil Microbiology and Biotechnology |

### Resource Conservation (RC)

| | | |
|---|---|---|
| BIOL*3130 | [0.50] | Conservation Biology |
| BIOL*4040 | [0.50] | Natural Resources Policy |
| ECON*1050 | [0.50] | Introductory Microeconomics |
| FARE*2700 | [0.50] | Survey of Natural Resource Economics |

2.50 additional science credits, at least 1.50 of which are at the 3000 or 4000 level

Recommended:

| | | |
|---|---|---|
| BIOL*4060 | [0.50] | Restoration Ecology |
| BIOL*4150 | [0.50] | Wildlife Conservation and Management |
| ECON*2100 | [0.50] | Economic Growth and Environmental Quality |
| ENVB*2030 | [0.50] | Current Issues in Forest Science |
| ENVB*4780 | [0.50] | Forest Ecology |
| ENVS*3320 | [0.50] | Principles of Landscape Ecology |

## Minor (Honours Program)

A minimum of 5.00 credits is required to completed the minor, which must include:

| | | |
|---|---|---|
| BIOL*3010 | [0.50] | Laboratory and Field Work in Ecology |
| BIOL*3110 | [0.50] | Population Ecology |
| BIOL*3120 | [0.50] | Community Ecology |
| BIOL*4110 | [0.75] | Ecological Methods |
| BIOL*4120 | [0.50] | Evolutionary Ecology |

One of:

| | | |
|---|---|---|
| BIOL*3020 | [0.50] | Population Genetics |
| BIOL*3400 | [0.50] | Evolution |

One of:

| | | |
|---|---|---|
| BOT*2100 | [0.50] | Life Strategies of Plants |
| ZOO*2090 | [0.50] | Vertebrate Structure and Function |

One of:

| | | |
|---|---|---|
| GEOG*1220 | [0.50] | Human Impact on the Environment |
| GEOG*1300 | [0.50] | Introduction to the Biophysical Environment |
| GEOL*1050 | [0.50] | Geology and the Environment |

0.75 credits chosen in consultation with the faculty advisor

# Environmental Biology (ENVB)

**School of Environmental Sciences, Ontario Agricultural College**

The honours B.Sc. program in Environmental Biology combines a broad education in the life sciences with a more specialized understanding of the biological consequences of interactions between humans and the environment. This major prepares students for post-graduate work in environmental biology and related life sciences and provides a strong foundation for students wishing to pursue careers in teaching, government service or the private sector.

## Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. This major requires the completion of 20.00 credits. A minimum of 16.00 of these 20.00 must be science credits. Of these 16.00 science credits, a minimum of 6.00 must be at the 3000 - and 4000-levels with a minimum of 2.00 credits at the 4000-level.

### Semester 1

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science elective

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

One of:

| | | |
|---|---|---|
| CIS*1200 | [0.50] | Introduction to Computing |
| CIS*1500 | [0.50] | Introduction to Programming |
| MATH*2080 | [0.50] | Elements of Calculus II |
| STAT*2040 | [0.50] | Statistics I |

0.50 Arts or Social Science elective

### Semester 3

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| STAT*2040 | [0.50] | Statistics I (if not taken in semester 2) |
| TOX*2000 | [0.50] | Principles of Toxicology |

1.00 electives or restricted electives chosen from lists A, B, C and/or D (or 1.50 if STAT*2040 was taken in semester 2)

### Semester 4

| | | |
|---|---|---|
| BIOL*3110 | [0.50] | Population Ecology |
| ENVB*2100 | [0.50] | Problem-Solving in Environmental Biology |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |

1.00 electives or restricted electives chosen from lists A, B, C and/or D

### Semester 5

2.50 electives or restricted electives chosen from lists A, B, C and/or D (at least 1.00 restricted electives must be selected, including at least one ENVB course)

Students are encouraged to take (ENVS*3410 and ENVS*3420) or ENVS*3430 in Semesters 5 and 6.

### Semester 6

| | | |
|---|---|---|
| BIOL*3400 | [0.50] | Evolution |
| ENVB*3330 | [0.50] | Ecosystem Processes and Applications |

1.50 electives or restricted electives chosen from lists A, B, C and/or D

### Semester 7

2.50 electives or restricted electives chosen from lists A, B, C and/or D

Students contemplating graduate studies are encouraged to take ENVS*4410 in semester 7 and ENVS*4420 in semester 8, or ENVS*4430 in either semester 7 or 8.

### Semester 8

2.50 electives or restricted electives chosen from lists A, B, C and/or D

## Restricted Electives

Select 4.50 credits from the following lists of restricted electives during Semesters 3-8. At least 1.00 of these credits must be from ENVB courses.

Students should note that some restricted electives (marked by asterisks **) require other restricted electives as prerequisites. Students should consult the most recent undergraduate calendar for specific requirements.

### List A - Environment & Agriculture

Minimum of 1.00 credits from the following list:

| | | |
|---|---|---|
| CROP*2110 | [0.50] | Crop Ecology |
| CROP*2280 | [0.50] | Crops in Land Reclamation |
| ENVB*2040 | [0.50] | Plant Health and the Environment |
| ENVB*3040 | [0.50] | Natural Chemicals in the Environment |
| ENVB*3210 | [0.50] | Plant Pathology |
| ENVB*4040 | [0.50] | Behaviour of Insects ** |
| ENVB*4100 | [0.50] | Integrated Management of Invasive Insect Pests ** |
| ENVB*4130 | [0.50] | Chemical Ecology: Principles & Practice ** |
| MICR*3220 | [0.50] | Plant Microbiology |
| MICR*4140 | [0.50] | Soil Microbiology and Biotechnology |
| NRS*3000 | [0.50] | Environmental Issues in Agriculture and Landscape Management |
| PBIO*4750 | [0.50] | Genetic Engineering of Plants ** |

### List B - Impacts of Pollution on Living Organisms

Minimum of 1.00 credits from the following list:

| | | |
|---|---|---|
| BIOL*3450 | [0.50] | Introduction to Aquatic Environments |
| BIOL*4350 | [0.50] | Biology of Polluted Waters ** |
| BIOL*4610 | [0.75] | Arctic Ecology |
| ENVB*3010 | [0.50] | Climate Change Biology |
| ENVB*3030 | [0.50] | Pesticides and the Environment |
| ENVB*3280 | [0.50] | Waterborne Disease Ecology |
| ENVB*4240 | [0.50] | Biological Activity of Pesticides |
| ENVB*4550 | [0.50] | Toxicological Risk Characterization ** |
| GEOG*3020 | [0.50] | Global Environmental Change |
| MBG*4270 | [0.50] | DNA Replication, Recombination and Repair ** |
| MICR*4180 | [0.50] | Microbial Processes in Environmental Management |
| PBIO*4530 | [0.50] | Environmental Pollution Stresses on Plants ** |
| TOX*3360 | [0.50] | Environmental Chemistry and Toxicology |

### List C - Conservation of Biodiversity & Natural Resources

Minimum of 1.00 credits from the following list:

| | | |
|---|---|---|
| BIOL*3130 | [0.50] | Conservation Biology |
| BIOL*4040 | [0.50] | Natural Resources Policy |
| BIOL*4150 | [0.50] | Wildlife Conservation and Management |
| BIOL*4600 | [0.50] | Tropical Ecology |
| ENVB*2030 | [0.50] | Current Issues in Forest Science |
| ENVB*3090 | [0.50] | Insect Diversity and Biology |
| ENVB*3230 | [0.50] | Agroforestry Systems ** |
| ENVB*3250 | [0.50] | Forest Health and Disease |
| ENVB*3270 | [0.50] | Forest Biodiversity ** |
| ENVB*4020 | [0.50] | Water Quality and Environmental Management ** |
| ENVB*4220 | [0.50] | Biology of Aquatic Insects ** |
| ENVB*4260 | [0.50] | Field Entomology ** |
| ENVB*4270 | [0.50] | Insect Biosystematics ** |
| ENVB*4780 | [0.50] | Forest Ecology ** |
| NRS*2120 | [0.50] | Introduction to Environmental Stewardship |
| NRS*3100 | [0.50] | Resource Planning Techniques |
| SOIL*3050 | [0.50] | Land Utilization ** |
| SOIL*3080 | [0.50] | Soil and Water Conservation ** |

### List D - Supporting Courses

| | | |
|---|---|---|
| ENVS*3410 | [0.50] | Independent Research I |
| ENVS*3420 | [0.50] | Independent Research II |
| ENVS*3430 | [1.00] | Independent Research |
| ENVS*4410 | [1.00] | Advanced Independent Research I |
| ENVS*4420 | [1.00] | Advanced Independent Research II |
| ENVS*4430 | [2.00] | Advanced Independent Research |

The following restricted elective courses are required as prerequisites for some courses in lists A, B and C:

| | | |
|---|---|---|
| BIOL*3120 | [0.50] | Community Ecology |
| BOT*2100 | [0.50] | Life Strategies of Plants |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| SOIL*2010 | [0.50] | Soil Science |

## Environmental Geoscience and Geomatics (EGG)

**Department of Geography, College of Social and Applied Human Sciences**

This program provides opportunities for study of the processes and properties of the biophysical environment and a core foundation in the analytical techniques (i.e. Geographical Information Science and Remote Sensing) used for their interpretation, analysis and presentation.

Graduates of the program that select courses required for a 'Professional Geoscientist' will meet the academic requirements for eligibility for membership as an Environmental Geoscientist in the Association of Professional Geoscientists of Ontario (APGO), allowing for use of the designation P. Geo. Ontario's legislation under the Professional Geoscientists Act, 2000 (the Act), requires registration with the APGO of anyone wishing to practice geoscience in Ontario. Details on the course requirements for APGO membership can be found on the Department of Geography website:

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult with a B.Sc. Faculty Advisor in the Department of Geography. All students are encouraged to consult with the advisor on a regular basis.

The major will require the completion of 20.00 credits as indicated below:

#### Semester 1

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| CHEM*1040 | [0.50] | General Chemistry I |
| GEOL*1050 | [0.50] | Geology and the Environment |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

One of:

| | | |
|---|---|---|
| MATH*1080 | [0.50] | Elements of Calculus I |
| MATH*1200 | [0.50] | Calculus I |

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

#### Semester 2

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| GEOG*1300 | [0.50] | Introduction to the Biophysical Environment |
| PHYS*1130 | [0.50] | Physics with Applications |

0.50 Arts or Social Science electives* (GEOG*1220 is recommended)

#### Semester 3

| | | |
|---|---|---|
| GEOG*2000 | [0.50] | Geomorphology |
| GEOG*2420 | [0.50] | The Earth From Space |
| GEOG*2480 | [0.50] | Mapping and GIS |

One of:

| | | |
|---|---|---|
| GEOG*2460 | [0.50] | Analysis in Geography |
| STAT*2040 | [0.50] | Statistics I |

0.50 Arts or Social Science electives*

#### Semester 4

| | | |
|---|---|---|
| GEOG*2110 | [0.50] | Climate and the Biophysical Environment |
| GEOG*2210 | [0.50] | Environment and Resources |

One of:

| | | |
|---|---|---|
| CIS*1200 | [0.50] | Introduction to Computing |
| CIS*1500 | [0.50] | Introduction to Programming |
| MATH*1210 | [0.50] | Calculus II |
| MATH*2080 | [0.50] | Elements of Calculus II |

1.00 approved Science electives*

#### Semester 5

| | | |
|---|---|---|
| GEOG*3000 | [0.50] | Fluvial Processes |
| GEOG*3110 | [0.50] | Biotic and Natural Resources |

One of:

| | | |
|---|---|---|
| GEOG*3020 | [0.50] | Global Environmental Change |
| GEOG*3090 | [0.50] | Gender and Environment |
| GEOG*3210 | [0.50] | Management of the Biophysical Environment |

1.00 electives, at least 0.50 from approved Science electives*

#### Semester 6

| | | |
|---|---|---|
| GEOG*3420 | [0.50] | Remote Sensing of the Environment |
| GEOG*3480 | [0.50] | GIS and Spatial Analysis |
| GEOG*3610 | [0.50] | Environmental Hydrology |

1.00 electives, at least 0.50 from approved Science electives*

#### Semester 7

| | | |
|---|---|---|
| GEOG*4110 | [1.00] | Environmental Systems Analysis |

1.50 electives, at least 1.00 from approved Science electives* (GEOG*4690 is recommended)

#### Semester 8

| | | |
|---|---|---|
| GEOG*4480 | [1.00] | Applied Geographic Information Systems |

1.50 electives, at least 1.00 from approved Science electives*

### Program Requirements

1. Students are required to complete 16.00 credits in science of which a minimum of 6.00 credits must be 3000 or 4000 level, of which at least 2.00 must be at the 4000 level.
2. * Students should refer to the list of Approved Science and Arts/Social Science electives for BSc students: http://www.bsc.uoguelph.ca/Approved_electives.shtml

## Food Science (FOOD)

**Department of Food Science, Ontario Agricultural College**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor.

**Semester 1 - Fall**

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Note: CIS*1200, rather than an Arts or Social Science credit is recommended for those needing to improve their computer skills.

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*2080 | [0.50] | Elements of Calculus II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 Arts or Social Science electives

**Semester 3 - Fall**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| CHEM*2880 | [0.50] | Physical Chemistry |
| FOOD*2150 | [0.50] | Introduction to Nutritional and Food Science |
| MICR*2420 | [0.50] | Introduction to Microbiology |

0.50 electives

**Semester 4 - Winter**

| | | |
|---|---|---|
| FOOD*2100 | [0.50] | Communication in Food Science |
| FOOD*2620 | [0.50] | Food Engineering Principles |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |
| STAT*2040 | [0.50] | Statistics I |

0.50 electives

**Semester 5 - Fall**

| | | |
|---|---|---|
| FOOD*3030 | [0.50] | Food Chemistry I |
| FOOD*3160 | [0.75] | Food Processing I |
| FOOD*3230 | [0.75] | Food Microbiology |

0.50 electives

**Semester 6 - Winter**

| | | |
|---|---|---|
| FOOD*3040 | [0.50] | Food Chemistry II |
| FOOD*3170 | [0.50] | Food Processing II |
| FOOD*3260 | [0.50] | Industrial Microbiology |
| FOOD*3700 | [0.50] | Sensory Evaluation of Foods |

0.50 electives

**Semester 7 - Fall**

| | | |
|---|---|---|
| FOOD*4120 | [0.50] | Food Analysis |

2.00 electives

**Semester 8 - Winter**

| | | |
|---|---|---|
| FOOD*4600 | [1.00] | Food Product Development |

1.50 electives

**Notes:**

1. ENGL*1200 is recommended for those students needing to improve their English grammar.
2. FOOD*2150 could be replaced by FOOD*2010 with permission of department advisor.
3. Of the 6.50 electives credits:

   At least 2.00 must be Arts or Social Sciences.

   At least 2.00 must be from list of Restricted Electives.

   At least 1.00 must be from additional science electives (1.50 if MCS*3010 is chosen as a Restricted Elective)

**Restricted Electives:**

| | | |
|---|---|---|
| FOOD*4070 | [0.50] | Food Packaging |
| FOOD*4090 | [0.50] | Functional Foods and Nutraceuticals |
| FOOD*4110 | [0.50] | Meat and Poultry Processing |
| FOOD*4220 | [0.25] | Topics in Food Science |
| FOOD*4230 | [0.25] | Research in Food Science |
| FOOD*4310 | [0.50] | Food Safety Management Systems |
| FOOD*4400 | [0.50] | Dairy Processing |
| FOOD*4520 | [0.50] | Utilization of Cereal Grains for Human Food |
| MCS*3010 | [0.50] | Quality Management |
| POPM*4040 | [0.50] | Epidemiology of Food-borne Diseases |

**Credit Summary (20.00 total credits)**

4.00 - 1st year science required

9.50 - Required in semesters 3-8

2.00 - Restricted electives

2.00 - Arts or Social Science electives

1.00 or 1.50 - Additional Science electives (See Note 3 above)

1.00 or 1.50 - Free electives (See Note 3 above)

### Minor (Honours Program)

The Minor in Food Science consists of 5.00 credits as follows:

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| FOOD*3030 | [0.50] | Food Chemistry I |
| FOOD*3230 | [0.75] | Food Microbiology |
| MICR*2420 | [0.50] | Introduction to Microbiology |

One of:

| | | |
|---|---|---|
| FOOD*2010 | [0.50] | Principles of Food Science |
| FOOD*2150 | [0.50] | Introduction to Nutritional and Food Science |
| NUTR*2150 | [0.50] | Introduction to Nutritional and Food Sciences |

One of:

| | | |
|---|---|---|
| FOOD*2410 | [0.50] | Introduction to Food Processing |
| FOOD*3160 | [0.75] | Food Processing I |

**Restricted Electives**

Choose from the following list to bring the total to a minimum of 5.00 credits for the Minor:

| | | |
|---|---|---|
| FOOD*2620 | [0.50] | Food Engineering Principles |
| FOOD*3040 | [0.50] | Food Chemistry II |
| FOOD*3170 | [0.50] | Food Processing II |
| FOOD*3260 | [0.50] | Industrial Microbiology |
| FOOD*3700 | [0.50] | Sensory Evaluation of Foods |
| FOOD*4070 | [0.50] | Food Packaging |
| FOOD*4090 | [0.50] | Functional Foods and Nutraceuticals |
| FOOD*4110 | [0.50] | Meat and Poultry Processing |
| FOOD*4120 | [0.50] | Food Analysis |
| FOOD*4310 | [0.50] | Food Safety Management Systems |
| FOOD*4400 | [0.50] | Dairy Processing |
| FOOD*4520 | [0.50] | Utilization of Cereal Grains for Human Food |
| FOOD*4600 | [1.00] | Food Product Development |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |
| POPM*4040 | [0.50] | Epidemiology of Food-borne Diseases |

## Food Science (Co-op) (FOOD:C)

**Department of Food Science, Ontario Agricultural College**

### Major (Honours Program)

**Semester 1 - Fall**

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Note: CIS*1200, rather than an Arts or Social Science credit is recommended for those needing to improve their computer skills.

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*2080 | [0.50] | Elements of Calculus II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 Arts or Social Science electives

**Summer Semester**

Off

**Semester 3 - Fall**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| CHEM*2880 | [0.50] | Physical Chemistry |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| FOOD*2150 | [0.50] | Introduction to Nutritional and Food Science |
| MICR*2420 | [0.50] | Introduction to Microbiology |

0.50 electives

**Semester 4 - Winter**

| | | |
|---|---|---|
| FOOD*2100 | [0.50] | Communication in Food Science |
| FOOD*2620 | [0.50] | Food Engineering Principles |

NUTR*3210 [0.50] Fundamentals of Nutrition
STAT*2040 [0.50] Statistics I
0.50 electives

**Summer Semester**

COOP*1000 [0.00] Co-op Work Term I

**Semester 5 - Fall**

FOOD*3030 [0.50] Food Chemistry I
FOOD*3160 [0.75] Food Processing I
FOOD*3230 [0.75] Food Microbiology
0.50 electives

**Semester 6 - Winter**

FOOD*3040 [0.50] Food Chemistry II
FOOD*3170 [0.50] Food Processing II
FOOD*3260 [0.50] Industrial Microbiology
FOOD*3700 [0.50] Sensory Evaluation of Foods
0.50 electives

**Summer Semester**

Optional

**Fall Semester**

COOP*2000 [0.00] Co-op Work Term II

**Winter Semester**

COOP*3000 [0.00] Co-op Work Term III

**Semester 7 - Fall**

FOOD*4120 [0.50] Food Analysis
2.00 electives

**Semester 8 - Winter**

FOOD*4600 [1.00] Food Product Development
1.50 electives

**Notes:**

See Notes and Credit Summary in Food Science Major.

## Forest Systems (FSYS)

**School of Environmental Sciences, Ontario Agricultural College**

### Minor (Honours Program)

A minor in Forest Systems consists of a minimum of 5.00 credits from the following courses:

ENVB*2030 [0.50] Current Issues in Forest Science
ENVB*3330 [0.50] Ecosystem Processes and Applications
ENVB*4780 [0.50] Forest Ecology
One of
- ENVS*3410 [0.50] Independent Research I *
- ENVS*3430 [1.00] Independent Research *

Two of:
- ENVB*3230 [0.50] Agroforestry Systems
- ENVB*3250 [0.50] Forest Health and Disease
- ENVB*3270 [0.50] Forest Biodiversity

Four of:
- BIOL*3130 [0.50] Conservation Biology
- BIOL*4040 [0.50] Natural Resources Policy
- ENVB*3010 [0.50] Climate Change Biology
- GEOG*3110 [0.50] Biotic and Natural Resources
- GEOG*3610 [0.50] Environmental Hydrology
- GEOG*4110 [1.00] Environmental Systems Analysis
- HORT*3350 [0.50] Woody Plant Production and Culture
- SOIL*2010 [0.50] Soil Science

* ENVS*3410 or ENVS*3430 are preferred, but may be substituted by BIOL*4410 or NRS*4110 with the approval of the faculty advisor.

## Functional Foods and Nutraceuticals (FFAN)

**Department of Human Health and Nutritional Sciences, College of Biological Science**

**Department of Food Science, Ontario Agricultural College.**

### Minor (Honours Program)

A minor in Functional Foods and Nutraceuticals consists of 5.00 credits.

BIOC*2580 [0.50] Introduction to Biochemistry
ECON*1050 [0.50] Introductory Microeconomics
NUTR*3210 [0.50] Fundamentals of Nutrition
TOX*2000 [0.50] Principles of Toxicology
One of:
- FOOD*2010 [0.50] Principles of Food Science
- FOOD*2150 [0.50] Introduction to Nutritional and Food Science
- NUTR*2150 [0.50] Introduction to Nutritional and Food Sciences

One of:
- FOOD*4090 [0.50] Functional Foods and Nutraceuticals
- NUTR*4090 [0.50] Functional Foods and Nutraceuticals

2.00 Restricted Electives*

*restricted electives should be chosen in consultation with the Nutritional and Nutraceutical Sciences faculty advisor. Any 3000 and 4000 level courses from the following subject areas are eligible as restricted electives: Nutrition**, Food Science**, Biomedical Sciences**, Toxicology, Population Medicine, Animal Science, Plant Biology, Human Kinetics**, and Pathology.

**students in these majors must select restricted electives outside of the major

## Geographic Information Systems (GIS) and Environmental Analysis

**Department of Geography, College of Social and Applied Human Sciences**

### Minor (Honours Program)

A minimum of 5.00 credits is required from:

GEOG*1300 [0.50] Introduction to the Biophysical Environment
GEOG*2420 [0.50] The Earth From Space
GEOG*2480 [0.50] Mapping and GIS
GEOG*3420 [0.50] Remote Sensing of the Environment
GEOG*3480 [0.50] GIS and Spatial Analysis
GEOG*4480 [1.00] Applied Geographic Information Systems
At least 1.50 credits from:
- GEOG*2110 [0.50] Climate and the Biophysical Environment
- GEOG*2210 [0.50] Environment and Resources
- GEOG*3110 [0.50] Biotic and Natural Resources
- GEOG*3210 [0.50] Management of the Biophysical Environment
- GEOG*4110 [1.00] Environmental Systems Analysis
- GEOG*4210 [0.50] Environmental Governance

## Geology (GEOL)

**School of Environmental Sciences, Ontario Agricultural College**

### Minor (Honours Program)

A minor will consist of at least 5.00 credits in Geology. The following 6 courses are mandatory:

GEOL*1050 [0.50] Geology and the Environment
GEOL*2020 [0.50] Stratigraphy
GEOL*2110 [0.50] Earth Material Science
GEOL*2200 [0.50] Glacial Geology
GEOL*3090 [0.50] Applied Structural Geology
GEOL*4090 [0.50] Sedimentology

The remaining credits can be chosen from Geology or the Geomorphology offerings in Geography in the calendar and must be 2000 level or above.

## Human Kinetics (HK)

**Department of Human Health and Nutritional Sciences, College of Biological Science**

Human Kinetics is concerned with understanding capacities for, and limits of, human movement at different ages and with the role of physical activity in human health. Through the use of electives, students may structure a program emphasizing biomechanics and ergonomics, human population biology or nutrition, exercise and metabolism.

If lacking the fundamentals of word processing, spread sheet use and data management, the student should select CIS*1200 as early in the program as possible.

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum of 20.00 credits, of which 16.00 must be from the list of acceptable science courses, are required

**Semester 1**

BIOL*1080 [0.50] Biological Concepts of Health
CHEM*1040 [0.50] General Chemistry I
MATH*1080 [0.50] Elements of Calculus I
PHYS*1070 [0.50] Introductory Physics for Life Sciences
0.50 arts or social science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1050 [0.50] General Chemistry II
PHYS*1080 [0.50] Physics for Life Sciences
0.50 arts or social science electives

**Semester 3**

BIOC*2580 [0.50] Introduction to Biochemistry
MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
STAT*2040 [0.50] Statistics I
0.50 electives

0.50 Arts or Social Science electives

**Semester 4**

| | | |
|---|---|---|
| HK*2270 | [0.50] | Principles of Human Biomechanics |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |

0.50 electives
0.50 Arts or Social Science electives

**Semester 5**

| | | |
|---|---|---|
| HK*3600 | [0.75] | Applied Human Kinetics I |
| HK*3940 | [1.25] | Human Physiology |

One of

| | | |
|---|---|---|
| HK*3401 | [0.75] | Human Anatomy: Dissection |
| HK*3501 | [0.75] | Human Anatomy: Prosection |

**Semester 6**

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| HK*3100 | [0.50] | Neuromuscular Physiology |
| HK*4600 | [0.75] | Applied Human Kinetics II |

One of

| | | |
|---|---|---|
| HK*3402 | [0.75] | Human Anatomy: Dissection (if registered in HK*3401 in semester 5) |
| HK*3502 | [0.75] | Human Anatomy (if registered in HK*3501 in semester 5) |

**Semester 7**

| | | |
|---|---|---|
| HK*4550 | [0.50] | Human Cardio-respiratory Physiology |
| NUTR*4210 | [0.50] | Nutrition, Exercise and Energy Metabolism |

1.50 electives or restricted electives

**Semester 8**

2.50 electives or restricted electives

**Restricted Electives**

A minimum of 1.00 credits of restricted electives are required which must be selected from HK*4XXX, NUTR*4XXX (must be an approved B.Sc. Science Elective).

## Marine and Freshwater Biology (MFB)

**Department of Integrative Biology, College of Biological Science**

The Major in Marine and Freshwater Biology provides a broad ecological perspective on aquatic environments based on the physical as well as the biological sciences. This major prepares students for post-graduate work in the aquatic sciences, and provides a sound science background for students wishing to pursue careers in teaching, government service or the private sector.

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum total of 20.00 credits is required to complete the major.

**Semester 1**

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives*
Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 Arts or Social Science electives*

**Semester 3**

| | | |
|---|---|---|
| STAT*2040 | [0.50] | Statistics I |
| ZOO*2090 | [0.50] | Vertebrate Structure and Function |
| ZOO*2100 | [0.50] | Developmental Biology |

1.00 electives**

**Semester 4**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| ZOO*2700 | [0.50] | Invertebrate Morphology & Evolution |

1.00 electives**

**Semester 5**

| | | |
|---|---|---|
| BIOL*3110 | [0.50] | Population Ecology |
| BIOL*3400 | [0.50] | Evolution |
| BIOL*3450 | [0.50] | Introduction to Aquatic Environments |
| ZOO*3200 | [0.50] | Comparative Animal Physiology I |
| ZOO*3700 | [0.50] | Integrative Biology of Invertebrates |

**Semester 6**

| | | |
|---|---|---|
| BIOL*3120 | [0.50] | Community Ecology |
| ZOO*3210 | [0.50] | Comparative Animal Physiology II |

1.50 electives**, ***

**Semester 7**

| | | |
|---|---|---|
| BIOL*4350 | [0.50] | Biology of Polluted Waters |
| ZOO*4570 | [0.50] | Marine Ecological Processes |
| ZOO*4910 | [0.50] | Integrative Vertebrate Biology |
| ZOO*4930 | [0.25] | Lab Studies in Ichthyology |

0.75 electives**

**Semester 8**

| | | |
|---|---|---|
| BIOL*4010 | [0.50] | Adaptational Physiology |
| ZOO*4330 | [0.50] | Biology of Fishes |

1.50 electives**
* CIS*1200 is recommended for those needing to improve their computer skills
** suggested electives list available from the faculty advisors
*** BIOL*2250 is strongly recommended if independent research project courses are anticipated in semesters 7 and/or 8

**Electives - must include:**

1. A minimum of 0.75 credits from:

| | | |
|---|---|---|
| BIOL*4110 | [0.75] | Ecological Methods |
| BIOL*4410 | [0.75] | Field Ecology |
| BIOL*4610 | [0.75] | Arctic Ecology |
| BIOL*4700 | [0.50] | Field Biology |
| BIOL*4710 | [0.25] | Field Biology |
| BIOL*4800 | [0.50] | Field Biology |
| BIOL*4810 | [0.25] | Field Biology |
| IBIO*4500 | [0.75] | Research in Integrative Biology I |
| IBIO*4510 | [0.75] | Research in Integrative Biology II |
| IBIO*4521/2 | [2.00] | Thesis in Integrative Biology |
| ZOO*4300 | [0.75] | Marine Biology and Oceanography |
| ZOO*4540 | [0.50] | Marine and Freshwater Research |

2. Other field or research courses with approval of faculty advisor.
3. At least 1.00 Arts and/or Social Science electives.

## Mathematical Science (MSCI)

**Department of Mathematics & Statistics, College of Physical and Engineering Science**

### Minor (Honours Program)

This requires 1.00 calculus credits and 4.00 other credits chosen from mathematics, statistics, and computing and information science. For these 4.00 credits students will choose at least 0.50 from each discipline. At least 1.00 credits must be at the 3000 level or above. This minor cannot be combined with a major in Mathematics, Statistics, or Computing and Information Science.

## Mathematics (MATH)

**Department of Mathematics and Statistics, College of Physical and Engineering Science**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A total of 20.00 credits is required to complete the Major which includes at least 10.00 credits in Mathematics & Statistics. This major must include at least 6.00 credits at the 3000 or 4000 level from the approved list of science electives of which at least 2.00 credits must be at the 4000 level (and may include STAT*4340). At least 1.00 credits in Arts and Social Science must be completed.

**Semester 1**

| | | |
|---|---|---|
| CHEM*1040 | [0.50] | General Chemistry I |
| CIS*1500 | [0.50] | Introduction to Programming |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
0.50 electives (CIS*2500 recommended)

**Semester 3**

MATH*2000 [0.50] Set Theory
MATH*2160 [0.50] Linear Algebra I
MATH*2200 [0.50] Advanced Calculus I
STAT*2040 [0.50] Statistics I
0.50 Arts or Social Science electives

**Semester 4**

MATH*2130 [0.50] Numerical Methods
MATH*2170 [0.50] Differential Equations I
MATH*2210 [0.50] Advanced Calculus II
One of:
MATH*3160 [0.50] Linear Algebra II
0.50 electives
0.50 electives

**Semester 5**

MATH*3100 [0.50] Differential Equations II
MATH*3200 [0.50] Real Analysis
One of:
MATH*3130 [0.50] Abstract Algebra
MATH*3240 [0.50] Operations Research
One of:*
STAT*3100 [0.50] Introductory Mathematical Statistics I
STAT*3240 [0.50] Applied Regression Analysis
0.50 electives

**Note:** Students who wish to take STAT*4340 in semester 8 should take STAT*3100 in semester 5, STAT*3110 in semester 6 and STAT*3240 in semester 5 or 7.

**Semester 6**

MATH*3260 [0.50] Complex Analysis
One of:
MATH*3160 [0.50] Linear Algebra II (if not taken in Sem. 4)
0.50 electives
1.50 electives

**Semester 7**

0.50 credits from a 4000 level mathematics
1.50 electives**
One of:
MATH*3130 [0.50] Abstract Algebra
MATH*3240 [0.50] Operations Research

**Semester 8**

1.00 credits from a 4000 level mathematics **
1.50 electives

*A student selecting STAT*3100 should take STAT*3110 in semester 6.

**Students are reminded that the major requires 2.00 credits (four courses) at the 4000 level in Mathematics.

## Minor (Honours Program)

A total of 5.00 credits is required to complete the Minor, including:

2.50 credits from:

(MATH*1080 or MATH*1200)

(MATH*1210 or MATH*2080)

MATH*2000 [0.50] Set Theory
(MATH*2150 or MATH*2160)
MATH*2200 [0.50] Advanced Calculus I
0.50 Statistics (STAT*) credits at the 2000 level or above.

2.00 additional Mathematics credits at the 2000 level or above, including 1.50 credits at the 3000 or 4000 level.

# Microbiology (MICR)

**Department of Molecular and Cellular Biology, College of Biological Science**

Microbiology programs are designed to give students a good understanding of microorganisms, including diversity, ecology, physiology, molecular genetics, current approaches in bacterial genomics/proteomics, and microbial associations with animal hosts and the environments. Such knowledge will provide the basis for further work with microbes in medicine, agricultural industries (including biotechnology, pharmaceuticals, food and beverage) and the environment (surveillance and bioremediation).

Students can take the B.Sc. program with a Major or a Minor in Microbiology, or combine the minor with another major. Students should plan their programs in consultation with the microbiology faculty advisor. As course offerings may change during the program, students are strongly encouraged to review their plans at least once a year with their advisors, and to check the departmental website for program news.

## Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum of 6.00 science credits must be at the 3000/4000 level of which at least 2.00 credits must be at the 4000 level (including the 1.00 from the restricted elective credits).

**Semester 1**

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1040 [0.50] General Chemistry I
MATH*1080 [0.50] Elements of Calculus I
PHYS*1070 [0.50] Introductory Physics for Life Sciences
0.50 Arts or Social Science electives
Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
CHEM*1050 [0.50] General Chemistry II
PHYS*1080 [0.50] Physics for Life Sciences
0.50 Arts or Social Science electives

**Semester 3**

BIOC*2580 [0.50] Introduction to Biochemistry
MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
MICR*2420 [0.50] Introduction to Microbiology
STAT*2040 [0.50] Statistics I
0.50 Arts or Social Science electives

**Semester 4**

BIOC*3560 [0.50] Structure and Function in Biochemistry
MCB*2050 [0.50] Molecular Biology of the Cell
MICR*2430 [0.50] Microbiology Methods I
0.50 electives
0.50 Arts or Social Science electives

**Semester 5**

MBG*3080 [0.50] Bacterial Genetics
MICR*3420 [0.50] Microbial Diversity
1.50 electives or restricted electives

**Semester 6**

MBG*3350 [0.75] Laboratory Methods in Molecular Biology I
MICR*3260 [0.50] Microbial Adaptation and Development
MICR*3430 [0.50] Microbiology Methods II
A minimum of 0.75 electives or restricted electives

**Semester 7**

2.50 electives or restricted electives which can include MCB*4500

**Semester 8**

2.50 electives or restricted electives which can include MCB*4510

**Restricted Elective Credits**

3.50 restricted elective credits of which 1.00 credit must be at the 4000 level.

BIOC*4540 [0.75] Enzymology
BIOC*4580 [0.50] Membrane Biochemistry
BIOL*3050 [0.50] Mycology
ENVB*3280 [0.50] Waterborne Disease Ecology
FOOD*3230 [0.75] Food Microbiology
FOOD*3260 [0.50] Industrial Microbiology
FOOD*4400 [0.50] Dairy Processing
MCB*4060 [0.50] Molecular & Cell Biology of Yeast
MCB*4500 [1.00] Research Project in Molecular & Cellular Biology I
MCB*4510 [1.00] Research Project in Molecular & Cellular Biology 2
MCB*4600 [0.50] Topics in Molecular and Cellular Biology
MICR*3220 [0.50] Plant Microbiology
MICR*3230 [0.50] Immunology
MICR*3330 [0.50] World of Viruses
MICR*4010 [0.50] Pathogenic Bacteriology
MICR*4140 [0.50] Soil Microbiology and Biotechnology *
MICR*4180 [0.50] Microbial Processes in Environmental Management *
MICR*4280 [0.50] Microbial Ecology
MICR*4330 [0.50] Molecular Virology
MICR*4430 [0.50] Medical Virology
MICR*4520 [0.50] Microbial Cell Biology
MICR*4530 [0.50] Immunology II
PATH*3040 [0.50] Principles of Parasitology
*Only 1 of MICR*4140 and MICR*4180 can be used to meet the restricted elective requirements.

## Minor (Honours Program)

The minor in Microbiology consists of the following 5.25 credits:

2.25 credits including:

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| MBG*3350 | [0.75] | Laboratory Methods in Molecular Biology I |
| MICR*2420 | [0.50] | Introduction to Microbiology |
| MICR*2430 | [0.50] | Microbiology Methods I |

2.00 credits from:

| | | |
|---|---|---|
| BIOL*3050 | [0.50] | Mycology |
| FOOD*3230 | [0.75] | Food Microbiology |
| FOOD*3260 | [0.50] | Industrial Microbiology |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| MBG*3080 | [0.50] | Bacterial Genetics |
| MICR*3220 | [0.50] | Plant Microbiology |
| MICR*3230 | [0.50] | Immunology |
| MICR*3260 | [0.50] | Microbial Adaptation and Development |
| MICR*3330 | [0.50] | World of Viruses |
| MICR*3420 | [0.50] | Microbial Diversity |
| MICR*4140 | [0.50] | Soil Microbiology and Biotechnology |
| MICR*4180 | [0.50] | Microbial Processes in Environmental Management |
| MICR*4520 | [0.50] | Microbial Cell Biology |

1.00 credits from:

| | | |
|---|---|---|
| MCB*4060 | [0.50] | Molecular & Cell Biology of Yeast |
| MICR*4010 | [0.50] | Pathogenic Bacteriology |
| MICR*4280 | [0.50] | Microbial Ecology |
| MICR*4330 | [0.50] | Molecular Virology |
| MICR*4430 | [0.50] | Medical Virology |
| MICR*4530 | [0.50] | Immunology II |

# Microbiology (Co-op) (MICR:C)

**Department of Molecular and Cellular Biology, College of Biological Science**

Students in the Major in Microbiology program may take the Co-op option. Students do not begin their first work term until they have completed semester 3 and courses BIOL*1070, BIOL*1080, BIOL*1090 and MICR*2430. Students in the co-op program must also complete COOP*1100 in the second academic semester. At least 3 work terms (COOP*1000, COOP*2000, COOP*3000) are required in the co-op program, and the course requirements are the same as shown for the major program. Some courses must be taken during a different semester than usual, and Co-op students generally require an additional semester to meet all the program requirements. Students should plan their programs in consultation with the faculty advisor. A total of 20.00 credits are required to complete the major. A minimum of 6.00 science credits must be at the 3000/4000 level of which at least 2.00 credits must be at the 4000 level (including the 1.00 from the restricted elective credits).

## Major (Honours Program)

### Semester 1 - Fall

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2 - Winter

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 Arts or Social Science electives

### Summer Semester

No academic semester or work term

### Semester 3 - Fall

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| MICR*2420 | [0.50] | Introduction to Microbiology |
| STAT*2040 | [0.50] | Statistics I |

0.50 Arts or Social Science electives

### Semester 4 - Winter

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| MICR*2430 | [0.50] | Microbiology Methods I |

0.50 electives

0.50 Arts or Social Science electives

### Summer Semester

| | | |
|---|---|---|
| COOP*1000 | [0.00] | Co-op Work Term I |

### Semester 5 - Fall

| | | |
|---|---|---|
| MBG*3080 | [0.50] | Bacterial Genetics |
| MICR*3420 | [0.50] | Microbial Diversity |

1.50 electives or restricted electives

### Semester 6 - Winter

| | | |
|---|---|---|
| MBG*3350 | [0.75] | Laboratory Methods in Molecular Biology I |
| MICR*3260 | [0.50] | Microbial Adaptation and Development |
| MICR*3430 | [0.50] | Microbiology Methods II |

A minimum of 0.75 electives or restricted electives

### Summer - Semester

Optional

### Fall Semester

| | | |
|---|---|---|
| COOP*2000 | [0.00] | Co-op Work Term II |

### Winter Semester

| | | |
|---|---|---|
| COOP*3000 | [0.00] | Co-op Work Term III |

### Semester 7 - Fall

2.50 electives or restricted electives which can include MCB*4500

### Semester 8 - Winter

2.50 electives or restricted electives which can include MCB*4510

## Restricted Elective Credits

3.50 restricted elective credits of which 1.00 credit must be at the 4000 level.

| | | |
|---|---|---|
| BIOC*4540 | [0.75] | Enzymology |
| BIOC*4580 | [0.50] | Membrane Biochemistry |
| BIOL*3050 | [0.50] | Mycology |
| ENVB*3280 | [0.50] | Waterborne Disease Ecology |
| FOOD*3230 | [0.75] | Food Microbiology |
| FOOD*3260 | [0.50] | Industrial Microbiology |
| FOOD*4400 | [0.50] | Dairy Processing |
| MCB*4060 | [0.50] | Molecular & Cell Biology of Yeast |
| MCB*4500 | [1.00] | Research Project in Molecular & Cellular Biology I |
| MCB*4510 | [1.00] | Research Project in Molecular & Cellular Biology 2 |
| MCB*4600 | [0.50] | Topics in Molecular and Cellular Biology |
| MICR*3220 | [0.50] | Plant Microbiology |
| MICR*3230 | [0.50] | Immunology |
| MICR*3330 | [0.50] | World of Viruses |
| MICR*4010 | [0.50] | Pathogenic Bacteriology |
| MICR*4140 | [0.50] | Soil Microbiology and Biotechnology * |
| MICR*4180 | [0.50] | Microbial Processes in Environmental Management * |
| MICR*4520 | [0.50] | Microbial Cell Biology |
| MICR*4530 | [0.50] | Immunology II |
| MICR*4280 | [0.50] | Microbial Ecology |
| MICR*4330 | [0.50] | Molecular Virology |
| MICR*4430 | [0.50] | Medical Virology |
| PATH*3040 | [0.50] | Principles of Parasitology |

*Only 1 of MICR*4140 and MICR*4180 can be used to meet the restricted elective requirements.

# Molecular Biology and Genetics (MBG)

**Department of Molecular and Cellular Biology, College of Biological Science**

The B.Sc. program with a Major in Molecular Biology and Genetics is a broadly based program in genetics including related areas of cell and molecular biology. In consultation with the Faculty Advisor, students can choose a general program or can focus their courses in areas such as molecular biology, cell biology, developmental biology, genetics, or agricultural genetics. The program qualifies students for postgraduate training in cell or molecular biology and genetics including clinical genetics and genetic counselling, and provides an excellent background for careers in biotechnology, toxicology, agriculture and medical research. Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor.

## Major (Honours Program)

A total of 20.00 credits is required to complete the major.

### Semester 1

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

One of:

| | | |
|---|---|---|
| CIS*1200 | [0.50] | Introduction to Computing |
| CIS*1500 | [0.50] | Introduction to Programming |

**Semester 3**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| MICR*2420 | [0.50] | Introduction to Microbiology |
| STAT*2040 | [0.50] | Statistics I |

0.50 electives or restricted electives

**Semester 4**

| | | |
|---|---|---|
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| MICR*2430 | [0.50] | Microbiology Methods I |
| STAT*2050 | [0.50] | Statistics II |

1.00 electives or restricted electives

**Semester 5**

| | | |
|---|---|---|
| MBG*3350 | [0.75] | Laboratory Methods in Molecular Biology I |

1.75 electives or restricted electives

**Semester 6**

2.50 electives or restricted electives

**Semester 7***

| | | |
|---|---|---|
| MCB*4500 | [1.00] | Research Project in Molecular & Cellular Biology I |

1.50 electives or restricted electives

**Semester 8***

| | | |
|---|---|---|
| MCB*4510 | [1.00] | Research Project in Molecular & Cellular Biology 2 |

1.50 electives or restricted electives

*instead of the 2 semester sequence of MCB*4500 / MCB*4510 students may choose to take MCB*4600 and 1.50 subject area electives at the 4000 level.

**Restricted Electives**

1. Ecology Elective - 0.50 credits

| | | |
|---|---|---|
| BIOL*2060 | [0.50] | Ecology |
| BIOL*3110 | [0.50] | Population Ecology |
| BOT*3050 | [0.50] | Plant Functional Ecology |
| MICR*4280 | [0.50] | Microbial Ecology |

2. Arts and Social Science Electives - 2.00 credits
3. Physiology Elective - 0.50 credits

| | | |
|---|---|---|
| BIOM*3200 | [1.00] | Mammalian Physiology |
| BOT*3310 | [0.50] | Plant Growth and Development |
| HK*3940 | [1.25] | Human Physiology |
| ZOO*3200 | [0.50] | Comparative Animal Physiology I |

4. Subject Area Electives - 3.00 credits (4.50 if MCB*4600 is taken instead of MCB*4500 and MCB*4510)

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| BIOL*3020 | [0.50] | Population Genetics |
| BIOL*3300 | [0.50] | Applied Bioinformatics |
| MBG*3050 | [0.50] | Human Genetics |
| MBG*3060 | [0.50] | Quantitative Genetics |
| MBG*3080 | [0.50] | Bacterial Genetics |
| MBG*3100 | [0.50] | Plant Genetics |
| MBG*3360 | [0.75] | Laboratory Methods in Molecular Biology II |
| MBG*3660 | [0.50] | Genomics |
| MBG*4030 | [0.50] | Animal Breeding Methods |
| MBG*4040 | [0.50] | Genetics and Molecular Biology of Development |
| MBG*4070 | [0.50] | Genetics and Molecular Biology of Development |
| MBG*4080 | [0.50] | Molecular Genetics |
| MBG*4110 | [0.50] | Advanced Concepts in Genetics |
| MBG*4160 | [0.50] | Plant Breeding |
| MBG*4240 | [0.50] | Applied Molecular Genetics |
| MBG*4270 | [0.50] | DNA Replication, Recombination and Repair |
| MBG*4300 | [0.50] | Plant Molecular Genetics |
| MCB*4010 | [0.50] | Advanced Cell Biology |
| MCB*4050 | [0.50] | Protein and Nucleic Acid Structure |
| MICR*3330 | [0.50] | World of Viruses |
| MICR*4330 | [0.50] | Molecular Virology |

## Minor (Honours Program)

A minor in Molecular Biology and Genetics requires 5.00 credits in Molecular Biology and Genetics chosen in consultation with the faculty advisor, and will include:

| | | |
|---|---|---|
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |

4.00 credits from:

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| BIOL*3020 | [0.50] | Population Genetics |
| BIOL*3300 | [0.50] | Applied Bioinformatics |
| MBG*3050 | [0.50] | Human Genetics |
| MBG*3060 | [0.50] | Quantitative Genetics |
| MBG*3080 | [0.50] | Bacterial Genetics |
| MBG*3100 | [0.50] | Plant Genetics |
| MBG*3660 | [0.50] | Genomics |
| MBG*4030 | [0.50] | Animal Breeding Methods |
| MBG*4040 | [0.50] | Genetics and Molecular Biology of Development |
| MBG*4070 | [0.50] | Genetics and Molecular Biology of Development |
| MBG*4080 | [0.50] | Molecular Genetics |
| MBG*4110 | [0.50] | Advanced Concepts in Genetics |
| MBG*4160 | [0.50] | Plant Breeding |
| MBG*4240 | [0.50] | Applied Molecular Genetics |
| MBG*4270 | [0.50] | DNA Replication, Recombination and Repair |
| MBG*4300 | [0.50] | Plant Molecular Genetics |
| MCB*4010 | [0.50] | Advanced Cell Biology |
| MCB*4050 | [0.50] | Protein and Nucleic Acid Structure |
| MICR*3330 | [0.50] | World of Viruses |
| MICR*4330 | [0.50] | Molecular Virology |

# Nanoscience (NANO)

**Administered jointly by the Department of Chemistry and the Department of Physics, College of Physical and Engineering Science.**

## Major (Honours Program)

The major will require the completion of 20.00 credits as indicated below.

**Semester 1**

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| NANO*1000 | [0.50] | Introduction to Nanoscience |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |

0.50 electives

**Semester 3**

| | | |
|---|---|---|
| CHEM*2060 | [0.50] | Structure and Bonding |
| MATH*2160 | [0.50] | Linear Algebra I |
| NANO*2000 | [0.50] | Synthesis of Nanomaterials |
| PHYS*2310 | [0.50] | Mechanics I |
| PHYS*2330 | [0.50] | Electricity and Magnetism I |

**Semester 4**

| | | |
|---|---|---|
| CHEM*2070 | [0.50] | Structure and Spectroscopy |
| MATH*2170 | [0.50] | Differential Equations I |
| NANO*2100 | [0.50] | Analysis of Nanomaterials |

1.00 electives*

**Semester 5**

One of:

| | | |
|---|---|---|
| CHEM*3860 | [0.50] | Quantum Chemistry |
| PHYS*3230 | [0.50] | Quantum Mechanics I |

| | | |
|---|---|---|
| NANO*3500 | [0.50] | Thin Film Science |
| NANO*3600 | [0.50] | Computational Methods in Materials Science |

1.00 electives

**Semester 6**

| | | |
|---|---|---|
| NANO*3200 | [0.50] | Nanolithographic Techniques |
| NANO*3300 | [0.50] | Spectroscopy of Nanomaterials |
| NANO*3700 | [0.50] | Introduction to Quantum Computing |

1.00 electives

**Semester 7**

| | | |
|---|---|---|
| NANO*4100 | [0.50] | Biological Nanomaterials |

2.00 electives

**Semester 8**

| | | |
|---|---|---|
| NANO*4200 | [0.50] | Topics in Nanomaterials |

2.00 electives
* If a student wants to take PHYS*3230 in semester 5, then they must select PHYS*2320 and PHYS*2340 as electives in semester 4.

### Selection of electives is subject to the following rules:

1. The student must select at least 1.00 credits in Arts or Social Science.
2. The program must include at least 6.00 science credits at the 3000 and 4000 level of which at least 2.00 must be at the 4000 level.
3. In semesters 7 and 8, the student must select to do either NANO*4900 or NANO*4910.

In completing the science requirements for the degree, some suggested complementary areas of focus are:

#### Chemistry: Inorganic

Semester 4: CHEM*2480
Semester 5: CHEM*3640
Semester 6: CHEM*3650
Semester 7: CHEM*2820, CHEM*4620
Semester 8: CHEM*2700

#### Chemistry: Organic

Semester 4: CHEM*2700
Semester 5: CHEM*3750
Semester 6: CHEM*3760
Semester 7: CHEM*2820, CHEM*4730
Semester 8: CHEM*2480, CHEM*4720

#### Chemistry: Physical/Analytical

Semester 4: CHEM*2480
Semester 5: CHEM*2820
Semester 6: CHEM*3430 or CHEM*3870
Semester 7: CHEM*3440, CHEM*3860
Semester 8: CHEM*3870, CHEM*3430

#### Engineering

Semester 2: CIS*1500
Semester 4: ENGG*2450
Semester 5: ENGG*2410, ENGG*3450
Semester 6: ENGG*4550
Semester 7: ENGG*4080

#### Mathematics and Statistics

Semester 4: STAT*2040
Semester 5: STAT*3100
Semester 6: MATH*2130
Semester 7: NANO*4500, MATH*3240
Semester 8: NANO*4510, MATH*3160

#### Physics

Semester 4: PHYS*2320, PHYS*2340
Semester 5: PHYS*3240, MATH*2200
Semester 6: PHYS*3220
Semester 7: PHYS*4240, PHYS*4180
Semester 8: PHYS*4040

***Note**: Courses marked with an asterisk may require additional prerequisites. Students should consult the relevant course descriptions for further information.

## Nanoscience (NANO:C)

**Administered jointly by the Department of Chemistry and the Department of Physics, College of Physical and Engineering Science**

### Major (Honours Program)

The major will require the completion of 20.00 credits as indicated below. To graduate from the co-op program, a minimum of 4 successfully completed work terms is normally required.

#### Semester 1 - Fall

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1200 | [0.50] | Calculus I |
| NANO*1000 | [0.50] | Introduction to Nanoscience |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

#### Semester 2 - Winter

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |

0.50 electives

#### Semester 3 - Fall

| | | |
|---|---|---|
| CHEM*2060 | [0.50] | Structure and Bonding |
| COOP*1100 | [0.00] | Introduction to Co-operative Education |
| MATH*2160 | [0.50] | Linear Algebra I |
| NANO*2000 | [0.50] | Synthesis of Nanomaterials |
| PHYS*2310 | [0.50] | Mechanics I |
| PHYS*2330 | [0.50] | Electricity and Magnetism I |

#### Semester 4 - Winter

| | | |
|---|---|---|
| CHEM*2070 | [0.50] | Structure and Spectroscopy |
| MATH*2170 | [0.50] | Differential Equations I |
| NANO*2100 | [0.50] | Analysis of Nanomaterials |

1.00 electives*

#### Summer Semester

| | | |
|---|---|---|
| COOP*1000 | [0.00] | Co-op Work Term I |

#### Semester 5 - Fall

One of:

| | | |
|---|---|---|
| CHEM*3860 | [0.50] | Quantum Chemistry |
| PHYS*3230 | [0.50] | Quantum Mechanics I |
| NANO*3500 | [0.50] | Thin Film Science |
| NANO*3600 | [0.50] | Computational Methods in Materials Science |

1.00 electives

#### Winter Semester

| | | |
|---|---|---|
| COOP*2000 | [0.00] | Co-op Work Term II |

#### Summer Semester

| | | |
|---|---|---|
| COOP*3000 | [0.00] | Co-op Work Term III |

#### Semester 6 - Fall

| | | |
|---|---|---|
| NANO*4100 | [0.50] | Biological Nanomaterials |

2.00 electives

#### Semester 7 - Winter

| | | |
|---|---|---|
| NANO*3200 | [0.50] | Nanolithographic Techniques |
| NANO*3300 | [0.50] | Spectroscopy of Nanomaterials |
| NANO*3700 | [0.50] | Introduction to Quantum Computing |

1.00 electives

#### Summer Semester

| | | |
|---|---|---|
| COOP*4000 | [0.00] | Co-op Work Term IV |

#### Fall Semester

| | | |
|---|---|---|
| COOP*5000 | [0.00] | Co-op Work Term V |

#### Semester 8

| | | |
|---|---|---|
| NANO*4200 | [0.50] | Topics in Nanomaterials |

2.00 electives
* If a student wants to take PHYS*3230 in semester 5, then they must select PHYS*2320 and PHYS*2340 as electives in semester 4.

**Note:** Four work terms are required for the completion of the co-op degree. It is also necessary thatthere be at least one work term in each of Winter, Fall, and Summer semesters. Therefore, one of the summer work terms could be missed and the student would still graduate successfully. It is only required to complete 4 of the 5 listed work terms. A report is required for each work term completed, even when all 5 are done. Contact the co-op faculty advisor for further details.

### Selection of electives is subject to the following rules:

1. The student must select at least 1.00 credits in Arts or Social Science.
2. The program must include at least 6.00 science credits at the 3000 and 4000 level of which at least 2.00 must be at the 4000 level.
3. In semesters 7 and 8, the student must select to do either NANO*4900 or NANO*4910.

In completing the science requirements for the degree, some suggested complementary areas of focus are found under the listing for the regular program.

## Neuroscience (NEUR)

**Office of the Associate Dean, B.Sc. Program**

### Minor (Honours Program)

A minor in Neuroscience shall include a minimum of 5.00 credits including:

| | | |
|---|---|---|
| NEUR*4000 | [0.50] | Current Issues in Neuroscience |
| PSYC*2410 | [0.50] | Behavioural Neuroscience I |

1 of:

| | | |
|---|---|---|
| PSYC*2010 | [0.50] | Quantification in Psychology |
| STAT*2040 | [0.50] | Statistics I |

and at least 0.50 credits from:

| | | |
|---|---|---|
| BIOM*2000 | [0.50] | Concepts in Human Physiology for B.A. students only |
| BIOM*3200 | [1.00] | Mammalian Physiology |
| HK*3940 | [1.25] | Human Physiology |
| ZOO*3200 | [0.50] | Comparative Animal Physiology I |

1.00 credits from an independent research project in the neurosciences, approved by the faculty advisor, selected from a combination of:

| | | |
|---|---|---|
| BIOM*4420 | [0.50] | Research Modules |
| BIOM*4521/2 | [2.00] | Research in Biomedical Sciences |
| HK*4360 | [1.00] | Research in Human Health and Nutritional Sciences |
| HK*4371/2 | [1.00] | Research in Human Health and Nutritional Sciences II |
| IBIO*4500 | [0.75] | Research in Integrative Biology I |
| IBIO*4510 | [0.75] | Research in Integrative Biology II |
| MCB*4500 | [1.00] | Research Project in Molecular & Cellular Biology I |
| NEUR*4401/2 | [1.00] | Research in Neurosciences |
| NEUR*4450 | [1.00] | Research in Neurosciences |
| PSYC*4510 | [0.50] | Current Issues in Psychology |
| PSYC*4870 | [0.50] | Honours Thesis I |
| PSYC*4880 | [1.00] | Honours Thesis II |

0.50 credits of the required research project may be selected from:

| | | |
|---|---|---|
| BIOM*4500 | [0.50] | Literature-based Research in Biomedical Sciences |
| HK*4230 | [0.50] | Advanced Study in Human Health and Nutritional Sciences |
| MCB*4600 | [0.50] | Topics in Molecular and Cellular Biology |
| PSYC*4500 | [0.50] | Current Theoretical Issues in Psychology |

and 2.00 from the following:

| | | |
|---|---|---|
| BIOM*3000 | [0.50] | Functional Mammalian Neuroanatomy |
| BIOM*3090 | [0.50] | Principles of Pharmacology |
| BIOM*4030 | [0.50] | Endocrine Physiology |
| HK*3100 | [0.50] | Neuromuscular Physiology |
| PHYS*2030 | [0.50] | Biophysics of Excitable Cells |
| PSYC*2390 | [0.50] | Principles of Sensation and Perception |
| PSYC*3030 | [0.50] | Neurochemical Basis of Behaviour |
| PSYC*3410 | [0.50] | Behavioural Neuroscience II |
| PSYC*4050 | [0.50] | Seminar in Animal Learning |
| PSYC*4470 | [0.50] | Behavioural Neuroscience Seminar |
| PSYC*4600 | [0.50] | Cognitive Neuroscience |
| PSYC*4750 | [0.50] | Seminar in Motivation and Emotion |

In fulfillment of the 2.00 additional credits, students may take 1 of:

| | | |
|---|---|---|
| BIOM*3040 | [0.75] | Medical Embryology |
| ZOO*2100 | [0.50] | Developmental Biology |

and non-B.Sc. students may also select:

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |

Please note that some of the restricted electives require prerequisites that are not included in the minor.

## Nutritional and Nutraceutical Sciences (NANS)

**Department of Human Health and Nutritional Sciences, College of Biological Science**

The Nutritional and Nutraceutical Sciences major is concerned with understanding the contribution of food, beverage and nutritional supplement consumption to growth, development of optimal biological function, maintenance of health, and treatment of disease.

If lacking the fundamentals of word processing, spread sheet use and data management, the student should select CIS*1200 as early in the program as possible.

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A total of 20.00 credits is required, including 2.00 credits from Arts and Social Sciences courses.

#### Semester 1

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 arts or social science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

#### Semester 2

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 arts or social science electives

#### Semester 3

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| STAT*2040 | [0.50] | Statistics I |

0.50 electives or restricted electives

0.50 arts or social science electives

#### Semester 4

| | | |
|---|---|---|
| BIOC*3560 | [0.50] | Structure and Function in Biochemistry |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |

0.50 electives or restricted electives

0.50 arts or social science electives

#### Semester 5

| | | |
|---|---|---|
| HK*3940 | [1.25] | Human Physiology |
| NUTR*3330 | [0.50] | Micronutrients, Phytochemicals and Health |
| NUTR*3390 | [0.75] | Applied Nutritional and Nutraceutical Sciences I |

#### Semester 6

| | | |
|---|---|---|
| BIOM*3090 | [0.50] | Principles of Pharmacology |
| NUTR*4090 | [0.50] | Functional Foods and Nutraceuticals |
| NUTR*4320 | [0.50] | Nutrition and Metabolic Control of Disease |
| NUTR*4330 | [0.75] | Applied Nutritional and Nutraceutical Sciences II |

A minimum of 0.25 electives or restricted electives

#### Semester 7

| | | |
|---|---|---|
| NUTR*4210 | [0.50] | Nutrition, Exercise and Energy Metabolism |
| NUTR*4510 | [0.50] | Toxicology, Nutrition and Food |

1.50 electives or restricted electives

#### Semester 8

2.50 electives or restricted electives

#### Restricted Electives

1.00 credits from the following:

| | | |
|---|---|---|
| HK*4230 | [0.50] | Advanced Study in Human Health and Nutritional Sciences |
| HK*4360 | [1.00] | Research in Human Health and Nutritional Sciences |
| HK*4371/2 | [1.00] | Research in Human Health and Nutritional Sciences II |
| HK*4460 | [0.50] | Regulation of Human Metabolism |
| NUTR*4350 | [0.50] | Current Issues in Nutrition |
| NUTR*4360 | [0.50] | Current Issues in Nutrigenomics |
| PATH*3610 | [0.50] | Principles of Disease |

### Minor (Honours Program)

A minor in Nutritional and Nutraceutical Sciences (NANS) requires 5.00 credits as follows:

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |
| NUTR*3330 | [0.50] | Micronutrients, Phytochemicals and Health |
| NUTR*4090 | [0.50] | Functional Foods and Nutraceuticals |
| STAT*2040 | [0.50] | Statistics I |

At least 0.50 credits from:

| | | |
|---|---|---|
| ANSC*3080 | [0.50] | Agricultural Animal Physiology (restricted to ABIO majors) |
| BIOM*3200 | [1.00] | Mammalian Physiology |
| HK*3940 | [1.25] | Human Physiology |
| ZOO*3200 | [0.50] | Comparative Animal Physiology I |

and 2.00 credits from:

| | | |
|---|---|---|
| ANSC*3170 | [0.50] | Nutrition of Fish and Crustacea |
| ANSC*3180 | [0.50] | Wildlife Nutrition |
| ANSC*4260 | [0.50] | Beef Cattle Nutrition |
| ANSC*4270 | [0.50] | Dairy Cattle Nutrition |
| ANSC*4280 | [0.50] | Poultry Nutrition |
| ANSC*4290 | [0.50] | Swine Nutrition |
| ANSC*4560 | [0.50] | Pet Nutrition |
| EQN*4020 | [0.50] | Feeding the Performance Horse |
| FOOD*2010 | [0.50] | Principles of Food Science |
| HK*4230 | [0.50] | Advanced Study in Human Health and Nutritional Sciences |
| HK*4360 | [1.00] | Research in Human Health and Nutritional Sciences |
| HK*4371/2 | [1.00] | Research in Human Health and Nutritional Sciences II |
| NUTR*2150 | [0.50] | Introduction to Nutritional and Food Sciences |
| NUTR*3390 | [0.75] | Applied Nutritional and Nutraceutical Sciences I |
| NUTR*4210 | [0.50] | Nutrition, Exercise and Energy Metabolism |
| NUTR*4320 | [0.50] | Nutrition and Metabolic Control of Disease |
| NUTR*4330 | [0.75] | Applied Nutritional and Nutraceutical Sciences II |
| NUTR*4350 | [0.50] | Current Issues in Nutrition |
| NUTR*4360 | [0.50] | Current Issues in Nutrigenomics |
| NUTR*4510 | [0.50] | Toxicology, Nutrition and Food |

## Physical Science (PSCI)

**College of Physical and Engineering Science**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. This major will require the completion of 20.00 credits as indicated below:

1. **Basic Science Core - 4.00 credits**

1.00 - Biology (BIOL*1070, BIOL*1080, BIOL*1090)

1.00 - Chemistry (CHEM*1040, CHEM*1050)

1.00 - Physics [(PHYS*1000, PHYS*1010) or (PHYS*1070, PHYS*1080) or (PHYS*1080, PHYS*1130)]

1.00 - Mathematical Science [(MATH*1080, MATH*2080) or (MATH*1200, MATH*1210)]

2. **Subject Area Core - 8.00 credits**

   0.50 STAT*2040

   0.50 (CIS*1200 or CIS*1500 )

   7.00 physical science credits, including at least 4.00 credits at the 3000 or 4000 level of which 2.00 credits must be at the 4000 level.

3. **Science Electives - 4.00 credits**

   4.00 science credits from the List of Approved Science Electives for B.Sc. Students*

4. **Arts and Social Science Electives - 2.00**

   2.00 acceptable Arts or Social Science credits selected from the List of Approved B.Sc. Electives*

5. **Free Electives - 2.00 credits**

**Note:** the program must include a total of 6.00 science credits at the 3000 or 4000 level. Of these, at least 2.00 credits must be physical science at the 4000 level.

### Semester 1

CHEM*1040 [0.50] General Chemistry I
One of:
- PHYS*1000 [0.50] An Introduction to Mechanics
- PHYS*1070 [0.50] Introductory Physics for Life Sciences
- PHYS*1080 [0.50] Physics for Life Sciences

One of:
- MATH*1080 [0.50] Elements of Calculus I
- MATH*1200 [0.50] Calculus I

One of
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health
- BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2

CHEM*1050 [0.50] General Chemistry II
One of:
- PHYS*1010 [0.50] Introductory Electricity and Magnetism
- PHYS*1080 [0.50] Physics for Life Sciences
- PHYS*1130 [0.50] Physics with Applications

One of:
- MATH*1210 [0.50] Calculus II
- MATH*2080 [0.50] Elements of Calculus II

One of
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health
- BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology

0.50 Arts or Social Science electives

### Semester 3

1.50 science electives from the approved list of acceptable B.Sc. science electives*
0.50 electives
One of:
- CIS*1200 [0.50] Introduction to Computing
- CIS*1500 [0.50] Introduction to Programming

OR
- STAT*2040 [0.50] Statistics I

### Semester 4

1.50 science electives from the approved list of B.Sc. science electives*
0.50 electives
One of:
- CIS*1200 [0.50] Introduction to Computing
- CIS*1500 [0.50] Introduction to Programming

(if a statistics course is chosen in Semester 3)
OR
- STAT*2040 [0.50] Statistics I

(if a computing course is chosen in Semester 3)

### Semester 5 to 8

Total of 2.50 credits per semester including at least 2.00 science electives.

Sufficient courses at the 3000 or 4000 level must be selected in Semesters 5 through 8 to total 6.00 credits in science at the 3000 or 4000 level with at least 2.00 physical science at the 4000 level.

*approved course lists are available in the B.Sc. Academic Counselling Office or at: http://www.bsc.uoguelph.ca/Approved_electives.shtml

## Honours Physical Science (With a Minor)

The requirements and schedules are the same as for Honours Physical Science. Available Minor subjects are listed at the beginning of the B.SC. Program section under the heading Honours Program Minors.

## Physics (PHYS)

**Department of Physics, College of Physical and Engineering Science**

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. Since some of the required courses are not offered every semester, students entering the Major in Honours Physics should plan their program in consultation with the Department of Physics Faculty Advisor.

## Major (Honours Program)

This major requires the completion of 21.25 credits. At least 1.00 credits must be from Arts and/or Social Science courses.

### Semester 1*

CHEM*1040 [0.50] General Chemistry I
CIS*1500 [0.50] Introduction to Programming
MATH*1200 [0.50] Calculus I
PHYS*1000 [0.50] An Introduction to Mechanics
One of
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health
- BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

### Semester 2*

CHEM*1050 [0.50] General Chemistry II
MATH*1210 [0.50] Calculus II
PHYS*1010 [0.50] Introductory Electricity and Magnetism
One of
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health
- BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology

0.50 Arts or Social Science electives

* students who have taken physics courses other than PHYS*1000 in Semester 1 and PHYS*1010 in Semester 2, may proceed to semester 3 with the permission of the Department of Physics

### Semester 3

MATH*2160 [0.50] Linear Algebra I
MATH*2200 [0.50] Advanced Calculus I
PHYS*2440 [0.75] Mechanics I
PHYS*2460 [0.75] Electricity and Magnetism I
One of:
- STAT*2040 [0.50] Statistics I
- 0.50 Arts electives
- 0.50 Social Science electives

### Semester 4

MATH*2170 [0.50] Differential Equations I
PHYS*2260 [0.50] Quantum Physics
PHYS*2450 [0.75] Mechanics II
PHYS*2470 [0.75] Electricity and Magnetism II
One of:
- STAT*2040 [0.50] Statistics I
- STAT*2120 [0.50] Probability and Statistics for Engineers
- 0.50 electives

### Semester 5

MATH*3100 [0.50] Differential Equations II
PHYS*3100 [0.75] Electronics
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3240 [0.50] Statistical Physics I
One of:
- MATH*2000 [0.50] Set Theory
- 0.50 electives

### Semester 6

PHYS*3220 [0.50] Waves and Optics
PHYS*3400 [0.50] Advanced Mechanics
PHYS*3510 [0.50] Intermediate Laboratory

PHYS*4040 [0.50] Quantum Mechanics II
One of:
MATH*3170 [0.50] Partial Differential Equations and Special Functions
MATH*3260 [0.50] Complex Analysis
0.50 electives

**Semester 7+**

PHYS*4180 [0.50] Advanced Electromagnetic Theory
PHYS*4500 [0.50] Advanced Physics Laboratory
One of:
PHYS*4240 [0.50] Statistical Physics II
0.50 electives
One of:
PHYS*4001 [0.50] Research in Physics
0.50 electives
0.50 electives **

Note: Either PHYS*4001/2 in semesters 7 and 8, or PHYS*4300 in semester 8 must be taken

**Semester 8+**

One of:
PHYS*4002 [0.50] Research in Physics
PHYS*4300 [0.50] Inquiry in Physics
2.00 electives **

+ students going on to graduate school in physics should take PHYS*4001/2 ,PHYS*4120, PHYS*4130, PHYS*4150, PHYS*4240

** Either PHYS*4001/2 in semesters 7 and 8, or PHYS*4300 in semester 8 must be taken. In addition, at least 1.50 credits must be from lists A and B below. At least 1.00 credits must be from list A. Substitutions of courses in list B by other 3000 or 4000 level courses must be approved by the Physics Faculty Advisor.

**List A**

PHYS*4120 [0.50] Atomic and Molecular Physics
PHYS*4130 [0.50] Subatomic Physics
PHYS*4150 [0.50] Solid State Physics

**List B**

EDRD*3120 [0.50] Educational Communication
GEOG*3420 [0.50] Remote Sensing of the Environment
GEOL*3060 [0.50] Groundwater
PHYS*4540 [0.50] Molecular Biophysics
PHYS*4560 [0.50] Biophysical Methods
PHYS*4910 [0.50] Advanced Topics in Physics I
PHYS*4920 [0.50] Advanced Topics in Physics II
PHYS*4930 [0.50] Advanced Topics in Physics III
POLS*3370 [0.50] Environmental Politics and Governance
STAT*3240 [0.50] Applied Regression Analysis
STAT*3510 [0.50] Environmental Risk Assessment

## Minor (Honours Program)

A minor in Physics requires 5.00 credits in physics courses including at least 1.00 at the 3000 or 4000 level.

The following four courses, with a weight of 0.75 each, are required:

PHYS*2440 [0.75] Mechanics I
PHYS*2450 [0.75] Mechanics II
PHYS*2460 [0.75] Electricity and Magnetism I
PHYS*2470 [0.75] Electricity and Magnetism II

The following courses are strongly recommended:

PHYS*1000 [0.50] An Introduction to Mechanics
PHYS*1010 [0.50] Introductory Electricity and Magnetism

# Physics (Co-op) (PHYS:C)

**Department of Physics, College of Physical and Engineering Science**

Since some of the required courses are not offered every semester, students entering the Major in Physics (Co-op) should plan their program in consultation with the Department of Physics Faculty Advisor. To graduate from the Co-op program a minimum of 4 successfully completed work terms (COOP*1000, COOP*2000, COOP*3000, COOP*4000) is normally required.

## Major (Honours Program)

This major requires the completion of 21.25 credits.

**Semester 1 - Fall**

CHEM*1040 [0.50] General Chemistry I
CIS*1500 [0.50] Introduction to Programming
MATH*1200 [0.50] Calculus I
PHYS*1000 [0.50] An Introduction to Mechanics
One of
BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

CHEM*1050 [0.50] General Chemistry II
MATH*1210 [0.50] Calculus II
PHYS*1010 [0.50] Introductory Electricity and Magnetism
One of
BIOL*1070 [0.50] Discovering Biodiversity
BIOL*1080 [0.50] Biological Concepts of Health
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
One of:
CIS*2500 [0.50] Intermediate Programming
0.50 Arts or Social Science electives*

**Semester 3 - Fall**

COOP*1100 [0.00] Introduction to Co-operative Education
MATH*2160 [0.50] Linear Algebra I
MATH*2200 [0.50] Advanced Calculus I
PHYS*2440 [0.75] Mechanics I
PHYS*2460 [0.75] Electricity and Magnetism I
One of:
MATH*2000 [0.50] Set Theory
STAT*2040 [0.50] Statistics I
0.50 Arts or Social Science electives*

**Semester 4 - Winter**

MATH*2170 [0.50] Differential Equations I
PHYS*2260 [0.50] Quantum Physics
PHYS*2450 [0.75] Mechanics II
PHYS*2470 [0.75] Electricity and Magnetism II
One of:
STAT*2040 [0.50] Statistics I
STAT*2120 [0.50] Probability and Statistics for Engineers
0.50 electives

**Summer Semester**

COOP*1000 [0.00] Co-op Work Term I ++

**Semester 5 - Fall**

MATH*3100 [0.50] Differential Equations II
PHYS*3100 [0.75] Electronics
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3240 [0.50] Statistical Physics I
One of:
MATH*2000 [0.50] Set Theory
0.50 electives

**Winter Semester**

COOP*2000 [0.00] Co-op Work Term II ++

**Summer Semester**

COOP*3000 [0.00] Co-op Work Term III ++

**Semester 6 - Fall +**

PHYS*4180 [0.50] Advanced Electromagnetic Theory
One of:
CIS*2520 [0.50] Data Structures
0.50 electives**
One of:
MATH*2000 [0.50] Set Theory
0.50 electives**
One of:
PHYS*4240 [0.50] Statistical Physics II
0.50 electives**
0.50 electives **

**Semester 7 - Winter +**

PHYS*3220 [0.50] Waves and Optics
PHYS*3400 [0.50] Advanced Mechanics
PHYS*3510 [0.50] Intermediate Laboratory
PHYS*4040 [0.50] Quantum Mechanics II
One of:
MATH*3170 [0.50] Partial Differential Equations and Special Functions
MATH*3260 [0.50] Complex Analysis
0.50 electives**

**Summer Semester**

COOP*4000 [0.00] Co-op Work Term IV ++

**Fall Semester**

COOP*5000 [0.00] Co-op Work Term V ++

**Semester 8 - Winter +**

PHYS*4500 [0.50] Advanced Physics Laboratory
One of:
PHYS*4130 [0.50] Subatomic Physics
0.50 electives**
One of:
PHYS*4150 [0.50] Solid State Physics
0.50 electives**
One of:
PHYS*4300 [0.50] Inquiry in Physics
0.50 electives**
0.50 electives**

* 1.00 must be taken as Arts or Social Science electives in this Major

+ students going on to graduate school in physics should take PHYS*4130, PHYS*4150, and PHYS*4240

**At least 1.50 credits must be from lists A and B below. At least 1.00 credits must be from list A. Substitutions of courses in list B by other 3000 or 4000 level courses must be approved by the Physics Faculty Advisor.

++Four work terms are required for the completion of the co-op degree. It is also necessary that there be at least one work term in each of Fall, Winter and Summer semesters. Therefore, one of the summer work terms could be missed and the student would still graduate successfully. Whether the student completes four or five work terms, a report is required for each work term completed. Contact the co-op faculty advisor for further details.

**List A**

PHYS*4130 [0.50] Subatomic Physics
PHYS*4150 [0.50] Solid State Physics
PHYS*4240 [0.50] Statistical Physics II

**List B**

EDRD*3120 [0.50] Educational Communication
GEOG*3420 [0.50] Remote Sensing of the Environment
GEOL*3060 [0.50] Groundwater
PHYS*4300 [0.50] Inquiry in Physics
PHYS*4540 [0.50] Molecular Biophysics
PHYS*4560 [0.50] Biophysical Methods
PHYS*4910 [0.50] Advanced Topics in Physics I
PHYS*4920 [0.50] Advanced Topics in Physics II
PHYS*4930 [0.50] Advanced Topics in Physics III
POLS*3370 [0.50] Environmental Politics and Governance
STAT*3240 [0.50] Applied Regression Analysis
STAT*3510 [0.50] Environmental Risk Assessment

## Plant Science (PLSC)

**Department of Plant Agriculture, Ontario Agricultural College**

**School of Environmental Sciences, Ontario Agricultural College**

**Department of Integrative Biology, College of Biological Science**

**Department of Molecular and Cellular Biology, College of Biological Science**

## Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. The major requires the completion of 20.00 credits and students must declare one of the following areas of emphasis: Applied Plant Science, Botany, Plant Biotechnology, Plant Environmental Science or Unspecialized.

**Semester 1**

BIOL*1070 [0.50] Discovering Biodiversity
CHEM*1040 [0.50] General Chemistry I
MATH*1080 [0.50] Elements of Calculus I
PHYS*1070 [0.50] Introductory Physics for Life Sciences
0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1050 [0.50] General Chemistry II
PHYS*1080 [0.50] Physics for Life Sciences
One of:
CIS*1200 [0.50] Introduction to Computing
CIS*1500 [0.50] Introduction to Programming
MATH*2080 [0.50] Elements of Calculus II
0.50 Arts or Social Science electives

**Semester 3**

AGR*2470 [0.50] Introduction to Plant Agriculture
BIOC*2580 [0.50] Introduction to Biochemistry
BOT*2100 [0.50] Life Strategies of Plants
MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
0.50 Arts and Social Science electives

**Semester 4**

MCB*2050 [0.50] Molecular Biology of the Cell
STAT*2040 [0.50] Statistics I
One of:
BIOL*2060 [0.50] Ecology
CROP*2110 [0.50] Crop Ecology
1.00 electives or restricted electives

**Semester 5**

BOT*3410 [0.50] Plant Anatomy
2.00 electives or restricted electives

**Semester 6**

BOT*3310 [0.50] Plant Growth and Development
BOT*3710 [0.50] Plant Diversity and Evolution
1.50 electives or restricted electives

**Semester 7**

2.50 electives or restricted electives

**Semester 8**

BOT*4380 [0.50] Metabolism in the Whole Life of Plants
2.00 electives or restricted electives

### Program Requirements

1. A minimum of 6.00 credits must be at the 3000 or 4000 levels with a minimum of 2.00 credits at the 4000 level.
2. 1.50 credits of Arts and Social Science electives

### Electives and Restricted Elective (9.00 credits)

1. Students are to choose 5.00 credits for an area of emphasis: Applied Plant Science, Botany, Plant Biotechnology, Plant Environmental Science or Unspecialized.
2. Of the 9.00 credits, 6.50 must be approved science electives.
3. Restricted electives, indicated with †, are non-science electives.
4. Restricted electives, indicated with **, require other restricted electives as prerequisites. Students should consult the most recent undergraduate calendar for specific requirements.
5. ‡Students interested in graduate studies are encouraged to take two semesters of research projects which will count towards restricted elective requirements in an area of emphasis:

AGR*4450 [1.00] Research Project I
AGR*4460 [1.00] Research Project II
or
IBIO*4500 [0.75] Research in Integrative Biology I
IBIO*4510 [0.75] Research in Integrative Biology II
or
MCB*4500 [1.00] Research Project in Molecular & Cellular Biology I **
MCB*4510 [1.00] Research Project in Molecular & Cellular Biology 2

### Area of Emphasis

**Applied Plant Science (APSC)**

SOIL*2010 [0.50] Soil Science
CROP*4240 [0.50] Weed Science
ENVB*3210 [0.50] Plant Pathology
ENVB*4100 [0.50] Integrated Management of Invasive Insect Pests **
‡ 3.00 credits from:
CROP*3300 [0.50] Grain Crops
CROP*3310 [0.50] Protein and Oilseed Crops
CROP*3340 [0.50] Managed Grasslands
CROP*4220 [0.50] Cropping Systems **
ENVB*2040 [0.50] Plant Health and the Environment
ENVB*3030 [0.50] Pesticides and the Environment
ENVB*3160 [0.50] Management of Turfgrass Diseases **
ENVB*4070 [0.50] Biological and Cultural Control of Plant Diseases **
HORT*2450 [0.50] Introduction to Turfgrass Science
HORT*3010 [0.50] Annual, Perennial and Indoor Plants - Identification and Use
HORT*3050 [0.50] Management of Turfgrass Insect Pests and Weeds **
HORT*3230 [0.50] Plant Propagation
HORT*3270 [0.50] Medicinal Plants
HORT*3280 [0.50] Greenhouse Production
HORT*3350 [0.50] Woody Plant Production and Culture
HORT*3430 [0.50] Wine-Grape Culture
HORT*3510 [0.50] Vegetable Production
HORT*4200 [0.50] Turf, the Environment and Society **

| | | |
|---|---|---|
| HORT*4300 | [0.50] | Postharvest Physiology |
| HORT*4420 | [0.50] | Fruit Crops |
| HORT*4450 | [0.50] | Advanced Turfgrass Science ** |
| LARC*2240 | [0.50] | Plants in the Landscape |
| MBG*3100 | [0.50] | Plant Genetics |
| MBG*4160 | [0.50] | Plant Breeding |
| NRS*3000 | [0.50] | Environmental Issues in Agriculture and Landscape Management ** |
| OAGR*2050 | [0.50] | Gateway to Organic Agriculture |
| OAGR*4160 | [0.50] | Design of Organic Production Systems |
| PBIO*3110 | [0.50] | Crop Physiology |
| PBIO*3750 | [0.50] | Plant Tissue Culture |
| PBIO*4100 | [0.50] | Soil Plant Relationships |
| PBIO*4750 | [0.50] | Genetic Engineering of Plants |
| SOIL*3080 | [0.50] | Soil and Water Conservation |
| SOIL*3200 | [0.50] | Environmental Soil Biology |
| SOIL*4090 | [0.50] | Soil Management |

**Botany (BOT)**

| | | |
|---|---|---|
| BOT*3050 | [0.50] | Plant Functional Ecology |
| MBG*3100 | [0.50] | Plant Genetics |
| PBIO*4000 | [0.50] | Molecular and Cellular Aspects of Plant-Microbe Interactions |
| PBIO*4150 | [0.50] | Molecular and Cellular Aspects of Plant Development |

‡ 3.00 credits from:

One of:

| | | |
|---|---|---|
| BIOL*2250 | [0.50] | Biostatistics and the Life Sciences |
| BIOL*3010 | [0.50] | Laboratory and Field Work in Ecology |
| BIOL*3050 | [0.50] | Mycology |
| STAT*2250 | [0.50] | Biostatistics and the Life Sciences |
| BIOL*3110 | [0.50] | Population Ecology |
| MBG*4300 | [0.50] | Plant Molecular Genetics |
| MICR*2420 | [0.50] | Introduction to Microbiology |
| MICR*3220 | [0.50] | Plant Microbiology |
| PBIO*3110 | [0.50] | Crop Physiology |
| PBIO*3750 | [0.50] | Plant Tissue Culture |
| PBIO*4750 | [0.50] | Genetic Engineering of Plants |

**Plant Biotechnology (PBTC)**

| | | |
|---|---|---|
| MBG*3100 | [0.50] | Plant Genetics |
| MBG*3350 | [0.75] | Laboratory Methods in Molecular Biology I |
| PBIO*3750 | [0.50] | Plant Tissue Culture |
| PBIO*4750 | [0.50] | Genetic Engineering of Plants |

‡ minimum of 2.75 credits from:

| | | |
|---|---|---|
| BIOL*3300 | [0.50] | Applied Bioinformatics |
| MBG*3660 | [0.50] | Genomics |
| MBG*4160 | [0.50] | Plant Breeding |
| MBG*4300 | [0.50] | Plant Molecular Genetics |
| MCB*4010 | [0.50] | Advanced Cell Biology |
| MICR*2420 | [0.50] | Introduction to Microbiology |
| MICR*3220 | [0.50] | Plant Microbiology |
| MICR*3230 | [0.50] | Immunology |
| MICR*3330 | [0.50] | World of Viruses |
| PBIO*3110 | [0.50] | Crop Physiology |
| PBIO*4150 | [0.50] | Molecular and Cellular Aspects of Plant Development |

**Plant Environmental Science (PESC)**

| | | |
|---|---|---|
| BOT*3050 | [0.50] | Plant Functional Ecology |
| ENVB*2040 | [0.50] | Plant Health and the Environment |
| ENVB*4780 | [0.50] | Forest Ecology |
| GEOG*2480 | [0.50] | Mapping and GIS |

‡ 3.00 credits from:

| | | |
|---|---|---|
| BIOL*3010 | [0.50] | Laboratory and Field Work in Ecology |
| BIOL*3110 | [0.50] | Population Ecology |
| BIOL*3120 | [0.50] | Community Ecology |
| BIOL*3130 | [0.50] | Conservation Biology ** |
| BIOL*4050 | [0.50] | Advanced Eukaryotic Microbiology |
| ENVB*2030 | [0.50] | Current Issues in Forest Science |
| ENVB*2040 | [0.50] | Plant Health and the Environment |
| ENVB*3000 | [0.50] | Nature Interpretation ** |
| ENVB*3030 | [0.50] | Pesticides and the Environment |
| ENVB*3040 | [0.50] | Natural Chemicals in the Environment |
| ENVB*3090 | [0.50] | Insect Diversity and Biology |
| ENVB*3210 | [0.50] | Plant Pathology |
| ENVB*3250 | [0.50] | Forest Health and Disease |
| ENVB*3330 | [0.50] | Ecosystem Processes and Applications ** |
| ENVB*4070 | [0.50] | Biological and Cultural Control of Plant Diseases ** |
| ENVB*4100 | [0.50] | Integrated Management of Invasive Insect Pests ** |
| GEOG*2210 | [0.50] | Environment and Resources |
| GEOG*3210 | [0.50] | Management of the Biophysical Environment ** |
| GEOG*4210 | [0.50] | Environmental Governance ** |
| GEOG*4220 | [0.50] | Local Environmental Management |
| LARC*3320 | [0.50] | Principles of Landscape Ecology ** |
| NRS*2120 | [0.50] | Introduction to Environmental Stewardship ** |
| PHIL*2070 | [0.50] | Philosophy of the Environment |
| POLS*3370 | [0.50] | Environmental Politics and Governance |
| SOIL*2010 | [0.50] | Soil Science |

**Unspecialized (UNSP)**

Choose 5.00 credits from any courses listed in the other areas of emphasis.

**Minor (Honours Program)**

A minor in Plant Science requires 5.00 credits in the Plant Science Program chosen in consultation with the Faculty Advisor. The courses include:

| | | |
|---|---|---|
| AGR*2470 | [0.50] | Introduction to Plant Agriculture |
| BOT*2100 | [0.50] | Life Strategies of Plants |
| BOT*3310 | [0.50] | Plant Growth and Development |
| BOT*3410 | [0.50] | Plant Anatomy |
| BOT*3710 | [0.50] | Plant Diversity and Evolution |
| BOT*4380 | [0.50] | Metabolism in the Whole Life of Plants |

2.00 credits from any courses listed in the areas of emphasis.

Restricted electives, indicated with , are non-science electives. Restricted electives, indicated with **, require other restricted electives as prerequisites.

## Psychology: Brain & Cognition (PBC)

**Department of Psychology, College of Social and Applied Human Sciences**

The B.Sc. Major in Psychology: Brain and Cognition offers an opportunity for students to develop interests within learning, perception, cognition, and biopsychology from a sound base in physical and biological sciences. Students primarily interested in other areas within psychology should consult the schedule of studies for the Bachelor of Arts program. Psychology courses in the above focuses may also be studied via the B.A. program.

### Note on Honours Courses

Honours Courses: courses designated with (H) are designed for students in a psychology honours specialization. This includes B.A. Honours Psychology (PYSC) major or minor, B.A. Information Systems and Human Behaviour (ISHB) major, B.Sc. Psychology: Brain and Cognition (PBC), major or minor, and the Neuroscience (NEUR) minor. (H) courses are Honours level requiring for registration a cumulative average of at least 70% in all course attempts in Psychology or registration in the ISHB major, NEUR minor, or PBC major or minor. Unless otherwise specified, all other courses may be taken by students in a general or honours program, providing the prerequisites are met.

### Major (Honours Program)

**Semester 1**

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

One of:

| | | |
|---|---|---|
| PSYC*1100 | [0.50] | Principles of Behaviour |
| PSYC*1200 | [0.50] | Dynamics of Behaviour |

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

One of:

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |

One of:

| | | |
|---|---|---|
| CIS*1200 | [0.50] | Introduction to Computing |
| CIS*1500 | [0.50] | Introduction to Programming |

One of:

| | | |
|---|---|---|
| PSYC*1100 | [0.50] | Principles of Behaviour |
| PSYC*1200 | [0.50] | Dynamics of Behaviour |

**Semester 3**

One of:

| | | |
|---|---|---|
| PSYC*2330 | [0.50] | Principles of Learning |
| PSYC*2410 | [0.50] | Behavioural Neuroscience I |

One of:

| | | |
|---|---|---|
| PSYC*2390 | [0.50] | Principles of Sensation and Perception |
| PSYC*2650 | [0.50] | Cognitive Psychology |

One of:

| | | |
|---|---|---|
| PSYC*2010 | [0.50] | Quantification in Psychology |
| STAT*2040 | [0.50] | Statistics I |

0.50 Arts/Non-Psychology Social Science electives *

0.50 elective or restricted electives*

**Semester 4**

PSYC*2040 [0.50] Research Statistics
PSYC*2360 [0.50] Introductory Research Methods
0.50 Psychology core (PSYC*2330, PSYC*2390, PSYC*2410, PSYC*2650)
One of:
- PSYC*2310 [0.50] Introduction to Social Psychology
- PSYC*2450 [0.50] Introduction to Developmental Psychology
- PSYC*2740 [0.50] Personality

0.50 Arts/Non-Psychology Social Science electives *

**Semester 5 ****

2.50 electives or restricted electives (Students contemplating graduate studies should see Graduate Studies Advisory Note below)

**Semester 6 ****

PSYC*3250 [0.50] Psychological Measurement
2.00 electives or restricted electives

**Semester 7 ****

2.50 electives or restricted electives

**Semester 8 ****

2.50 electives or restricted electives*

**Restricted Electives**

3.00 credits from:

| | | |
|---|---|---|
| PSYC*3030 | [0.50] | Neurochemical Basis of Behaviour |
| PSYC*3100 | [0.50] | Evolutionary Psychology |
| PSYC*3330 | [0.50] | Memory |
| PSYC*3340 | [0.50] | Psycholinguistics |
| PSYC*3370 | [0.50] | Experimental Design and Analysis |
| PSYC*3380 | [0.50] | Non-experimental Research Methods |
| PSYC*3410 | [0.50] | Behavioural Neuroscience II |
| PSYC*3440 | [0.50] | Cognitive Development |
| PSYC*3850 | [0.50] | Intellectual Disabilities |
| PSYC*3900 | [0.50] | Psychology Research Internship *** |
| PSYC*4050 | [0.50] | Seminar in Animal Learning |
| PSYC*4470 | [0.50] | Behavioural Neuroscience Seminar |
| PSYC*4500 | [0.50] | Current Theoretical Issues in Psychology *** |
| PSYC*4510 | [0.50] | Current Issues in Psychology *** |
| PSYC*4600 | [0.50] | Cognitive Neuroscience |
| PSYC*4750 | [0.50] | Seminar in Motivation and Emotion |
| PSYC*4870 | [0.50] | Honours Thesis I *** |
| PSYC*4880 | [1.00] | Honours Thesis II *** |
| PSYC*4900 | [0.50] | Psychology Seminar |

**Program Requirements:**

1. Students are required to complete 16.00 credits in science of which a minimum of 6.00 credits must be at the 3000/4000 level and at least 2.00 credits of these must be 4000 level
2. *Students should refer to the list of Approved Science and Arts/Social Science electives for BSc students: http://www.bsc.uoguelph.ca/Approved_electives.shtml
3. The selection of electives should take into consideration the prerequisites for preferred advanced courses. With the permission of the Psychology Department PRIOR to course selection, up to 2 non-psychology credits can be used towards the psychology credits if such courses enhance the student's psychology program.

**** Graduate Studies Advisory Note**

Students planning to enter a graduate program in Psychology are advised to complete PSYC*3370 and PSYC*3380 in Semesters 5 and 6, as well as and PSYC*4880 in Semesters 7 and 8, respectively. PSYC*4370 or PSYC*4900 must be completed prior to or concurrently with either PSYC*4870 or PSYC*4880.

*** Depending upon the project chosen, these courses will be evaluated by the faculty advisor to determine their suitability as science electives.

## Minor (Honours Program)

A minor in Psychology: Brain and Cognition requires 5.00 psychology credits as follows:

PSYC*1100 [0.50] Principles of Behaviour
PSYC*1200 [0.50] Dynamics of Behaviour
PSYC*2360 [0.50] Introductory Research Methods
2.00 credits from 2000 level psychology core courses selected as follows:

a. 1.50 credits from:

| | | |
|---|---|---|
| PSYC*2330 | [0.50] | Principles of Learning |
| PSYC*2390 | [0.50] | Principles of Sensation and Perception |
| PSYC*2410 | [0.50] | Behavioural Neuroscience I |
| PSYC*2650 | [0.50] | Cognitive Psychology |

b. 0.50 credits from:

| | | |
|---|---|---|
| PSYC*2310 | [0.50] | Introduction to Social Psychology |
| PSYC*2450 | [0.50] | Introduction to Developmental Psychology |
| PSYC*2740 | [0.50] | Personality |

1.00 credits from courses in Restricted Electives list above

One of:

| | | |
|---|---|---|
| PSYC*2010 | [0.50] | Quantification in Psychology |
| STAT*2040 | [0.50] | Statistics I |

# Statistics (STAT)

**Department of Mathematics and Statistics, College of Physical and Engineering Science**

Students in this program will acquire the ability to use modern statistical methods in a variety of applications, the theoretical understanding necessary to develop statistical methods to meet new needs and a solid preparation for further study. As well, since statistical computing is a fundamental tool for the application and development of modern statistical methods, students will develop skills in computer applications programming using such high-level languages as SAS and S-PLUS.

Students may enter this major in any semester. A student wishing to declare the major must consult the Faculty Advisor. A total of 20.00 credits is required to complete the major. Required 1000 level courses are listed under Semester 1 and Semester 2 of the recommended Schedule of Studies for Major. At least 8.00 credits in Statistics and Mathematics are required at the 2000 level or above, as follows: MATH*2130, MATH*2150, MATH*2160, MATH*2200, STAT*2040, STAT*2050, STAT*3100, STAT*3110, STAT*3210, STAT*3240, STAT*3320. Five other courses (2.50 credits) in Statistics at the 3000 or 4000 level, of which at least four (2.00 credits) must be at the 4000 level. One other course (0.50 credits) in Mathematics or Statistics at the 2000 level or above.

## Major (Honours Program)

**Semester 1**

| | | |
|---|---|---|
| CHEM*1040 | [0.50] | General Chemistry I |
| CIS*1500 | [0.50] | Introduction to Programming |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

0.50 Arts or Social Science electives*

**Semester 3**

MATH*2200 [0.50] Advanced Calculus I
STAT*2040 [0.50] Statistics I
One of:
- MATH*2150 [0.50] Applied Matrix Algebra
- MATH*2160 [0.50] Linear Algebra I

0.50 Arts or Social Science electives
0.50 electives**

**Semester 4**

MATH*2130 [0.50] Numerical Methods
STAT*2050 [0.50] Statistics II
1.50 electives**

**Semester 5**

STAT*3100 [0.50] Introductory Mathematical Statistics I
STAT*3240 [0.50] Applied Regression Analysis
STAT*3320 [0.50] Sampling Theory with Applications
1.00 electives**

**Semester 6**

STAT*3110 [0.50] Introductory Mathematical Statistics II
STAT*3210 [0.50] Experimental Design
1.50 electives**

**Semester 7**

2.50 electives**

**Semester 8**

2.50 electives**

*The recommended Arts or Social Science elective can be postponed to a future semester if the student wishes to take STAT*2040 in Semester 2.

** Electives must satisfy the following requirements:

1. Electives must include at least 2.50 credits in Statistics at the 3000 or 4000 level, and an additional 0.50 credits in Statistics or Mathematics at the 2000 level or above.
2. At least 2.00 credits in Statistics must be at the 4000 level.
3. Electives plus core courses must include at least 6.00 credits at the 3000 or 4000 level from the B.Sc. Program Committee approved list of science electives.
4. At least 1.00 credits in Arts or Social Science must be completed.

### Minor (Honours Program)

A total of 5.00 credits in Statistics and Mathematics are required, including:

One of:

| | | |
|---|---|---|
| MATH*1080 | [0.50] | Elements of Calculus I |
| MATH*1200 | [0.50] | Calculus I |

One of:

| | | |
|---|---|---|
| MATH*1210 | [0.50] | Calculus II |
| MATH*2080 | [0.50] | Elements of Calculus II |

One of:

| | | |
|---|---|---|
| MATH*2150 | [0.50] | Applied Matrix Algebra |
| MATH*2160 | [0.50] | Linear Algebra I |

| | | |
|---|---|---|
| STAT*2040 | [0.50] | Statistics I |
| STAT*2050 | [0.50] | Statistics II |
| STAT*3100 | [0.50] | Introductory Mathematical Statistics I |
| STAT*3110 | [0.50] | Introductory Mathematical Statistics II |
| STAT*3240 | [0.50] | Applied Regression Analysis |

0.50 additional credits in Statistics
0.50 additional credits in Statistics or Mathematics

## Theoretical Physics (THPY)

**Department of Physics, College of Physical and Engineering Science**

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. Since some of the required courses are not offered every semester, students entering the Major in Theoretical Physics should plan their program in consultation with the Faculty Advisor.

### Major (Honours Program)

This major requires the completion of 21.25 credits. At least 1.00 of these credits must be obtained from the completion of Arts and/or Social Science courses.

#### Semester 1

| | | |
|---|---|---|
| CHEM*1040 | [0.50] | General Chemistry I |
| CIS*1500 | [0.50] | Introduction to Programming |
| MATH*1200 | [0.50] | Calculus I |
| PHYS*1000 | [0.50] | An Introduction to Mechanics |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

#### Semester 2

| | | |
|---|---|---|
| CHEM*1050 | [0.50] | General Chemistry II |
| MATH*1210 | [0.50] | Calculus II |
| PHYS*1010 | [0.50] | Introductory Electricity and Magnetism |

One of

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |

0.50 Arts or Social Science electives

**Note:** students who have taken physics courses other than PHYS*1000 in Semester 1 and PHYS*1010 in Semester 2, may proceed to semester 3 with the permission of the Department of Physics

#### Semester 3

| | | |
|---|---|---|
| MATH*2160 | [0.50] | Linear Algebra I |
| MATH*2200 | [0.50] | Advanced Calculus I |
| PHYS*2440 | [0.75] | Mechanics I |
| PHYS*2460 | [0.75] | Electricity and Magnetism I |

One of:

| | | |
|---|---|---|
| STAT*2040 | [0.50] | Statistics I |

0.50 Arts electives
0.50 Social Science electives

#### Semester 4

| | | |
|---|---|---|
| MATH*2170 | [0.50] | Differential Equations I |
| PHYS*2260 | [0.50] | Quantum Physics |
| PHYS*2450 | [0.75] | Mechanics II |
| PHYS*2470 | [0.75] | Electricity and Magnetism II |

One of:*

| | | |
|---|---|---|
| MATH*2210 | [0.50] | Advanced Calculus II |

0.50 electives

#### Semester 5

| | | |
|---|---|---|
| MATH*3100 | [0.50] | Differential Equations II |
| PHYS*3100 | [0.75] | Electronics |
| PHYS*3230 | [0.50] | Quantum Mechanics I |
| PHYS*3240 | [0.50] | Statistical Physics I |

One of:

| | | |
|---|---|---|
| MATH*2000 | [0.50] | Set Theory |

0.50 electives

#### Semester 6

| | | |
|---|---|---|
| MATH*3260 | [0.50] | Complex Analysis |
| PHYS*3220 | [0.50] | Waves and Optics |
| PHYS*3400 | [0.50] | Advanced Mechanics |
| PHYS*3510 | [0.50] | Intermediate Laboratory |
| PHYS*4040 | [0.50] | Quantum Mechanics II |

#### Semester 7

| | | |
|---|---|---|
| PHYS*4120 | [0.50] | Atomic and Molecular Physics |
| PHYS*4180 | [0.50] | Advanced Electromagnetic Theory |
| PHYS*4240 | [0.50] | Statistical Physics II |

Two of:

| | | |
|---|---|---|
| PHYS*4001 | [0.50] | Research in Physics |
| PHYS*4500 | [0.50] | Advanced Physics Laboratory |

One 3000 or 4000 level mathematics course
0.50 electives
0.50 electives

Note: Either PHYS*4001/2 in semesters 7 and 8, or PHYS*4300 in semester 8, must be taken.

#### Semester 8

| | | |
|---|---|---|
| PHYS*4130 | [0.50] | Subatomic Physics |
| PHYS*4150 | [0.50] | Solid State Physics |

One of:

| | | |
|---|---|---|
| PHYS*4002 | [0.50] | Research in Physics |
| PHYS*4300 | [0.50] | Inquiry in Physics |

One 3000 or 4000 level mathematics course
0.50 electives

**Note**: Either PHYS*4001/2 in semesters 7 and 8, or PHYS*4300 in semester 8, must be taken.

*those not taking MATH*2210 in Semester 4 must consult the Department of Physics Departmental Advisor

## Toxicology (TOX)

**Interdisciplinary Program, Departments of Biomedical Sciences, Chemistry, School of Environmental Sciences, Molecular and Cellular Biology**

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum of 20.00 credits are required for graduation.

#### Semester 1

| | | |
|---|---|---|
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

#### Semester 2

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |
| STAT*2040 | [0.50] | Statistics I |

0.50 Arts or Social Science electives

#### Semester 3

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| CHEM*2480 | [0.50] | Analytical Chemistry I |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| TOX*2000 | [0.50] | Principles of Toxicology |

0.50 Arts or Social Science electives

#### Semester 4

| | | |
|---|---|---|
| CHEM*2700 | [0.50] | Organic Chemistry I |
| MCB*2050 | [0.50] | Molecular Biology of the Cell |

STAT*2050 [0.50] Statistics II
TOX*3360 [0.50] Environmental Chemistry and Toxicology
0.50 electives or restricted electives*

**Semester 5**

BIOC*3560 [0.50] Structure and Function in Biochemistry
CHEM*3750 [0.50] Organic Chemistry II
TOX*3300 [0.50] Analytical Toxicology
1.00 credits from:
- BIOM*3200 [1.00] Mammalian Physiology
- ZOO*3200 [0.50] Comparative Animal Physiology I
- 0.50 electives or restricted electives*

**Semester 6**

BIOM*3090 [0.50] Principles of Pharmacology
ENVB*3030 [0.50] Pesticides and the Environment
PATH*3610 [0.50] Principles of Disease
One of:
- ZOO*3210 [0.50] Comparative Animal Physiology II (if ZOO*3200 slected in semester 5)
- 0.50 electives or restricted electives (if BIOM*3200 selected in semester 5)

0.50 electives or restricted electives*

**Semester 7**

MBG*3350 [0.75] Laboratory Methods in Molecular Biology I
TOX*4000 [0.50] Medical Toxicology
TOX*4590 [0.50] Biochemical Toxicology
0.75 electives or restricted electives*

**Semester 8**

TOX*4100 [0.50] Toxicological Pathology
TOX*4200 [0.50] Topics in Toxicology
TOX*4550 [0.50] Toxicological Risk Characterization
1.00 electives or restricted electives*

*** Restricted Electives**

At least 1.50 credits must be completed from the following list of allowable courses.

**Students are advised to pay particular attention to pre-requisite requirements when choosing individual courses, and seek advice as needed.

**List A - Research**

TOX*4900 [1.00] Toxicology Research Project I
TOX*4910 [1.00] Toxicology Research Project II

**List B - Biomedical**

BIOM*4070 [0.75] Biomedical Histology
BIOM*4090 [0.50] Pharmacology
MBG*4270 [0.50] DNA Replication, Recombination and Repair
MICR*3230 [0.50] Immunology
NUTR*3210 [0.50] Fundamentals of Nutrition
NUTR*4510 [0.50] Toxicology, Nutrition and Food

**List C - Environmental**

BIOL*2060 [0.50] Ecology
BIOL*3450 [0.50] Introduction to Aquatic Environments
BIOL*4350 [0.50] Biology of Polluted Waters
BOT*2100 [0.50] Life Strategies of Plants
ENVB*4240 [0.50] Biological Activity of Pesticides
MICR*4180 [0.50] Microbial Processes in Environmental Management
PBIO*4530 [0.50] Environmental Pollution Stresses on Plants
SOIL*2010 [0.50] Soil Science
STAT*3510 [0.50] Environmental Risk Assessment

## Toxicology (Co-op) (TOX:C)

**Interdisciplinary Program, Departments of Biomedical Sciences, Chemistry, School of Environmental Sciences, Molecular and Cellular Biology**

### Major (Honours Program)

A minimum of 20.00 credits are required for graduation.

**Semester 1 - Fall**

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1040 [0.50] General Chemistry I
MATH*1080 [0.50] Elements of Calculus I
PHYS*1070 [0.50] Introductory Physics for Life Sciences
0.50 Arts or Social Science electives
Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

BIOL*1080 [0.50] Biological Concepts of Health
CHEM*1050 [0.50] General Chemistry II
COOP*1100 [0.00] Introduction to Co-operative Education
PHYS*1080 [0.50] Physics for Life Sciences
STAT*2040 [0.50] Statistics I
0.50 Arts or Social Science electives

**Semester 3 - Fall**

BIOC*2580 [0.50] Introduction to Biochemistry
CHEM*2480 [0.50] Analytical Chemistry I
MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
TOX*2000 [0.50] Principles of Toxicology
0.50 Arts or Social Science electives

**Winter Semester**

COOP*1000 [0.00] Co-op Work Term I

**Semester 4 - Summer**

CHEM*2700 [0.50] Organic Chemistry I
PATH*3610 [0.50] Principles of Disease
STAT*2050 [0.50] Statistics II
TOX*3360 [0.50] Environmental Chemistry and Toxicology
0.50 electives or restricted electives*

**Semester 5 - Fall**

BIOC*3560 [0.50] Structure and Function in Biochemistry
CHEM*3750 [0.50] Organic Chemistry II
TOX*3300 [0.50] Analytical Toxicology
1.00 credits from:
- MCB*2050 [0.50] Molecular Biology of the Cell
- BIOM*3200 [1.00] Mammalian Physiology
- ZOO*3200 [0.50] Comparative Animal Physiology I

**Semester 6 - Winter**

BIOM*3090 [0.50] Principles of Pharmacology
ENVB*3030 [0.50] Pesticides and the Environment
One of:
- ZOO*3210 [0.50] Comparative Animal Physiology II (if ZOO*3200 taken in semester 5)
- MCB*2050 [0.50] Molecular Biology of the Cell (if BIOM*3200 taken in semester 5)

1.00 electives or restricted electives*

**Summer Semester**

COOP*2000 [0.00] Co-op Work Term II

**Fall Semester**

COOP*3000 [0.00] Co-op Work Term III

**Semester 7 - Winter**

TOX*4100 [0.50] Toxicological Pathology
TOX*4200 [0.50] Topics in Toxicology
TOX*4550 [0.50] Toxicological Risk Characterization
1.00 electives or restricted electives*

**Semester 8- Fall**

MBG*3350 [0.75] Laboratory Methods in Molecular Biology I
TOX*4000 [0.50] Medical Toxicology
TOX*4590 [0.50] Biochemical Toxicology
0.75 electives or restricted electives*

*** Restricted Electives**

At least 1.50 credits must be completed from the following list of allowable courses.

**Students are advised to pay particular attention to pre-requisite requirements when choosing individual courses, and seek advice as needed.

**List A - Research**

TOX*4900 [1.00] Toxicology Research Project I
TOX*4910 [1.00] Toxicology Research Project II

**List B - Biomedical**

BIOM*4070 [0.75] Biomedical Histology
BIOM*4090 [0.50] Pharmacology
MBG*4270 [0.50] DNA Replication, Recombination and Repair
MICR*3230 [0.50] Immunology
NUTR*3210 [0.50] Fundamentals of Nutrition
NUTR*4510 [0.50] Toxicology, Nutrition and Food

**List C - Environmental**

BIOL*2060 [0.50] Ecology
BIOL*3450 [0.50] Introduction to Aquatic Environments
BIOL*4350 [0.50] Biology of Polluted Waters
BOT*2100 [0.50] Life Strategies of Plants
ENVB*4240 [0.50] Biological Activity of Pesticides
MICR*4180 [0.50] Microbial Processes in Environmental Management
PBIO*4530 [0.50] Environmental Pollution Stresses on Plants
SOIL*2010 [0.50] Soil Science
STAT*3510 [0.50] Environmental Risk Assessment

## Wild Life Biology (WLB)

**Department of Integrative Biology, College of Biological Science**

The Major in Wild Life Biology provides exposure to the ecological principles upon which the scientific management of wild life is based. This major prepares students for post-graduate work in ecology and management of wild life and provides a sound science background for students wishing to pursue careers in teaching, government service or the private sector.

### Major (Honours Program)

Students may enter this major in semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum total of 20.00 credits is required to complete the major.

**Semester 1**

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 Arts or Social Science electives

**Semester 3**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| STAT*2040 | [0.50] | Statistics I |
| ZOO*2090 | [0.50] | Vertebrate Structure and Function |
| ZOO*2100 | [0.50] | Developmental Biology |

0.50 electives *

**Semester 4**

| | | |
|---|---|---|
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| NUTR*3210 | [0.50] | Fundamentals of Nutrition |
| ZOO*2700 | [0.50] | Invertebrate Morphology & Evolution |

1.00 electives *

**Semester 5**

| | | |
|---|---|---|
| BIOL*3010 | [0.50] | Laboratory and Field Work in Ecology |
| BIOL*3110 | [0.50] | Population Ecology |
| BIOL*3400 | [0.50] | Evolution |
| BOT*3050 | [0.50] | Plant Functional Ecology |
| ZOO*3200 | [0.50] | Comparative Animal Physiology I |

**Semester 6**

| | | |
|---|---|---|
| ANSC*3180 | [0.50] | Wildlife Nutrition |
| BIOL*3120 | [0.50] | Community Ecology |
| ZOO*3210 | [0.50] | Comparative Animal Physiology II |

1.00 electives *, **

**Semester 7 *****

| | | |
|---|---|---|
| BIOL*4110 | [0.75] | Ecological Methods |
| BIOL*4150 | [0.50] | Wildlife Conservation and Management |
| ZOO*4070 | [0.50] | Animal Behaviour |
| ZOO*4910 | [0.50] | Integrative Vertebrate Biology |

0.25 electives *

**Semester 8**

2.50 electives *

CIS*1200 is recommended for those needing to improve their computer skills

* suggested electives list available from faculty advisors

** BIOL*2250 is strongly recommended if independent research project courses are anticipated in semester 7 and/or 8

*** a minimum of 0.75 credits from these courses may be taken as an alternative to BIOL*4110 in semester 7:

| | | |
|---|---|---|
| BIOL*4410 | [0.75] | Field Ecology |
| BIOL*4610 | [0.75] | Arctic Ecology |
| BIOL*4700 | [0.50] | Field Biology |
| BIOL*4710 | [0.25] | Field Biology |
| BIOL*4800 | [0.50] | Field Biology |
| BIOL*4810 | [0.25] | Field Biology |
| IBIO*4500 | [0.75] | Research in Integrative Biology I |
| IBIO*4510 | [0.75] | Research in Integrative Biology II |
| IBIO*4521/2 | [2.00] | Thesis in Integrative Biology |
| ZOO*4300 | [0.75] | Marine Biology and Oceanography |

Other field or research courses with approval of faculty advisor.

**Electives must include:**

1. A minimum of 0.50 credits from:

| | | |
|---|---|---|
| ZOO*4920 | [0.25] | Lab Studies in Ornithology |
| ZOO*4930 | [0.25] | Lab Studies in Ichthyology |
| ZOO*4940 | [0.25] | Lab Studies in Herpetology |
| ZOO*4950 | [0.25] | Lab Studies in Mammalogy |

2. At least 1.00 Arts and/or Social Science electives.

## Zoology (ZOO)

**Department of Integrative Biology, College of Biological Science**

The Major in Zoology offers a broad education in the life sciences while providing a more specialized understanding of the structure, function and ecology of animals. This major qualifies students for post-graduate work in zoology and other life sciences and provides a sound science background for students wishing to pursue careers in teaching, government service or the private sector.

### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major must consult the Faculty Advisor. A minimum total of 20.00 credits is required to complete the major. At least 6.00 science credits must be at the 3000 or 4000 level, 2.00 of which must be at the 4000 level.

8.50 credits are electives, including at least 1.00 Arts or Social Science electives and 0.75 credit from restricted electives. BIOL*2250 is strongly recommended if independent research project courses are anticipated in semesters 7 and/or 8 CIS*1 200 is recommended for those needing to improve their computer skills.

**Semester 1**

| | | |
|---|---|---|
| BIOL*1070 | [0.50] | Discovering Biodiversity |
| CHEM*1040 | [0.50] | General Chemistry I |
| MATH*1080 | [0.50] | Elements of Calculus I |
| PHYS*1070 | [0.50] | Introductory Physics for Life Sciences |

0.50 Arts or Social Science electives *

Students who are lacking one 4U /grade 12 course in Biology, Chemistry or Physics must take the equivalent introductory course in first semester. The required first-year science courses in that subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2**

| | | |
|---|---|---|
| BIOL*1080 | [0.50] | Biological Concepts of Health |
| BIOL*1090 | [0.50] | Introduction to Molecular and Cellular Biology |
| CHEM*1050 | [0.50] | General Chemistry II |
| PHYS*1080 | [0.50] | Physics for Life Sciences |

0.50 Arts or Social Science electives

**Semester 3**

| | | |
|---|---|---|
| STAT*2040 | [0.50] | Statistics I |
| ZOO*2090 | [0.50] | Vertebrate Structure and Function |
| ZOO*2100 | [0.50] | Developmental Biology |

1.00 electives or restricted electives

**Semester 4**

| | | |
|---|---|---|
| BIOC*2580 | [0.50] | Introduction to Biochemistry |
| MBG*2040 | [0.50] | Foundations in Molecular Biology and Genetics |
| ZOO*2700 | [0.50] | Invertebrate Morphology & Evolution |

1.00 electives or restricted electives

**Semester 5**

| | | |
|---|---|---|
| BIOL*3110 | [0.50] | Population Ecology |
| BIOL*3400 | [0.50] | Evolution |
| ZOO*3200 | [0.50] | Comparative Animal Physiology I |
| ZOO*3700 | [0.50] | Integrative Biology of Invertebrates |

0.50 electives or restricted electives

**Semester 6**

| | | |
|---|---|---|
| BIOL*3120 | [0.50] | Community Ecology |
| ZOO*3000 | [0.50] | Comparative Histology |
| ZOO*3210 | [0.50] | Comparative Animal Physiology II |

1.00 electives or restricted electives

**Semester 7**

| | | |
|---|---|---|
| ZOO*4070 | [0.50] | Animal Behaviour |
| ZOO*4910 | [0.50] | Integrative Vertebrate Biology |

1.50 electives or restricted electives

**Semester 8**

2.50 electives or restricted electives

**Restricted Electives must include:**

1. A minimum of 0.25 credits from:

| | | |
|---|---|---|
| ZOO*4920 | [0.25] | Lab Studies in Ornithology |
| ZOO*4930 | [0.25] | Lab Studies in Ichthyology |

| | | |
|---|---|---|
| ZOO*4940 | [0.25] | Lab Studies in Herpetology |
| ZOO*4950 | [0.25] | Lab Studies in Mammalogy |

2. A minimum of 0.50 credits from:

| | | |
|---|---|---|
| BIOL*4410 | [0.75] | Field Ecology |
| BIOL*4610 | [0.75] | Arctic Ecology |
| BIOL*4700 | [0.50] | Field Biology |
| BIOL*4710 | [0.25] | Field Biology |
| BIOL*4800 | [0.50] | Field Biology |
| BIOL*4810 | [0.25] | Field Biology |
| IBIO*4500 | [0.75] | Research in Integrative Biology I |
| IBIO*4510 | [0.75] | Research in Integrative Biology II |
| IBIO*4521/2 | [2.00] | Thesis in Integrative Biology |
| ZOO*4170 | [0.50] | Experimental Comparative Animal Physiology |
| ZOO*4300 | [0.75] | Marine Biology and Oceanography |

Other field or research courses with approval of faculty advisor.

## Minor (Honours Program)

Students in programs other than Zoology, Wildlife Biology, Marine and Freshwater Biology and Ecology who have a strong interest in Zoology may choose to take a minor in Zoology.

A minor in Zoology requires a minimum of 5.00 credits, 4.00 of which must be from the following list:

| | | |
|---|---|---|
| BIOL*3110 | [0.50] | Population Ecology |
| BIOL*3120 | [0.50] | Community Ecology |
| BIOL*3400 | [0.50] | Evolution |
| ZOO*2090 | [0.50] | Vertebrate Structure and Function |
| ZOO*2100 | [0.50] | Developmental Biology |
| ZOO*2700 | [0.50] | Invertebrate Morphology & Evolution |
| ZOO*3000 | [0.50] | Comparative Histology |
| ZOO*3200 | [0.50] | Comparative Animal Physiology I |
| ZOO*3210 | [0.50] | Comparative Animal Physiology II |
| ZOO*3700 | [0.50] | Integrative Biology of Invertebrates |
| ZOO*4070 | [0.50] | Animal Behaviour |
| ZOO*4330 | [0.50] | Biology of Fishes |
| ZOO*4910 | [0.50] | Integrative Vertebrate Biology |
| ZOO*4920 | [0.25] | Lab Studies in Ornithology |
| ZOO*4930 | [0.25] | Lab Studies in Ichthyology |
| ZOO*4940 | [0.25] | Lab Studies in Herpetology |
| ZOO*4950 | [0.25] | Lab Studies in Mammalogy |

The remaining 1.00 credits may also come from this list or from outside this list, in consultation with a faculty advisor.