2017-2018 Undergraduate Calendar

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2017-2018 academic year, including the Summer Semester 2017, the Fall Semester 2017 and the Winter Semester 2018.

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:
- The Association of Universities Canada

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Revision Information:

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tbody>
<tr>
<td>February 1, 2017</td>
<td>Initial Publication</td>
</tr>
<tr>
<td>March 29, 2017</td>
<td>Second Publication</td>
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<tr>
<td>May 31, 2017</td>
<td>Third Publication</td>
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<tr>
<td>June 9, 2017</td>
<td>Fourth Publication</td>
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<tr>
<td>August 17, 2017</td>
<td>Fifth Publication</td>
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The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2017-2018 academic year, including the Summer Semester 2017, the Fall Semester 2017 and the Winter Semester 2018.

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.

The University will not be liable for any interruption in, or cancellation of, any academic activities as set forth in this calendar and related information where such interruption is caused by fire, strike, lock-out, inability to procure materials or trades, restrictive laws or governmental regulations, actions taken by faculty, staff or students of the University or by others, civil unrest or disobedience, public health emergencies, or any other cause of any kind beyond the reasonable control of the University.

In the event of a discrepancy between a print version (downloaded) and the Web version, the Web version will apply.

Published by: Enrolment 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 Advanced Education and Skills Development, 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.

Disclosure of Personal Information to the Ontario Ministry of Advanced Education and Skills Development

The University of Guelph is required to disclose personal information such as characteristics and educational outcomes to the Minister of Training, Colleges and Universities under s. 15 of the Ministry of Advanced Education and Skills Development Act, R.S.O. 1990, Chapter M.19, as amended. The Ministry collects this data for purposes including but not limited to planning, allocating and administering public funding to colleges, universities and other post-secondary educational and training institutions.

Amendments made to the Ministry of Advanced Education and Skills Development Act, authorizing the collection and use of personal information from colleges and universities by the Minister of Training Colleges and Universities, which were set out in Schedule 5 of the Childcare Modernization Act, 2014, came into force on March 31, 2015. The amendments strengthen the ability of the Minister to directly or indirectly collect and use personal information about students as required to conduct research and analysis, including longitudinal studies, and statistical activities conducted by or on behalf of the Ministry for purposes that relate to post-secondary education and training, including,

i. understanding the transition of students from secondary school to post-secondary education and training,
ii. understanding student participation and progress, mobility and learning and employment outcomes,
iii. understanding linkages among universities, colleges, secondary schools and other educational and training institutions prescribed by regulation,
iv. understanding trends in post-secondary education or training program choices made by students,
v. understanding sources and patterns of student financial resources, including financial assistance and supports provided by government and post-secondary educational and training institutions,
vi. planning to enhance the affordability and accessibility of post-secondary education and training and the quality and effectiveness of the post-secondary sector,
vii. identifying conditions or barriers that inhibit student participation, progress, completion and transition to employment or future post-secondary educational or training opportunities, and
viii. developing key performance indicators.

Information that the University is required to provide includes but is not limited to: first, middle and last name, Ontario Educational Number, citizenship, date of birth, gender, first three digits of a student’s postal code, mother tongue, degree program and major(s) in which the student is enrolled, year of study and whether the student has transferred from another institution.

Further information on the collection and use of student-level enrolment-related data can be obtained from the Ministry of Training Colleges and Universities website: https://www.ontario.ca/page/ministry-advanced-education-and-skills-development (English) or https://www.ontario.ca/fr/page/ministere-de-lenseignement-superieur-et-de-la-formation-professionnelle (French) or by writing to the Director, Postsecondary Finance and Information Management Branch, Postsecondary Education Division, 7th Floor, Mowat Block, 900 Bay Street, Toronto, ON M7A 1L2.


Frequently Asked Questions related to the Ministry's enrolment and OEN data activities are also posted at: http://www.tcu.gov.on.ca/pepg/publications/NoticeOfCollection.pdf

Authority to Disclose Personal Information to Statistics Canada

The Ministry of Advanced Education and Skills Development discloses student-level enrolment-related data it collects from the colleges and universities as required by Statistics Canada in accordance with Section 13 of the Federal Statistics Act. This gives Ministry of Advanced Education and Skills Development Act authority to disclose personal information in accordance with s. 42(1) (e) of FIPPA

Notification of Disclosure of Personal Information to Statistics Canada

For further information, please see the 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 Enrolment 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.


viii.


Learning Outcomes

On December 5, 2012, the University of Guelph Senate approved five University-wide Learning Outcomes as the basis from which to guide the development of undergraduate degree programs, specializations and courses:

1. Critical and Creative Thinking
2. Literacy
3. Global Understanding
4. Communicating
5. Professional and Ethical Behaviour

These learning outcomes are also intended to serve as a framework through which our educational expectations are clear to students and the broader public; and to inform the process of outcomes assessment through the quality assurance process (regular reviews) of programs and departments.

An on-line guide to the learning outcomes, links to the associated skills, and detailed rubrics designed to support the development and assessment of additional program and discipline-specific outcomes, are available for reference on the Learning Outcomes website.

1. Critical and Creative Thinking

Critical and creative thinking is a concept in which one applies logical principles, after much inquiry and analysis, to solve problems in with a high degree of innovation, divergent thinking and risk taking. Those mastering this outcome show evidence of integrating knowledge and applying this knowledge across disciplinary boundaries. Depth and breadth of understanding of disciplines is essential to this outcome.

In addition, Critical and Creative Thinking includes, but is not limited to, the following outcomes: Inquiry and Analysis; Problem Solving; Creativity; and Depth and Breadth of Understanding.

2. Literacy

Literacy is the ability to extract information from a variety of resources, assess the quality and validity of the material, and use it to discover new knowledge. The comfort in using quantitative literacy also exists in this definition, as does using technology effectively and developing visual literacy.

In addition, Literacy includes, but is not limited to, the following outcomes: Information Literacy, Quantitative Literacy, Technological Literacy, and Visual Literacy.

3. Global Understanding:

Global understanding encompasses the knowledge of cultural similarities and differences, the context (historical, geographical, political and environmental) from which these arise, and how they are manifest in modern society. Global understanding is exercised as civic engagement, intercultural competence and the ability to understand an academic discipline outside of the domestic context.

In addition, Global Understanding includes, but is not limited to, the following outcomes: Global Understanding, Sense of Historical Development, Civic Knowledge and Engagement, and Intercultural Competence.

4. Communicating

Communicating is the ability to interact effectively with a variety of individuals and groups, and convey information successfully in a variety of formats including oral and written communication. Communicating also comprises attentiveness and listening, as well as reading comprehension. It includes the ability to communicate and synthesize information, arguments, and analyses accurately and reliably.

In addition, Communicating includes, but is not limited to, the following outcomes: Oral Communication, Written Communication, Reading Comprehension, and Integrative Communication.

5. Professional and Ethical Behaviour

Professional and ethical behaviour requires the ability to accomplish the tasks at hand with proficient skills in teamwork and leadership, while remembering ethical reasoning behind all decisions. The ability for organizational and time management skills is essential in bringing together all aspects of managing self and others. Academic integrity is central to mastery in this outcome.

In addition, Professional and Ethical Behaviour includes, but is not limited to, the following outcomes: Teamwork, Ethical Reasoning, Leadership, and Personal Organization and Time Management.
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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 thehonours 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 major 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 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 each 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 from 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

Majors 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 Engineering and Physical Sciences 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

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. 1st Year 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 2.50 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 at 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 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**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1090</td>
<td>Introduction to Molecular and Cellular Biology *</td>
<td>0.50</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>General Chemistry I</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*1080</td>
<td>Elements of Calculus I</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*1080</td>
<td>Physics for Life Sciences</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>0.50 Arts or Social Science electives</td>
<td></td>
</tr>
</tbody>
</table>

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at [http://www.bsc.uoguelph.ca/revisedss](http://www.bsc.uoguelph.ca/revisedss).

**Semester 2**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL*1070</td>
<td>Discovering Biodiversity *</td>
<td>0.50</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>General Chemistry II</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*1070</td>
<td>Physics for Life Sciences II</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>One of:</td>
<td></td>
</tr>
<tr>
<td>CIS*1000</td>
<td>Introduction to Computer Applications</td>
<td>0.50</td>
</tr>
<tr>
<td>CIS*1200</td>
<td>Introduction to Computing</td>
<td>0.50</td>
</tr>
<tr>
<td>CIS*1500</td>
<td>Introduction to Programming</td>
<td>0.50</td>
</tr>
<tr>
<td>STAT*2040</td>
<td>Statistics I</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*2080</td>
<td>Elements of Calculus II</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>0.50 Arts or Social Science electives</td>
<td></td>
</tr>
</tbody>
</table>

* 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**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM*1040</td>
<td>General Chemistry I</td>
<td>0.50</td>
</tr>
<tr>
<td>IPS*1500</td>
<td>Integrated Mathematics and Physics I</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>One of:</td>
<td></td>
</tr>
<tr>
<td>BIOL*1070</td>
<td>Discovering Biodiversity</td>
<td>0.50</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>Biological Concepts of Health</td>
<td>0.50</td>
</tr>
<tr>
<td>BIOL*1090</td>
<td>Introduction to Molecular and Cellular Biology</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>0.50 Arts or Social Science electives</td>
<td></td>
</tr>
</tbody>
</table>

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at [http://www.bsc.uoguelph.ca/revisedss](http://www.bsc.uoguelph.ca/revisedss).

**Semester 2**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM*1050</td>
<td>General Chemistry II</td>
<td>0.50</td>
</tr>
<tr>
<td>IPS*1510</td>
<td>Integrated Mathematics and Physics II</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>One of:</td>
<td></td>
</tr>
<tr>
<td>BIOL*1070</td>
<td>Discovering Biodiversity</td>
<td>0.50</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>Biological Concepts of Health</td>
<td>0.50</td>
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<td>0.50</td>
</tr>
<tr>
<td></td>
<td>0.50 Arts or Social Science electives</td>
<td></td>
</tr>
</tbody>
</table>

**Honours Programs (BSCH)**

**Honours Program Majors**

The following honours majors are available:

**Biological Sciences:**
- 20.00 credits - Animal Biology (ABIO)
- 20.00 credits - Biochemistry (BIOC)
- 20.00 credits - Biotechnology (BIOT)
- 20.00 credits - Microbiology (MICR)
- 20.00 credits - Molecular Biology and Genetics (MBG)
- 20.00 credits - Neuroscience (NEUR)
- 0.50 Arts or Social Science electives

**Physical Sciences:**
- 20.00 credits - Biological and Pharmaceutical Chemistry (BPCH)
- 20.00 credits - Chemical Physics (CHPY)
- 20.00 credits - Chemistry (CHEM)
- 20.00 credits - Environmental Geoscience and Geomatics (EGG)
- 20.00 credits - Mathematical Science (MSCI)
- 20.00 credits - Nanoscience (NANO)
- 20.00 credits - Physical Science (PSCI)
- 20.00 credits - Physics (PHYS)
- 20.00 credits - Theoretical Physics (THPY)

**Co-operative Educational Programs:**
- 20.00 credits - Biochemistry (Co-op) (BIOC:C)
- 20.00 credits - Biological and Medical Physics (Co-op) (BMPH:C)
- 20.00 credits - Biological and Pharmaceutical Chemistry (Co-op) (BPCH:C)
- 20.00 credits - Biomedical Toxicology (Co-op) (BTOX:C)
- 20.00 credits - Chemical Physics (Co-op) (CHPY:C)
- 20.00 credits - Chemistry (Co-op) (CHEM:C)
- 20.00 credits - Food Science (Co-op) (FOOD:C)
- 20.00 credits - Nanoscience (NANO:C)
- 20.00 credits - Microbiology (Co-op) (MICR:C)
- 20.00 credits - Physics (Co-op) (PHYS: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 - 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 - Geographic Information Systems (GIS) and Environmental Analysis

**Mathematical Sciences:**
- 5.00 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 Economics (BECN)

**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 1. Application forms can be obtained from the Co-op Education and Career Services website [https://www.recruitguelph.ca/cecs/](https://www.recruitguelph.ca/cecs/).
### 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 Biosciences, 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 may wish to consult the Faculty Advisor.

#### Semester 1

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1050</td>
<td>0.50</td>
<td>Biology of Plants &amp; Animals in Managed Ecosystems</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>0.50</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>MATH*1080</td>
<td>0.50</td>
<td>Elements of Calculus I</td>
</tr>
<tr>
<td>PHYS*1080</td>
<td>0.50</td>
<td>Physics for Life Sciences</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science electives

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: [http://www.bsc.uoguelph.ca/rewiseds](http://www.bsc.uoguelph.ca/rewiseds)

#### Semester 2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*1210</td>
<td>1.00</td>
<td>Principles of Animal Care and Welfare</td>
</tr>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>0.50</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>PHYS*1070</td>
<td>0.50</td>
<td>Physics for Life Sciences II</td>
</tr>
</tbody>
</table>

0.50 electives or restricted electives

### Semester 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGR*2350</td>
<td>0.50</td>
<td>Animal Production Systems, Health and Industry</td>
</tr>
<tr>
<td>BIOL*2580</td>
<td>0.50</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>MBG*2040</td>
<td>0.50</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>MBG*2400</td>
<td>0.50</td>
<td>Fundamentals of Plant and Animal Genetics</td>
</tr>
</tbody>
</table>

0.50 electives or restricted electives

### Semester 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*3080</td>
<td>0.50</td>
<td>Agricultural Animal Physiology</td>
</tr>
<tr>
<td>ANSC*3120</td>
<td>0.50</td>
<td>Introduction to Animal Nutrition</td>
</tr>
</tbody>
</table>

1.50 electives or restricted electives

### Semester 5

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*3080</td>
<td>0.50</td>
<td>Agricultural Animal Physiology</td>
</tr>
<tr>
<td>MBG*3060</td>
<td>0.50</td>
<td>Quantitative Genetics</td>
</tr>
</tbody>
</table>

1.00 electives or restricted electives

### Semester 6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*3040</td>
<td>0.50</td>
<td>Animal Reproduction</td>
</tr>
<tr>
<td>ANSC*3270</td>
<td>0.50</td>
<td>Animal Disorders</td>
</tr>
<tr>
<td>MBG*3060</td>
<td>0.50</td>
<td>Quantitative Genetics</td>
</tr>
</tbody>
</table>

1.00 electives or restricted electives

### Semester 7

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*4050</td>
<td>0.50</td>
<td>Biotechnology in Animal Science</td>
</tr>
<tr>
<td>MBG*4020</td>
<td>0.50</td>
<td>Genetics of Companion Animals</td>
</tr>
<tr>
<td>MBG*4030</td>
<td>0.50</td>
<td>Animal Breeding Methods and Applications</td>
</tr>
</tbody>
</table>

Animal Breeding & Genetics [0.50] Required

### Animal Nutrition [0.50] Required

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*4100</td>
<td>0.50</td>
<td>Applied Environmental Physiology and Animal Housing</td>
</tr>
<tr>
<td>ANSC*4350</td>
<td>0.50</td>
<td>Experiments in Animal Biology</td>
</tr>
<tr>
<td>ANSC*4470</td>
<td>0.50</td>
<td>Animal Metabolism</td>
</tr>
<tr>
<td>ANSC*4490</td>
<td>0.50</td>
<td>Applied Endocrinology</td>
</tr>
</tbody>
</table>

3. Additional 3.00 credits may be obtained by selecting courses from the above lists and from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*3050</td>
<td>0.50</td>
<td>Aquaculture: Advanced Issues</td>
</tr>
<tr>
<td>ANSC*4610</td>
<td>0.50</td>
<td>Critical Analysis in Animal Science</td>
</tr>
<tr>
<td>ANSC*4650</td>
<td>0.50</td>
<td>Comparative Immunology</td>
</tr>
<tr>
<td>ANSC*4700</td>
<td>0.50</td>
<td>Research in Animal Biology I</td>
</tr>
<tr>
<td>ANSC*4710</td>
<td>0.50</td>
<td>Research in Animal Biology II</td>
</tr>
<tr>
<td>BIOL*3560</td>
<td>0.50</td>
<td>Structure and Function in Biochemistry</td>
</tr>
<tr>
<td>EQN*3050</td>
<td>0.50</td>
<td>Equine Exercise Physiology</td>
</tr>
<tr>
<td>MICR*3230</td>
<td>0.50</td>
<td>Immunology</td>
</tr>
<tr>
<td>PATH*3610</td>
<td>0.50</td>
<td>Principles of Disease</td>
</tr>
<tr>
<td>POPM*3240</td>
<td>0.50</td>
<td>Epidemiology</td>
</tr>
<tr>
<td>POPM*4230</td>
<td>0.50</td>
<td>Animal Health</td>
</tr>
</tbody>
</table>

### Credit Summary (20.00 Total Credits)

- 3.50 - First year science credits
- 6.50 - Required science courses semesters 3 - 8
- 4.50 - Restricted electives (#2 and #3)
- 1.50 - Approved Science electives
- 1.00 - Required Arts and/or Social Science course (ANSC 1210)
- 1.00 - Approved Arts and/or Social Science electives
- 2.00 - Free electives - any approved elective for B.Sc. students.

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 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 may wish to consult the Faculty Advisor. The major will require the completion of at least 20.00 credits as indicated below:

#### Major (Honours Program)

##### Semester 1

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>0.50</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>MATH*1080</td>
<td>0.50</td>
<td>Elements of Calculus I</td>
</tr>
<tr>
<td>PHYS*1080</td>
<td>0.50</td>
<td>Physics for Life Sciences</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science electives

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at [http://www.bsc.uoguelph.ca/rewiseds](http://www.bsc.uoguelph.ca/rewiseds)

##### Semester 2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1070</td>
<td>0.50</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>0.50</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>MATH*2080</td>
<td>0.50</td>
<td>Elements of Calculus II</td>
</tr>
<tr>
<td>PHYS*1070</td>
<td>0.50</td>
<td>Physics for Life Sciences II</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science electives

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at [http://www.bsc.uoguelph.ca/rewiseds](http://www.bsc.uoguelph.ca/rewiseds)

##### Semester 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*2580</td>
<td>0.50</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>MBG*2040</td>
<td>0.50</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>MICR*2420</td>
<td>0.50</td>
<td>Introduction to Microbiology</td>
</tr>
<tr>
<td>STAT*2040</td>
<td>0.50</td>
<td>Statistics I</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science electives

##### Semester 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*2580</td>
<td>0.50</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>MBG*2040</td>
<td>0.50</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>MICR*2420</td>
<td>0.50</td>
<td>Introduction to Microbiology</td>
</tr>
<tr>
<td>STAT*2040</td>
<td>0.50</td>
<td>Statistics I</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science electives

##### Semester 5

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credit</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*3570</td>
<td>0.75</td>
<td>Analytical Biochemistry</td>
</tr>
<tr>
<td>CHEM*2880</td>
<td>0.50</td>
<td>Physical Chemistry</td>
</tr>
<tr>
<td>CHEM*3750</td>
<td>0.50</td>
<td>Organic Chemistry II</td>
</tr>
</tbody>
</table>

 electives or restricted electives to a maximum of 2.75 total credits

Last Revision: August 17, 2017
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 20.00 credits as indicated below.

### Stream A

#### Semester 1 - Fall
- BIO*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*1080 [0.50] Physics for Life Sciences

0.50 Arts or Social Science electives

#### Semester 2 - Winter
- BIO*1070 [0.50] Discovering Biodiversity
- BIO*1080 [0.50] Biological Concepts of Health
- CHEM*1050 [0.50] General Chemistry II
- COOP*1100 [0.00] Introduction to Co-operative Education
- MATH*2080 [0.50] Elements of Calculus II
- PHYS*1070 [0.50] Physics for Life Sciences II

#### Summer Semester
No academic semester or work term

#### Semester 3 - Fall
- BIO*2580 [0.50] Introduction to Biochemistry
- CHEM*2480 [0.50] Analytical Chemistry I
- 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 - Summer
- COOP*1000 [0.00] Co-op Work Term I

#### Semester 5 - Fall
- BIO*3560 [0.50] Structure and Function in Biochemistry
- CHEM*3750 [0.50] Organic Chemistry I
- MICR*2420 [0.50] Introduction to Microbiology
- STAT*2040 [0.50] Statistics I

Electives or restricted electives to a maximum of 2.75 total credits

#### Semester 6 - Fall
- MBG*3350 [0.75] Laboratory Methods in Molecular Biology I

Electives or restricted electives to a maximum of 2.75 total credits

#### Semester 7 - Winter
- BIO*4540 [0.75] Enzymology

Electives or restricted electives to a maximum of 2.75 total credits

#### Semester 8 - Fall
- 2.50 electives or restricted electives
Students must take as part of their program: 4.00 credits from the following list, with at least 1.00 of these credits from BIOC*4520, BIOC*4580, MCB*4050.

- Biomedical Physiology
- Biophysics of Excitable Cells
- Research Project in Molecular & Cellular Biology
- Organic Chemistry I
- World of Viruses
- Structure and Function in Biochemistry
- Molecular Biology of the Gene
- Protein and Nucleic Acid Structure
- Elements of Calculus I
- Laboratory Methods in Molecular Biology I
- Methods in Microbial Culture and Physiology
- Thermal Physics
- Analytical Chemistry I
- Topics in Molecular and Cellular Biology
- Advanced Cell Biology
- Dynamics of Cell Function and Signaling
- Immunology II
- Electricity and Magnetism I
- Biochemical Toxicology
- Molecular Biology of the Cell
- Molecular Biology of the Gene
- Crop Physiology
- Enzymology
- Discovering Biodiversity
- Research Project in Molecular & Cellular Biology
- Metabolic Processes
- Physics for Life Sciences
- Immunology
- Molecular Virology
- General Chemistry II
- Bacterial Genetics
- Energy
- Thermal Physics
- Molecular Virology
- Co-op Work Term IV
- Genetics of Plants
- Co-op Work Term II
- Statistics II
- Electromagnetism I
- Biochemical Toxicology
- General Astronomy
- Research Project in Molecular & Cellular Biology
- Genetic Engineering of Plants
- Co-op Work Term I
- Introduction to Biochemistry
- Analytical Chemistry I
- General Chemistry II
- Elements of Calculus I
- Electricity and Magnetism I
- Biochemistry
- Genetics of Plants
- Co-op Work Term III
- Genetics of Plants
- Electromagnetism I
- Biochemical Toxicology
- General Astronomy
- Research Project in Molecular & Cellular Biology
- Genetic Engineering of Plants
- Co-op Work Term IV
- Chemicals & Materials
- Chemistry
- General Chemistry I
- Mathematics
- Mathematics
- Statistics I
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Biol*1090 [0.50] Introduction to Molecular and Cellular Biology
Chem*1050 [0.50] General Chemistry II
Phys*1070 [0.50] Physics for Life Sciences II

0.50 electives or restricted electives*

Semester 3
Biol*2580 [0.50] Introduction to Biochemistry
Mbg*2040 [0.50] Foundations in Molecular Biology and Genetics
Zoo*2090 [0.50] Vertebrate Structure and Function

1.00 electives or restricted electives*

Semester 4
Biol*2060 [0.50] Ecology
Biol*2400 [0.50] Evolution
Stat*2230 [0.50] Biostatistics for Integrative Biology
Zoo*2700 [0.50] Vertebrate Morphology & Evolution

0.50 electives or restricted electives*

Semester 5
Mirc*2420 [0.50] Introduction to Microbiology

2.00 electives or restricted electives*

* Restricted Electives

The major in Biodiversity is a flexible program that allows students, in consultation with faculty advisors, to pursue their own interests and design a customized program of study. For example, students may wish to select their electives to focus on a particular taxonomic group such as microbes, plants, invertebrates, or vertebrates, and/or one of the three areas of research strength in the Department of Integrative Biology: physiology, ecology, or evolution.

1. At least 1.00 Arts and Social Science electives are required. The list of approved Arts and Social Science electives for B.Sc. students is available at: http://www.bsc.uoguelph.ca/Approved_electives.shtml#arts

2. A minimum of 0.50 credits from:
   - Bot*2100 [0.50] Life Strategies of Plants
   - Bot*3050 [0.50] Plant Functional Ecology
   - Zoo*3600 [0.50] Comparative Animal Physiology I

3. A minimum of 0.50 credits from:
   - Bot*3310 [0.50] Plant Growth and Development
   - Bot*3410 [0.50] Plant Anatomy
   - Zoo*3050 [0.50] Developmental Biology

4. A minimum of 0.50 credits from the following list. Biodiversity students are strongly encouraged to take at least one field course. Students should keep in mind that some of these courses have prerequisites that are not required courses for the BIOD major and should plan their programs accordingly.
   - 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
   - Bio*4500 [0.75] Research in Integrative Biology I
   - Bio*4510 [0.75] Research in Integrative Biology II
   - Bio*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.

Credit Summary (20.00 Total Credits)

4.00 - First year science credits
6.50 - Required science courses semesters 3 - 8
1.50 - Restricted elective (# 2, 3 and 4 in restricted elective list)
4.00 - Approved Science electives
1.00 - Arts and Social Science electives (# 1 in restricted elective list)
3.00 - Free electives - any approved elective for B.Sc. students.

*Of the total credits required, students are required to complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

Biological and Medical Physics (BMPH)
Department of Physics, College of Engineering and Physical Sciences

Major (Honours Program)

The program emphasizes the application of physics to biology and medicine. It provides an excellent background for careers in the expanding interdisciplinary research laboratories of government and industry, as well as a starting point for a career in medical physics. Completion of the program at an appropriate level will qualify a student to pursue post-graduate studies in biophysics, medical physics and related areas of physics.

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

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major may wish to consult the Faculty Advisor. This major requires the completion of 20.00 credits as follows:

Semester 1
Biol*1090 [0.50] Introduction to Molecular and Cellular Biology
Chem*1040 [0.50] General Chemistry I
Math*1160 [0.50] Linear Algebra I

1.00 credits from: Math*1080, Phys*1080 or (Math*1200, Phys*1080)
* IPS*1500 is recommended

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: http://www.bsc.uoguelph.ca/revissedss

Semester 2
Biol*1080 [0.50] Biological Concepts of Health
Chem*1050 [0.50] General Chemistry II
Cis*1500 [0.50] Introduction to Programming

1.00 credits from: IPS*1510, or (Math*2080, Phys*1070) or (Math*1210, Phys*1010)
* IPS*1510 is recommended

Semester 3
Math*2200 [0.50] Advanced Calculus I
Math*2270 [0.50] Applied Differential Equations
Phys*2240 [0.50] Thermal Physics
Phys*2330 [0.50] Electricity and Magnetism I

0.50 Arts or Social Science electives

Semester 4
Biol*2580 [0.50] Introduction to Biochemistry
Phys*2030 [0.50] Biophysics of Excitable Cells
Phys*2180 [0.50] Experimental Techniques in Physics
Phys*2310 [0.50] Mechanics
Phys*2340 [0.50] Electricity and Magnetism II

Semester 5
Nano*3060 [0.50] Computational Methods in Materials Science
Phys*3130 [0.50] Mathematical Physics
Phys*3230 [0.50] Quantum Mechanics I

1.00 electives **

Semester 6
Phys*3510 [0.50] Intermediate Laboratory
Phys*4040 [0.50] Quantum Mechanics II
Phys*4300 [0.50] Inquiries in Physics
Phys*4540 [0.50] Molecular Biophysics

0.50 electives **

Semester 7
Phys*3170 [0.50] Radioactivity and Radiation Interactions
Phys*4540 [0.50] Advanced Physics Laboratory

One of:
Phys*4001 [0.50] Research in Physics

0.50 electives

1.00 electives **

Semester 8
Phys*4070 [0.50] Clinical Applications of Physics in Medicine

One of:
Phys*4002 [0.50] Research in Physics

0.50 electives **

1.50 electives **

Note: Phys*4001/2 will be projects in biological or medical physics, some of which may be in areas outside the Department of Physics.
** A minimum of 1.00 credits in Arts/Social Science is required. In addition, students are required to complete 1.50 credits from either List A or List B as follows:

List A: Biological Physics stream
Biol*3560 [0.50] Structure and Function in Biochemistry
List B: Medical Physics stream

- BIOM*2000 [0.50] Concepts in Human Physiology
- ENGG*1040 [0.50] Medical Imaging Modalities
- MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
- PHYS*3000 [0.50] Optics: Fundamentals and Applications
- PHYS*4130 [0.50] Subatomic Physics

Credit Summary (20.00 Total Credits)

5.00 - First year science credits
9.50 - Required science courses semesters 3 – 8
1.50 - Restricted electives (from List A OR List B)
1.00 - Arts and/or Social Science electives
3.00 - Free electives - any approved elective for B.Sc. students.

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

Biological and Medical Physics (Co-op) (BMPH:C)

Department of Physics, College of Engineering and Physical Sciences

Major (Honours Program)

The program emphasizes the application of physics to biology and medicine. It provides an excellent background for careers in the expanding interdisciplinary research laboratories of government and industry, as well as a starting point for a career in medical physics. Completion of the program at an appropriate level will qualify a student to pursue post-graduate studies in biophysics, medical physics and related areas of physics.

Since some of the required courses are not offered every semester, students entering the Major in Biological and Medical 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 is normally required. Students are eligible to participate in a maximum two (2) work terms commencing in the summer and must follow the academic work schedule as outlined in the Co-operative Education & Career Services website: https://www.recruitguelph.ca/cecs.

This major requires the completion of 20.00 credits as follows:

**Semester 1 - Fall**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*1160</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2.00</td>
</tr>
</tbody>
</table>

1.50 credits from: IPS*1500, or (MATH*1080, PHYS*1080) or (MATH*1200, PHYS*1080)

* IPS*1500 is recommended

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: http://www.bsc.uoguelph.ca/revisedss

**Semester 2 - Winter**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>0.50</td>
</tr>
<tr>
<td>CTS*1500</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2.00</td>
</tr>
</tbody>
</table>

1.00 credits from: IPS*1510, or (MATH*2080, PHYS*1070) or (MATH*1210, PHYS*1010)

* IPS*1510 is recommended

**Semester 3 - Fall**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOP*1100</td>
<td>0.00</td>
</tr>
<tr>
<td>MATH*2200</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*2270</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*2240</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2.00</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science electives

**Semester 4 - Winter**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC*2580</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*2030</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*2180</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*2310</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2.00</td>
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</tbody>
</table>

**Summer Semester**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOP*1000</td>
<td>0.00</td>
</tr>
<tr>
<td>NANO*3600</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.50</td>
</tr>
</tbody>
</table>

**Semester 5 - Fall**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>COOP*3000</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0.50</td>
</tr>
</tbody>
</table>

**Semester 6 - Fall**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>PHYS*3170</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*3230</td>
<td>0.50</td>
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<tr>
<td><strong>Total</strong></td>
<td>1.00</td>
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</table>

**Semester 7 - Winter**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>PHYS*3510</td>
<td>0.50</td>
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<tr>
<td>PHYS*4040</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*4300</td>
<td>0.50</td>
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<tr>
<td>PHYS*4540</td>
<td>0.50</td>
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<tr>
<td><strong>Total</strong></td>
<td>1.50</td>
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**Semester 8 - Winter**

<table>
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<tr>
<th>Course Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>PHYS*4070</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*4500</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1.50</td>
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</tbody>
</table>

Credit Summary (20.00 Total Credits)

5.00 - First year science credits
9.50 - Required science courses semesters 3 – 8
1.50 - Restricted electives (from List A OR List B)
1.00 - Arts and/or Social Science electives
3.00 - Free electives - any approved elective for B.Sc. students.

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

Biological and Pharmaceutical Chemistry (BPCH)

Department of Chemistry, College of Engineering and Physical Sciences

Major (Honours Program)

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

**Semester 1**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOC*1090</td>
<td>0.50</td>
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<tr>
<td>CHEM*1040</td>
<td>0.50</td>
</tr>
<tr>
<td>IPS*1500</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2.00</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Semester 2</th>
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<tbody>
<tr>
<td>CHEM*1050 [0.50]</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>IPS*1510 [1.00]</td>
<td>Integrated Mathematics and Physics II</td>
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<tr>
<td>One of:</td>
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<tr>
<td>BIOL*1070 [0.50]</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080 [0.50]</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
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<tr>
<th>Semester 3</th>
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<tbody>
<tr>
<td>BIOC*2580 [0.50]</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>CHEM*2060 [0.50]</td>
<td>Structure and Bonding</td>
</tr>
<tr>
<td>CHEM*2880 [0.50]</td>
<td>Physical Chemistry</td>
</tr>
<tr>
<td>One of:</td>
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</tr>
<tr>
<td>MBG*2040 [0.50]</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>STAT*2040 [0.50]</td>
<td>Statistics I</td>
</tr>
<tr>
<td>0.50 electives or restricted electives</td>
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<table>
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<tr>
<th>Semester 4</th>
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<tbody>
<tr>
<td>CHEM*2070 [0.50]</td>
<td>Structure and Spectroscopy</td>
</tr>
<tr>
<td>CHEM*2700 [0.50]</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>CHEM*2400 [0.75]</td>
<td>Analytical Chemistry I</td>
</tr>
<tr>
<td>MICR*2420 [0.50]</td>
<td>Introduction to Microbiology</td>
</tr>
<tr>
<td>One of:</td>
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</tr>
<tr>
<td>MBG*2040 [0.50]</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>STAT*2040 [0.50]</td>
<td>Statistics I</td>
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<tr>
<th>Semester 5</th>
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</tr>
</thead>
<tbody>
<tr>
<td>BIOC*3570 [0.75]</td>
<td>Analytical Biochemistry</td>
</tr>
<tr>
<td>CHEM*3750 [0.50]</td>
<td>Organic Chemistry II</td>
</tr>
<tr>
<td>One of:</td>
<td></td>
</tr>
<tr>
<td>CHEM*3640 [0.50]</td>
<td>Chemistry of the Elements I **</td>
</tr>
<tr>
<td>0.50 electives or restricted electives *</td>
<td></td>
</tr>
<tr>
<td>One of:</td>
<td></td>
</tr>
<tr>
<td>TOX*3300 [0.50]</td>
<td>Analytical Toxicology ***</td>
</tr>
<tr>
<td>0.50 electives or restricted electives *</td>
<td></td>
</tr>
<tr>
<td>Electives or restricted electives to a maximum of 2.75 total credits in this semester* **</td>
<td></td>
</tr>
<tr>
<td>** CHEM<em>3640 is a prerequisite for CHEM</em>3650</td>
<td></td>
</tr>
<tr>
<td>*** TOX<em>3300 is a substitute for CHEM</em>3430 in Semester 6</td>
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<table>
<thead>
<tr>
<th>Semester 6</th>
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</thead>
<tbody>
<tr>
<td>Select either Option A or Option B</td>
<td></td>
</tr>
<tr>
<td>Option A (at Guelph)</td>
<td></td>
</tr>
<tr>
<td>BIOC*3560 [0.50]</td>
<td>Structure and Function in Biochemistry</td>
</tr>
<tr>
<td>CHEM*3430 [0.50]</td>
<td>Analytical Chemistry II: Instrumental Analysis</td>
</tr>
<tr>
<td>CHEM*3650 [0.50]</td>
<td>Chemistry of the Elements II</td>
</tr>
<tr>
<td>CHEM*3760 [0.50]</td>
<td>Organic Chemistry III</td>
</tr>
<tr>
<td>0.50 electives or restricted electives *</td>
<td></td>
</tr>
<tr>
<td>Option B (at Seneca)</td>
<td></td>
</tr>
<tr>
<td>2.50 credits from:</td>
<td></td>
</tr>
<tr>
<td>XSEN*3030 [0.50]</td>
<td>Pharmacology and Applied Toxicology</td>
</tr>
<tr>
<td>XSEN*3040 [0.50]</td>
<td>Occupational Health and Chemistry</td>
</tr>
<tr>
<td>XSEN*3060 [0.50]</td>
<td>Pharmaceutical Analysis - Advanced</td>
</tr>
<tr>
<td>XSEN*3070 [0.50]</td>
<td>Pharmaceutical Product Formulations</td>
</tr>
<tr>
<td>XSEN*3090 [0.50]</td>
<td>Biopharmaceuticals</td>
</tr>
<tr>
<td>XSEN*3200 [0.50]</td>
<td>Pharmaceutical Organic Chemistry</td>
</tr>
<tr>
<td>XSEN*3210 [0.50]</td>
<td>Introduction to Pharmaceutical Manufacturing</td>
</tr>
<tr>
<td>Note: All XSEN courses are taught at the Seneca@York campus of Seneca College in Toronto.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 7</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>One of:</td>
<td></td>
</tr>
<tr>
<td>CHEM*4730 [0.50]</td>
<td>Synthetic Organic Chemistry</td>
</tr>
<tr>
<td>CHEM*4740 [0.50]</td>
<td>Topics in Bio-Organic Chemistry</td>
</tr>
<tr>
<td>2.00 electives or restricted electives *</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 8</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.50 electives or restricted electives *</td>
<td></td>
</tr>
<tr>
<td>* Restricted Electives</td>
<td></td>
</tr>
<tr>
<td>**Students are advised to pay particular attention to pre-requisite requirements when choosing individual courses, and seek advice as needed.</td>
<td></td>
</tr>
<tr>
<td>1. 0.50 credits from the following:</td>
<td></td>
</tr>
<tr>
<td>MCB*2050 [0.50]</td>
<td>Molecular Biology of the Cell</td>
</tr>
<tr>
<td>TOX*2000 [0.50]</td>
<td>Principles of Toxicology</td>
</tr>
<tr>
<td>2. A minimum of 1.50 credits at the 4000 level and 2.50 credits at the 3000/4000 level from the following list:</td>
<td></td>
</tr>
<tr>
<td>BIOC*3560 [0.50]</td>
<td>Structure and Function in Biochemistry</td>
</tr>
<tr>
<td>BIOC*4520 [0.50]</td>
<td>Metabolic Processes</td>
</tr>
<tr>
<td>BIOC*4540 [0.75]</td>
<td>Enzymology **</td>
</tr>
<tr>
<td>BIOC*4580 [0.50]</td>
<td>Membrane Biochemistry</td>
</tr>
<tr>
<td>BIOM*3090 [1.00]</td>
<td>Principles of Pharmacology **</td>
</tr>
<tr>
<td>BIOM*3200 [1.00]</td>
<td>Biomedical Physiology</td>
</tr>
<tr>
<td>BIOM*4090 [0.50]</td>
<td>Pharmacology **</td>
</tr>
<tr>
<td>CHEM*3360 [0.50]</td>
<td>Environmental Chemistry and Toxicology</td>
</tr>
<tr>
<td>CHEM*3440 [0.50]</td>
<td>Analytical Chemistry III: Analytical Instrumentation</td>
</tr>
<tr>
<td>CHEM*3640 [0.50]</td>
<td>Chemistry of the Elements I</td>
</tr>
<tr>
<td>CHEM*3650 [0.50]</td>
<td>Chemistry of the Elements II **</td>
</tr>
<tr>
<td>CHEM*3760 [0.50]</td>
<td>Organic Chemistry III</td>
</tr>
<tr>
<td>CHEM*4010</td>
<td>Chemistry and Industry</td>
</tr>
<tr>
<td>CHEM*4400 [0.50]</td>
<td>Advanced Topics in Analytical Chemistry</td>
</tr>
<tr>
<td>CHEM*4630 [0.50]</td>
<td>Bioinorganic Chemistry **</td>
</tr>
<tr>
<td>CHEM*4720 [0.50]</td>
<td>Organic Reactivity **</td>
</tr>
<tr>
<td>CHEM*4730 [0.50]</td>
<td>Synthetic Organic Chemistry **</td>
</tr>
<tr>
<td>CHEM*4740 [0.50]</td>
<td>Topics in Bio-Organic Chemistry</td>
</tr>
<tr>
<td>CHEM*4900 [1.00]</td>
<td>Chemistry Research Project I **</td>
</tr>
<tr>
<td>CHEM*4910 [1.00]</td>
<td>Chemistry Research Project II **</td>
</tr>
<tr>
<td>MBG*3040 [0.50]</td>
<td>Molecular Biology of the Gene **</td>
</tr>
<tr>
<td>MCB*3350 [0.75]</td>
<td>Laboratory Methods in Molecular Biology I **</td>
</tr>
<tr>
<td>MCB*4050 [0.50]</td>
<td>Protein and Nucleic Acid Structure **</td>
</tr>
<tr>
<td>MICR*3230 [0.50]</td>
<td>Immunology</td>
</tr>
<tr>
<td>NUTR*3210 [0.50]</td>
<td>Fundamentals of Nutrition</td>
</tr>
<tr>
<td>PATH*3610 [0.50]</td>
<td>Principles of Disease</td>
</tr>
<tr>
<td>TOX*4590 [0.50]</td>
<td>Biochemical Toxicology **</td>
</tr>
<tr>
<td>XSEN*3030 [0.50]</td>
<td>Pharmacology and Applied Toxicology</td>
</tr>
<tr>
<td>XSEN*3040 [0.50]</td>
<td>Occupational Health and Chemistry</td>
</tr>
<tr>
<td>XSEN*3060 [0.50]</td>
<td>Pharmaceutical Analysis - Advanced</td>
</tr>
<tr>
<td>XSEN*3070 [0.50]</td>
<td>Pharmaceutical Product Formulations</td>
</tr>
<tr>
<td>XSEN*3090 [0.50]</td>
<td>Biopharmaceuticals</td>
</tr>
<tr>
<td>XSEN*3200 [0.50]</td>
<td>Pharmaceutical Organic Chemistry</td>
</tr>
<tr>
<td>XSEN*3210 [0.50]</td>
<td>Introduction to Pharmaceutical Manufacturing</td>
</tr>
</tbody>
</table>

** Credit Summary (20.00 Total Credits) **

| 4.00 | First year science credits |
| 6.50 | Required science courses semesters 3 – 8 |
| 5.00 | Restricted electives (#1 and 2 in restricted electives list) |
| 0.50 | Approved Science electives |
| 1.00 | - Arts and/or Social Science electives |
| 3.00 | Free electives - any approved elective for B.Sc. students. (could be less if restricted electives do not count as science) |
| Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level. |

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

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

** Major (Honours Program) **

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

<table>
<thead>
<tr>
<th>Semester 1 - Fall</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1090 [0.50]</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1040 [0.50]</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>IPS*1500 [1.00]</td>
<td>Integrated Mathematics and Physics I</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
<td></td>
</tr>
</tbody>
</table>

** 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 **

<table>
<thead>
<tr>
<th>Semester 2 - Winter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM*1050 [0.50]</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>COOP*1100 [0.00]</td>
<td>Introduction to Co-operative Education</td>
</tr>
<tr>
<td>IPS*1510 [1.00]</td>
<td>Integrated Mathematics and Physics I</td>
</tr>
<tr>
<td>One of:</td>
<td></td>
</tr>
<tr>
<td>BIOL*1070 [0.50]</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080 [0.50]</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semester 3 - Fall</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC*2580 [0.50]</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>CHEM*2060 [0.50]</td>
<td>Structure and Bonding</td>
</tr>
<tr>
<td>CHEM*2400 [0.75]</td>
<td>Analytical Chemistry I</td>
</tr>
<tr>
<td>CHEM*2880 [0.50]</td>
<td>Physical Chemistry</td>
</tr>
<tr>
<td>electives or restricted electives to a maximum of 2.75 total credits in this semester*</td>
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</tr>
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</table>
### Winter Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COOP*1000</td>
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<td>Co-op Work Term I</td>
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</table>

### Semester 4 - Summer

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM*2070</td>
<td>[0.50]</td>
<td>Structure and Spectroscopy</td>
</tr>
<tr>
<td>CHEM*2700</td>
<td>[0.50]</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>CHEM*3430</td>
<td>[0.50]</td>
<td>Analytical Chemistry II: Instrumental Analysis</td>
</tr>
<tr>
<td>STAT*2040</td>
<td>[0.50]</td>
<td>Statistics I</td>
</tr>
</tbody>
</table>

0.50 electives or restricted electives *

### Semester 5 - Fall

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC*3570</td>
<td>[0.75]</td>
<td>Analytical Biochemistry</td>
</tr>
<tr>
<td>CHEM*3750</td>
<td>[0.50]</td>
<td>Organic Chemistry II</td>
</tr>
</tbody>
</table>

One of:

- CHEM*3640 [0.50] Chemistry of the Elements I **
- 0.50 electives or restricted electives *
- electives or restricted electives to a maximum of 2.75 total credits in this semester*
- ** CHEM*3640 is a prerequisite for CHEM*3650

### Semester 6 - Winter

#### Option A (at Guelph)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC*3560</td>
<td>[0.50]</td>
<td>Structure and Function in Biochemistry</td>
</tr>
<tr>
<td>CHEM*3650</td>
<td>[0.50]</td>
<td>Chemistry of the Elements II</td>
</tr>
<tr>
<td>CHEM*3760</td>
<td>[0.50]</td>
<td>Organic Chemistry III</td>
</tr>
</tbody>
</table>

1.00 electives or restricted electives *

#### Option B (at Seneca)

2.50 credits from:

- 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*3090 [0.50] Biopharmaceuticals
- XSEN*3200 [0.50] Pharmaceutical Organic Chemistry
- XSEN*3210 [0.50] Introduction to Pharmaceutical Manufacturing

Note: All XSEN courses are taught at the Seneca@York campus of Seneca College in Toronto.

### Summer Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>COOP*2000</td>
<td>[0.00]</td>
<td>Co-op Work Term II</td>
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### Fall Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>COOP*3000</td>
<td>[0.00]</td>
<td>Co-op Work Term III</td>
</tr>
</tbody>
</table>

### Semester 7 - Winter

2.50 electives or restricted electives *

### Summer Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>COOP*4000</td>
<td>[0.00]</td>
<td>Co-op Work Term IV</td>
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### Semester 8 - Fall

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM*4730</td>
<td>[0.50]</td>
<td>Synthetic Organic Chemistry</td>
</tr>
<tr>
<td>CHEM*4740</td>
<td>[0.50]</td>
<td>Topics in Bio-Organic Chemistry</td>
</tr>
</tbody>
</table>

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] Biomedical 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 **

### Credit Summary (20.00 Total Credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM*4720</td>
<td>[0.50]</td>
<td>Organic Reactivity **</td>
</tr>
<tr>
<td>CHEM*4730</td>
<td>[0.50]</td>
<td>Synthetic Organic Chemistry **</td>
</tr>
<tr>
<td>CHEM*4740</td>
<td>[0.50]</td>
<td>Topics in Bio-Organic Chemistry</td>
</tr>
<tr>
<td>CHEM*4900</td>
<td>[1.00]</td>
<td>Chemistry Research Project I **</td>
</tr>
<tr>
<td>CHEM*4910</td>
<td>[1.00]</td>
<td>Chemistry Research Project II **</td>
</tr>
<tr>
<td>MBG*3040</td>
<td>[0.50]</td>
<td>Molecular Biology of the Gene **</td>
</tr>
<tr>
<td>MBG*3350</td>
<td>[0.75]</td>
<td>Laboratory Methods in Molecular Biology I **</td>
</tr>
<tr>
<td>MCB*4050</td>
<td>[0.50]</td>
<td>Protein and Nucleic Acid Structure **</td>
</tr>
<tr>
<td>MICR*3230</td>
<td>[0.50]</td>
<td>Immunology</td>
</tr>
<tr>
<td>NUTR*3210</td>
<td>[0.50]</td>
<td>Fundamentals of Nutrition</td>
</tr>
<tr>
<td>PATH*3610</td>
<td>[0.50]</td>
<td>Principles of Disease</td>
</tr>
<tr>
<td>TOX*4590</td>
<td>[0.50]</td>
<td>Biochemical Toxicology **</td>
</tr>
<tr>
<td>XSEN*3030</td>
<td>[0.50]</td>
<td>Pharmacology and Applied Toxicology</td>
</tr>
<tr>
<td>XSEN*3040</td>
<td>[0.50]</td>
<td>Occupational Health and Chemistry</td>
</tr>
<tr>
<td>XSEN*3060</td>
<td>[0.50]</td>
<td>Pharmaceutical Analysis - Advanced</td>
</tr>
<tr>
<td>XSEN*3070</td>
<td>[0.50]</td>
<td>Pharmaceutical Product Formulations</td>
</tr>
<tr>
<td>XSEN*3090</td>
<td>[0.50]</td>
<td>Biopharmaceuticals</td>
</tr>
<tr>
<td>XSEN*3200</td>
<td>[0.50]</td>
<td>Pharmaceutical Organic Chemistry</td>
</tr>
<tr>
<td>XSEN*3210</td>
<td>[0.50]</td>
<td>Introduction to Pharmaceutical Manufacturing</td>
</tr>
</tbody>
</table>

### Biological Science (BIOS)

#### College of Biological Science

**Major (Honours Program)**

The Biological Science major offers the opportunity to study a wide range of topics within biological science. The major is one of the most flexible within the B.Sc. After the core sciences in first and second year, students can tailor the degree to create a major all their own. With the wide breadth of courses offered, students can choose to focus their studies in one area of biological science or create a unique skill set and combination of courses not currently offered in any one of our majors. Students can also add a minor in either an area of science or arts and social science.

With this flexibility, students in the Biological Science major are encouraged to seek out study abroad opportunities through the Centre for International Programs. With a high number of elective spaces within the major, students can incorporate a study abroad and still meet the degree requirements within four years. Students who wish to pursue this option should start researching and planning in semesters 3 and 4.

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

#### Schedule of Studies

**Semester 1**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1090</td>
<td>[0.50]</td>
<td>Introduction to Molar and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>[0.50]</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>MATH*1080</td>
<td>[0.50]</td>
<td>Elements of Calculus I</td>
</tr>
<tr>
<td>PHYS*1080</td>
<td>[0.50]</td>
<td>Physics for Life Sciences</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at [bssc.uoguelph.ca/revisedss](http://bssc.uoguelph.ca/revisedss).  

**Semester 2**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1070</td>
<td>[0.50]</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>[0.50]</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>[0.50]</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>PHYS*1070</td>
<td>[0.50]</td>
<td>Physics for Life Sciences</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Semester 3**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*2400</td>
<td>[0.50]</td>
<td>Evolution</td>
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<tr>
<td>1.00 electives or restricted electives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.50 Arts or Social Science elective</td>
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<td></td>
</tr>
</tbody>
</table>

**Semester 4**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT*2040</td>
<td>[0.50]</td>
<td>Statistics I</td>
</tr>
</tbody>
</table>

---

*BSc U of Guelph Calendar*  
*Last Revision: August 17, 2017*
This joint program of the Department of Human Health and Nutritional Sciences and the Department of Biomedical Sciences provides students with a broad and integrated foundational overview of human and animal health through the study of function (biochemistry and physiology), structure (anatomy and histology), and paraclinical sciences (epidemiology and pharmacology). The program prepares students well for more advanced studies or applied training in many health-related fields including clinical practice, business, government, research and education. Through the use of electives, students may structure a program emphasizing aspects of health and disease. For more information on recommended electives contact the Faculty Advisor of the major.

In addition, this program is designed to partially meet the current requirements for 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 from first to second year is based on the cumulative average in the first two semesters (total of 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 wish to declare the specialization at the end of or beyond first year may apply directly to the Department of Biomedical Sciences by the last day of classes in the winter semester and meet the same requirements specified above.

Admission to the major will be based on the cumulative average in the two semesters (total of 5.00 credits) preceding application to the major (normally fall and winter). 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.

### Semester 1

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1070</td>
<td>Biological Concepts of Health</td>
<td>0.50</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>General Chemistry I</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*1070</td>
<td>Physics for Life Sciences</td>
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</tr>
<tr>
<td>PHYS*1080</td>
<td>Physics for Life Sciences</td>
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</table>

0.50 electives or restricted electives

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: [http://www.bsc.uoguelph.ca/revisedss](http://www.bsc.uoguelph.ca/revisedss).

### Semester 2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1070</td>
<td>Discovering Biodiversity</td>
<td>0.50</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>Introduction to Molecular and Cellular Biology</td>
<td>0.50</td>
</tr>
<tr>
<td>MATH*1070</td>
<td>General Chemistry II</td>
<td>0.50</td>
</tr>
<tr>
<td>PHYS*1070</td>
<td>Physics for Life Sciences II</td>
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0.50 electives or restricted electives

### Semester 3 (see admission statement above)

<table>
<thead>
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<th>Course Code</th>
<th>Title</th>
<th>Notes</th>
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</thead>
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<tr>
<td>BIOL*2580</td>
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<tr>
<td>MBG*2040</td>
<td>Foundations in Molecular Biology and Genetics</td>
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<tr>
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</table>

1.00 electives or restricted electives

### Semester 4

<table>
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</thead>
<tbody>
<tr>
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<td>Molecular Biology of the Cell</td>
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</tr>
<tr>
<td>NUTR*3210</td>
<td>Fundamentals of Nutrition</td>
<td>0.50</td>
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One of:

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<tbody>
<tr>
<td>BIOM*3200</td>
<td>Biomedical Physiology</td>
<td>1.00</td>
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<tr>
<td>HK*2810</td>
<td>Human Physiology I - Concepts and Principles</td>
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Electives or restricted electives to a maximum of 2.50 total credits in this semester.

**Note:** If HK*2810 is selected, then HK*3810 must be taken in Semester 5.

### Semester 5

<table>
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<tbody>
<tr>
<td>BIOL*3560</td>
<td>Structure and Function in Biochemistry</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Electives or restricted electives to a maximum of 2.75 total credits in this semester. BIOL*3210 is recommended.

**Note:** As part of the electives or restricted electives students must select HK*3810 in semester 4 if HK*2810 was selected in semester 4.

### Semester 6

<table>
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<tr>
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<tr>
<td>BIOM*3090</td>
<td>Principles of Pharmacology</td>
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</tr>
<tr>
<td>PATH*3610</td>
<td>Principles of Disease</td>
<td>0.50</td>
</tr>
<tr>
<td>POPM*3240</td>
<td>Epidemiology</td>
<td>0.50</td>
</tr>
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</table>

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
2.50 electives or restricted electives*

**Restricted Electives**

1. Anatomy Elective - [1 of (BIOM*3010, BIOM*3040), HK*3401/2, HK*3501/2]
2. Immunology Elective - ANSC*4650 or MICR*3230
3. Advanced Study Electives - 2.00 credits from BIOM*4030, BIOM*4050, BIOM*4070, BIOM*4090, BIOM*4110, BIOM*4150, BIOM*4180, BIOM*4300, BIOM*4500, BIOM*4510, BIOM*4521/2, HK*4070, HK*4230, HK*4340, HK*4360, HK*4371/2, HK*4441/2, HK*4460, NUTR*4320, NUTR*4360, NUTR*4510, TOX*4000

4. At least 2.00 credits of Arts and/or Social Science Electives are required. The approved list of Arts and Social Science Electives for B.Sc. students is available at: [http://www.bsc.uoguelph.ca/Approved_electives.shtml](http://www.bsc.uoguelph.ca/Approved_electives.shtml)

**Credit Summary (20.00 Total Credits)**

4.00 - First year science credits
5.75 - Required science courses semesters 3 – 8 (with HK 2810,3810 or 5.50 (with BIOM 3200)
4.00 - Restricted elective (with HK 3401/2 or HK 3501/2) 3.75 (with BIOM 3010, BIOM 3040) (Restricted elective #1, #2 and #3)
2.25 – 2.75 Approved Science electives depending on which anatomy and physiology courses are completed above.
2.00 - Arts and/or Social Science electives (# 4 in restricted elective list)
2.00 - Free electives - any approved elective for B.Sc. students.

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

**Biomedical Toxicology (BTOX)**

**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 may wish to 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*1080 [0.50] Physics for Life Sciences

0.50 Arts or Social Science electives

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: [http://www.bsc.uoguelph.ca/revisedss](http://www.bsc.uoguelph.ca/revisedss)

**Semester 2**
BIOL*1080 [0.50] Biological Concepts of Health
CHEM*1050 [0.50] General Chemistry II
PHYS*1070 [0.50] Physics for Life Sciences II
STAT*2400 [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
MBG*2050 [0.50] Molecular Biology of the Cell
NUTR*3210 [0.50] Fundamentals of Nutrition

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
BIOM*3200 [1.00] Biomedical Physiology

TOX*3300 [0.50] Analytical Toxicology

0.50 electives or restricted electives*

**Semester 6**
BIOM*3090 [0.50] Principles of Pharmacology
PATH*3610 [0.50] Principles of Disease

One of:
- BIOM*3040 [0.75] Medical Embryology
- MBG*3350 [0.75] Laboratory Methods in Molecular Biology I

**Credits Summary (20.00 Total Credits)**

4.00 - First year science credits
10.75 - Required science courses semesters 3 – 8
1.50 - Arts and/or Social Science electives
2.25 - Free electives - any approved elective for B.Sc. students

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

**Biomedical Toxicology (Co-op) (BTOX:C)**

**Interdisciplinary Program, Departments of Biomedical Sciences, Chemistry, School of Environmental Sciences, Molecular and Cellular Biology**

To graduate from the Co-op program a minimum of 3 successfully completed work terms (COOP*1000, COOP*2000, COOP*3000) is normally required.

**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] Physics for Life Sciences

0.50 Arts or Social Science electives

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: [http://www.bsc.uoguelph.ca/revisedss](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*1070 [0.50] Physics for Life Sciences II

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

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

**Semester 7**
NUTR*4510 [0.50] Toxicology, Nutrition and Food
TOX*4000 [0.50] Medical Toxicology

TOX*4590 [0.50] Biochemical Toxicology

1.00 electives or restricted electives*

**Semester 8**
BIOM*4090 [0.50] Pharmacology

TOX*4100 [0.50] Toxicological Pathology

TOX*4200 [0.50] Topics in Toxicology

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.**

ANSC*4650 [0.50] Comparative Immunology

BIOM*3040 [0.50] Medical Embryology
BIOM*4050 [0.50] Biomedical Aspects of Aging
BIOM*4070 [0.50] Biomedical Histology
BIOM*4150 [0.50] Cancer Biology

CHEM*3750 [0.50] Organic Chemistry II
CHEM*3760 [0.50] Organic Chemistry III
CHEM*4740 [0.50] Topics in Bio-Organic Chemistry

MBG*3040 [0.50] Molecular Biology of the Gene
MBG*3350 [0.75] Laboratory Methods in Molecular Biology I

MBG*4270 [0.50] DNA Replication, Recombination and Repair

MCB*4010 [0.50] Advanced Cell Biology

MICR*3230 [0.50] Immunology

NUTR*4090 [0.50] Functional Foods and Nutraceuticals

NUTR*4320 [0.50] Nutrition and Metabolic Control of Disease

PATH*3040 [0.50] Principles of Parasitology

POPM*3240 [0.50] Epidemiology

POPM*4040 [0.50] Epidemiology of Food-borne Diseases

STAT*2050 [0.50] Statistics II

STAT*3510 [0.50] Environmental Risk Assessment

TOX*4900 [1.00] Toxicology Research Project I

TOX*4910 [1.00] Toxicology Research Project II

2017-2018 Undergraduate Calendar
Last Revision: August 17, 2017
**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

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

**Semester 4 - Fall**
**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
**TOX*3300 [0.50]** Analytical Toxicology
**0.50 electives or restricted electives**

**Semester 5 - Winter**
**CHEM*2700 [0.50]** Organic Chemistry I
**BIOM*3200 [1.00]** Biomedical Physiology
**TOX*3360 [0.50]** Environmental Chemistry and Toxicology
**0.50 electives or restricted electives**

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

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

**Semester 6 - Winter**
**BIOM*3090 [0.50]** Principles of Pharmacology
**PATH*3610 [0.50]** Principles of Disease
**One of:**
- **BIOM*3040 [0.75]** Medical Embryology
- **MBG*3350 [0.75]** Laboratory Methods in Molecular Biology I *

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

**Semester 7 - Fall**
**NUTR*4510 [0.50]** Toxicology, Nutrition and Food
**TOX*4600 [0.50]** Medical Toxicology
**TOX*4590 [0.50]** Biochemical Toxicology
**1.00 electives or restricted electives**

**Semester 8- Winter**
**BIOM*4090 [0.50]** Pharmacology
**TOX*4100 [0.50]** Toxicological Pathology
**TOX*4200 [0.50]** Topics in Toxicology
**1.00 electives or restricted electives**

* **Restricted Electives**

At least 1.50 credits must be completed from the following list of allowable courses.

**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.**

**ANSC*4650 [0.50]** Comparative Immunology
**BIOM*3040 [0.75]** Medical Embryology
**BIOM*4050 [0.50]** Biomedical Aspects of Aging
**BIOM*4070 [0.50]** Biomedical Histology
**BIOM*4150 [0.50]** Cancer Biology
**CHEM*3750 [0.50]** Organic Chemistry II
**CHEM*3760 [0.50]** Organic Chemistry III
**CHEM*4740 [0.50]** Topics in Bio-Organic Chemistry
**MBG*3040 [0.50]** Molecular Biology of the Gene
**MBG*3350 [0.75]** Laboratory Methods in Molecular Biology I
**MBG*4270 [0.50]** DNA Replication, Recombination and Repair
**MCR*4010 [0.50]** Advanced Cell Biology
**MICR*3230 [0.50]** Immunology
**NUTR*4090 [0.50]** Functional Foods and Nutraceuticals
**NUTR*4320 [0.50]** Nutrition and Metabolic Control of Disease
**PATH*3040 [0.50]** Principles of Parasitology
**POPM*3240 [0.50]** Epidemiology
**POPM*4040 [0.50]** Epidemiology of Food-borne Diseases
**STAT*2050 [0.50]** Statistics II
**STAT*3510 [0.50]** Environmental Risk Assessment
**TOX*4900 [1.00]** Toxicology Research Project I
**TOX*4910 [1.00]** Toxicology Research Project II

**Credit Summary (20.00 Total Credits)**

4.00 - First year science credits
10.75 - Required science courses semesters 3 – 8
1.50 - Restricted electives
1.50 - Arts and/or Social Science electives
2.25 - Free electives - any approved elective for B.Sc. students

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.
### Chemical Physics (CHPY)

Administered by the Office of the Dean, College of Engineering and Physical Sciences 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 may wish to consult the Faculty Advisor. A minimum of 20.00 credits is required. At least 1.00 credits must be from Arts and/or Social Science courses.

#### Semester 1

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<tr>
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<tr>
<td>CHEM*1040</td>
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<td>General Chemistry I</td>
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<tr>
<td>IPS*1500</td>
<td>1.00</td>
<td>Integrated Mathematics and Physics I</td>
</tr>
<tr>
<td>MATH*1160</td>
<td>0.50</td>
<td>Linear Algebra I</td>
</tr>
<tr>
<td>One of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL*1070</td>
<td>0.50</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
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</table>

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/reviseds](http://www.bsc.uoguelph.ca/reviseds)

#### Semester 2

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<td>CIS*1500</td>
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<td>Introduction to Programming</td>
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<tr>
<td>BIOL*1070</td>
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<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>BIOL*1090</td>
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<td>Introduction to Molecular and Cellular Biology</td>
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#### Semester 3

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<td>MATH*2200</td>
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<td>Advanced Calculus I</td>
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<tr>
<td>MATH*2270</td>
<td>0.50</td>
<td>Applied Differential Equations</td>
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<tr>
<td>PHYS*2330</td>
<td>0.50</td>
<td>Electricity and Magnetism I</td>
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<tr>
<td>0.50 Arts or Social Science electives</td>
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#### Semester 4

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<td>Structure and Spectroscopy</td>
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<td>CHEM*2480</td>
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<td>Analytical Chemistry I</td>
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<td>PHYS*2180</td>
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<td>Experimental Techniques in Physics</td>
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<td>PHYS*2310</td>
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<td>Mechanics</td>
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#### Semester 5

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<tr>
<td>NANO*3600</td>
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<td>Computational Methods in Materials Science</td>
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<tr>
<td>PHYS*3130</td>
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<td>Mathematical Physics</td>
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<tr>
<td>PHYS*3230</td>
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<td>Quantum Mechanics I</td>
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<tr>
<td>CHEM*2820</td>
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<td>PHYS*2240</td>
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#### Semester 6

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<td>PHYS*3000</td>
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<td>Optics: Fundamentals and Applications</td>
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<td>PHYS*4040</td>
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<td>PHYS*4300</td>
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<td>CHEM*3870</td>
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<td>Molecular Spectroscopy</td>
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<tr>
<td>CHEM*4880</td>
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<td>Topics in Advanced Physical Chemistry</td>
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#### Semester 7

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<tr>
<td>CHEM*3440</td>
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<td>Analytical Chemistry III: Analytical Instrumentation</td>
</tr>
<tr>
<td>PHYS*4120</td>
<td>0.50</td>
<td>Atomic and Molecular Physics</td>
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<td>PHYS*4240</td>
<td>0.50</td>
<td>Statistical Physics II</td>
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<tr>
<td>PHYS*4001</td>
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<tr>
<td>CHEM*3870</td>
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<td>Molecular Spectroscopy</td>
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<tr>
<td>CHEM*4880</td>
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<td>Topics in Advanced Physical Chemistry</td>
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#### Semester 8

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<td>CHEM*3870</td>
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<td>Topics in Advanced Physical Chemistry</td>
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<tr>
<td>CHEM*4900</td>
<td>1.00</td>
<td>Chemistry Research Project I +</td>
</tr>
<tr>
<td>PHYS*4002</td>
<td>0.50</td>
<td>and 0.50 electives</td>
</tr>
</tbody>
</table>

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

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

### Major (Honours Program)

A minimum of 20.00 credits is required. At least Students are eligible to participate in a maximum two (2) work terms commencing in the summer and must follow the academic work schedule as outlined in the Co-operative Education & Career Services website: [https://www.recruitatualph.ca/cees/](https://www.recruitatualph.ca/cees/)

#### Semester 1 - Fall

<table>
<thead>
<tr>
<th>Code</th>
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<tr>
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<td>IPS*1500</td>
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<td>Integrated Mathematics and Physics I</td>
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<tr>
<td>MATH*1160</td>
<td>0.50</td>
<td>Linear Algebra I</td>
</tr>
<tr>
<td>One of:</td>
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<tr>
<td>BIOL*1070</td>
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<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>BIOL*1090</td>
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<td>Introduction to Molecular and Cellular Biology</td>
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</table>

#### Semester 2 - Winter

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<tr>
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<td>CIS*1500</td>
<td>0.50</td>
<td>Introduction to Programming</td>
</tr>
<tr>
<td>IPS*1510</td>
<td>1.00</td>
<td>Integrated Mathematics and Physics II</td>
</tr>
<tr>
<td>One of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL*1070</td>
<td>0.50</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
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#### Semester 3 - Fall

<table>
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<tr>
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<tbody>
<tr>
<td>CHEM*2060</td>
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<td>Structure and Bonding</td>
</tr>
<tr>
<td>MATH*2200</td>
<td>0.50</td>
<td>Advanced Calculus I</td>
</tr>
<tr>
<td>MATH*2270</td>
<td>0.50</td>
<td>Applied Differential Equations</td>
</tr>
<tr>
<td>PHYS*2330</td>
<td>0.50</td>
<td>Electricity and Magnetism I</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
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#### Semester 4 - Winter

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>CHEM*2070</td>
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<td>Structure and Spectroscopy</td>
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<tr>
<td>CHEM*2480</td>
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<td>Analytical Chemistry I</td>
</tr>
<tr>
<td>PHYS*2180</td>
<td>0.50</td>
<td>Experimental Techniques in Physics</td>
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<tr>
<td>PHYS*2310</td>
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<td>Mechanics</td>
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<tr>
<td>PHYS*2340</td>
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<td>Electricity and Magnetism II</td>
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<tr>
<td>PHYS*4300</td>
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<td>Inquiry in Physics</td>
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<tr>
<td>CHEM*3870</td>
<td>0.50</td>
<td>Molecular Spectroscopy</td>
</tr>
<tr>
<td>CHEM*4880</td>
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<td>Topics in Advanced Physical Chemistry</td>
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#### Summer Semester

<table>
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<tr>
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<tbody>
<tr>
<td>COOP*1000</td>
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<td>Co-op Work Term I ++</td>
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#### Fall Semester

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<tbody>
<tr>
<td>COOP*2000</td>
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<td>Co-op Work Term II ++</td>
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#### Semester 5 - Winter

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<tbody>
<tr>
<td>CHEM*3430</td>
<td>0.50</td>
<td>Analytical Chemistry II: Instrumental Analysis</td>
</tr>
<tr>
<td>PHYS*4300</td>
<td>0.50</td>
<td>Inquiry in Physics</td>
</tr>
<tr>
<td>One of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM*3870</td>
<td>0.50</td>
<td>Molecular Spectroscopy +</td>
</tr>
<tr>
<td>0.50 electives *</td>
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<tr>
<td>One of:</td>
<td></td>
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</tr>
<tr>
<td>CIS*2500</td>
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<td>Intermediate Programming</td>
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#### Summer Semester

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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>COOP*3000</td>
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<td>Co-op Work Term III ++</td>
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#### Semester 6 - Fall

<table>
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<tr>
<th>Code</th>
<th>Credits</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>CHEM*3860</td>
<td>0.50</td>
<td>Quantum Chemistry</td>
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</table>
NANO*3600 [0.50] Computational Methods in Materials Science  
PHYS*3130 [0.50] Mathematical Physics  
PHYS*3230 [0.50] Quantum Mechanics I  
One of:  
CHEM*2820 [0.50] Thermodynamics and Kinetics  
PHYS*2240 [0.50] Thermal Physics

**Winter Semester**  
COOP*4000 [0.00] Co-op Work Term IV ++  
(8-month work term in conjunction with COOP*5000)

**Summer Semester**  
COOP*5000 [0.00] Co-op Work Term V ++  
(8-month work term in conjunction with COOP*4000)

**Semester 7**  
CHEM*3440 [0.50] Analytical Chemistry III: Analytical Instrumentation  
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  
1.00 electives *

**Semester 8**  
PHYS*3000 [0.50] Optics: Fundamentals and Applications  
PHYS*4040 [0.50] Quantum Mechanics II  
One of:  
CHEM*3870 [0.50] Molecular Spectroscopy +  
CHEM*4880 [0.50] Topics in Advanced Physical Chemistry +  
0.50 electives *  
1.00 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.

Credit Summary (20.00 Total Credits)  
5.00 - First year science credits  
10.50 - Required science courses semesters 3 – 8  
3.00 - Free electives - any approved elective for B.Sc. students.

**Chemistry (CHEM)**  
Department of Chemistry, College of Engineering and Physical Sciences  
**Major (Honours Program)**  
Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major may wish to consult the Faculty Advisor. The major will require the completion of 20.00 credits as indicated below:

**Semester 1**  
BIOC*1090 [0.50] Introduction to Molecular and Cellular Biology  
CHEM*1040 [0.50] General Chemistry I  
IPS*1500 [1.00] Integrated Mathematics and Physics I  
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/revisedchs](http://www.bsc.uoguelph.ca/revisedchs)

**Semester 2**  
CHEM*1050 [0.50] General Chemistry II  
IPS*1510 [1.00] Integrated Mathematics and Physics II  
MATH*1160 [0.50] Linear Algebra I  
One of:  
BIOL*1070 [0.50] Discovering Biodiversity  
BIOL*1080 [0.50] Biological Concepts of Health

**Semester 3**  
BIOL*2580 [0.50] Introduction to Biochemistry

CHEM*2060 [0.50] Structure and Bonding  
CHEM*2400 [0.75] Analytical Chemistry I  
MATH*2270 [0.50] Applied Differential Equations  
Electives to a maximum of 2.75 total credits in this semester *

**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  
1.00 electives* or restricted electives**

**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.

Credit Summary (20.00 Total Credits)  
4.50 - First year science credits  
7.25 - Required science courses semesters 3 – 8  
3.00 - Restricted electives (#1 and 2 in restricted electives list)  
1.25 - Approved science electives  
1.00 - Arts and/or Social Science electives  
3.00 - Free electives - any approved elective for B.Sc. students. Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

**Minor (Honours Program)**  
A minor in Chemistry consists of at least 5.00 credits including the following courses:  
CHEM*1040 [0.50] General Chemistry I  
CHEM*1050 [0.50] General Chemistry II  
Of the additional 4.00 credits, students will select Chemistry courses (CHEM) at the 2000 level or above including a minimum of 1.00 credits at the 3000 or 4000 level. BIOC*2580 can be counted towards this specialization.

Chemistry (Co-op) (CHEM:C)  
Department of Chemistry, College of Engineering and Physical Sciences  
**Major (Honours Program)**  
The major will require the completion of 20.00 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.

**Semester 1 - Fall**  
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology  
CHEM*1050 [0.50] General Chemistry II  
IPS*1510 [1.00] Integrated Mathematics and Physics II  
MATH*1160 [0.50] Linear Algebra I  
One of:  
BIOL*1070 [0.50] Discovering Biodiversity  
BIOL*1080 [0.50] Biological Concepts of Health  
Note:  
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.
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](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
- IPS*1510 [1.00] Integrated Mathematics and Physics II
- MATH*1160 [0.50] Linear Algebra I
- BIOL*1070 [0.50] Discovering Biodiversity
- BIOL*1080 [0.50] Biological Concepts of Health

**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*2270 [0.50] Applied Differential Equations

Electives to a maximum of 2.75 total credits in this semester *

**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

1.00 electives *

**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

1.50 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.

**Credit Summary (20.00 Total Credits)**
- 4.50 - First year science credits
- 7.25 - Required science courses semesters 3 – 8
- 3.00 - Restricted electives (#1 and 2 in restricted electives list)

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**Computing and Information Science (CIS)**

**School of Computer Science, College of Engineering and Physical Sciences**

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)**

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

- BIOL*2060 [0.50] Ecology
- BIOL*3010 [0.50] Laboratory and Field Work in Ecology
- BIOL*3060 [0.50] Populations, Communities & Ecosystems
- BIOL*4110 [1.00] Ecological Methods
- BIOL*4120 [0.50] Evolutionary Ecology

Of the remaining 2.00 required credits, students will select from the following:

At least one of:
- BIOL*2400 [0.50] Evolution
- BIOL*3020 [0.50] Population Genetics

At least 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

**Ecology (ECOL)**

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

This minor provides a foundation in the principles and methods of ecology. It introduces the knowledge and skills necessary for work in conservation, environmental science and education, resource management, ecological consulting, or nature interpretation.

**Minor (Honours Program)**

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

- BIOL*2060 [0.50] Ecology
- BIOL*3010 [0.50] Laboratory and Field Work in Ecology
- BIOL*3060 [0.50] Populations, Communities & Ecosystems
- BIOL*4110 [1.00] Ecological Methods
- BIOL*4120 [0.50] Evolutionary Ecology

Of the remaining 2.00 required credits, students will select from the following:

At least one of:
- BIOL*2400 [0.50] Evolution
- BIOL*3020 [0.50] Population Genetics

At least 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

**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 may wish to 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.

**Semester 1**

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

0.50 Arts or Social Science elective

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: [http://www.bsc.uoguelph.ca/revisedss](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*1070 [0.50] Physics for Life Sciences

One of:
- CIS*1200 [0.50] Introduction to Computing
CIS*1500  
MATH*2080  
STAT*2040

0.50 Arts or Social Science elective

Semester 3

BIOC*2580  
ENVS*2330  
STAT*2040  
TOX*2000

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

Semester 4

BIOL*2060  
MBG*2040

1.50 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 ENVS course)

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

Semester 6

BIOL*2400

2.00 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

1. A minimum of 1.00 credits of Approved Arts and Social Science electives
2. Select 4.50 credits from the following lists of restricted electives during Semesters 3-8. 1.00 credits must be completed in each of lists A, B and C. Of the total 4.50 credits at least 1.00 of these credits must be from ENVS 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:

AGR*2050

[0.50] Agroecology

ENVS*2040

[0.50] Plant Health and the Environment

ENVS*2340

[0.50] Current Issues in Agriculture and Landscape Management

ENVS*3040

[0.50] Natural Chemicals in the Environment

ENVS*3210

[0.50] Plant Pathology

ENVS*3310

[0.50] Soil Biodiversity and Ecosystem Function **

ENVS*4100

[0.50] Integrated Management of Invasive Insect Pests **

MBG*3220

[0.50] Plant Microbiology

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] Limnology of Natural and Polluted Waters **

BIOL*4610

[0.75] Arctic Ecology

ENVS*3020

[0.50] Climate Change Biology

ENVS*3290

[0.50] Waterborne Disease Ecology

ENVS*4180

[0.50] Insecticide Biological Activity and Resistance

ENVS*4190

[0.50] Biological Activity of Herbicides

GEOG*3020

[0.50] Global Environmental Change

MBG*4270

[0.50] DNA Replication, Recombination and Repair **

PBIO*4530

[0.50] Plants and Environmental Pollution **

STAT*3550

[0.50] Environmental Risk Assessment

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*3060

[0.50] Populations, Communities & Ecosystems

BIOL*3130

[0.50] Conservation Biology

BIOL*4150

[0.50] Wildlife Conservation and Management

BIOL*4500

[0.50] Natural Resource Policy Analysis

ENVS*2120

[0.50] Introduction to Environmental Stewardship

ENVS*3080

[0.50] Soil and Water Conservation **

ENVS*3090

[0.50] Insect Diversity and Biology

ENVS*3150

[0.50] Aquatic Systems

ENVS*3230

[0.50] Agroforestry Systems **

ENVS*3250

[0.50] Forest Health and Disease

ENVS*3270

[0.50] Forest Biodiversity **

ENVS*3370

[0.50] Terrestrial Ecosystem Ecology

ENVS*4230

[0.50] Biology of Aquatic Insects **

ENVS*4260

[0.50] Field Entomology **

ENVS*4350

[0.50] Forest Ecology **

ENVS*4390

[1.00] Soil Variability and Land Evaluation

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*3510

[0.50] Independent Study I

ENVS*3520

[0.50] Independent Study II

ENVS*3530

[1.00] Independent Study

ENVS*4410

[1.00] Advanced Independent Research I

ENVS*4420

[1.00] Advanced Independent Research II

ENVS*4430

[2.00] Advanced Independent Research

ENVS*4510

[0.50] Advanced Independent Study I

ENVS*4520

[0.50] Advanced Independent Study II

ENVS*4530

[1.00] Advanced Independent Study

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

BIOL*3060

[0.50] Populations, Communities & Ecosystems

BOT*2100

[0.50] Life Strategies of Plants

ENVS*2060

[0.50] Soil Science

MBG*2050

[0.50] Molecular Biology of the Cell

Credit Summary (20.00 Total Credits)

4.00 - First year science credits

3.50 - Required science courses semesters 3 – 8 (3.00 if STAT 2040 is taken in Semester 2)

4.50 - Restricted electives (some restricted electives do not count as science electives towards degree therefore additional science electives may be required)

4.00 - Approved Science electives (4.50 if STAT 2040 is taken in semester 2, in place of CIS)

1.00 - Arts and/or Social Science electives (# 1 in restricted elective list)

3.00 - Free electives - any approved elective for B.Sc. students. (could be less if restricted electives do not count as science)

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

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 may wish to 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

GEOG*1300

[0.50] Earth: Hazards and Global Change

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/visedss

Last Revision: August 17, 2017

2017-2018 Undergraduate Calendar
### Semester 2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>0.50</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>GEOG*1300</td>
<td>0.50</td>
<td>Introduction to the Biophysical Environment</td>
</tr>
<tr>
<td>PHYS*1130</td>
<td>0.50</td>
<td>Physics with Applications</td>
</tr>
</tbody>
</table>

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

### Semester 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
</tr>
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<tbody>
<tr>
<td>ENVS*2240</td>
<td>0.50</td>
<td>Fundamentals of Environmental Geology</td>
</tr>
<tr>
<td>GEOG*2000</td>
<td>0.50</td>
<td>Geomorphology</td>
</tr>
<tr>
<td>GEOG*2420</td>
<td>0.50</td>
<td>The Earth From Space</td>
</tr>
<tr>
<td>GEOG*2480</td>
<td>0.50</td>
<td>Mapping and GIS</td>
</tr>
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</table>

0.50 Arts or Social Science electives*

### Semester 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG*2110</td>
<td>0.50</td>
<td>Climate and the Biophysical Environment</td>
</tr>
<tr>
<td>GEOG*2210</td>
<td>0.50</td>
<td>Environment and Resources</td>
</tr>
<tr>
<td>STAT*2040</td>
<td>0.50</td>
<td>Statistics I</td>
</tr>
</tbody>
</table>

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 |

0.50 approved Science electives*

### Semester 5

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
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<tbody>
<tr>
<td>GEOG*3000</td>
<td>0.50</td>
<td>Fluvial Processes</td>
</tr>
<tr>
<td>GEOG*3110</td>
<td>0.50</td>
<td>Biotic and Natural Resources</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
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<tbody>
<tr>
<td>GEOG*3420</td>
<td>0.50</td>
<td>Remote Sensing of the Environment</td>
</tr>
<tr>
<td>GEOG*3480</td>
<td>0.50</td>
<td>GIS and Spatial Analysis</td>
</tr>
<tr>
<td>GEOG*3610</td>
<td>0.50</td>
<td>Environmental Hydrology</td>
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</table>

1.00 electives, at least 0.50 from approved Science electives*

### Semester 7

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG*4110</td>
<td>1.00</td>
<td>Environmental Systems Analysis</td>
</tr>
</tbody>
</table>

1.50 electives, at least 0.50 from approved Science electives* (GEOG*4690 is recommended)

### Semester 8

<table>
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<th>Credits</th>
<th>Course Name</th>
</tr>
</thead>
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<tr>
<td>GEOG*4150</td>
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<td>Catchment Processes</td>
</tr>
<tr>
<td>GEOG*4480</td>
<td>1.00</td>
<td>Applied Geomatics</td>
</tr>
</tbody>
</table>

1.00 Approved Science electives*

### Credit Summary (20.00 Total Credits)

4.50 - First year science credits
8.50 - Required science courses semesters 3 – 8
1.00 - Required social science courses semesters 3 – 8
3.00 - Approved Science electives
1.00 - Arts and/or Social Science electives
2.00 - Free electives - any approved elective for B.Sc. students.

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

### 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 may wish to consult the Faculty Advisor.

### Semester 1 - Fall

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>0.50</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>MATH*1080</td>
<td>0.50</td>
<td>Elements of Calculus I</td>
</tr>
<tr>
<td>PHYS*1080</td>
<td>0.50</td>
<td>Physics for Life Sciences</td>
</tr>
</tbody>
</table>

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 lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: [http://www.bsc.uoguelph.ca/revisedds](http://www.bsc.uoguelph.ca/revisedds)

### Semester 2 - Winter

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>0.50</td>
<td>General Chemistry II</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science electives

### 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

Students not in the Food Science Major who are seeking further study in Food Science are encouraged to consider the Certificate in Food Science. See Special Study Opportunities, Chapter XI of the Calendar.

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

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

#### Major (Honours Program)

### Semester 1 - Fall

<table>
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<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>0.50</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>MATH*1080</td>
<td>0.50</td>
<td>Elements of Calculus I</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science 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:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOD*4070</td>
<td>0.50</td>
<td>Food Packaging</td>
</tr>
<tr>
<td>FOOD*4090</td>
<td>0.50</td>
<td>Functional Foods and Nutraceuticals</td>
</tr>
<tr>
<td>FOOD*4110</td>
<td>0.50</td>
<td>Meat and Poultry Processing</td>
</tr>
<tr>
<td>FOOD*4220</td>
<td>0.50</td>
<td>Topics in Food Science</td>
</tr>
<tr>
<td>FOOD*4230</td>
<td>0.50</td>
<td>Research in Food Science</td>
</tr>
<tr>
<td>FOOD*4310</td>
<td>0.50</td>
<td>Food Safety Management Systems</td>
</tr>
<tr>
<td>FOOD*4400</td>
<td>0.50</td>
<td>Dairy Processing</td>
</tr>
<tr>
<td>FOOD*4520</td>
<td>0.50</td>
<td>Utilization of Cereal Grains for Human Food</td>
</tr>
<tr>
<td>MCS*3010</td>
<td>0.50</td>
<td>Quality Management</td>
</tr>
<tr>
<td>POPM*4040</td>
<td>0.50</td>
<td>Epidemiology of Food-borne Diseases</td>
</tr>
</tbody>
</table>

### 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

Students not in the Food Science Major who are seeking further study in Food Science are encouraged to consider the Certificate in Food Science. See Special Study Opportunities, Chapter XI of the Calendar.

### 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.
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<td>POPM*4040</td>
<td>0.50</td>
<td>Epidemiology of Food-borne Diseases</td>
</tr>
</tbody>
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### 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

Students not in the Food Science Major who are seeking further study in Food Science are encouraged to consider the Certificate in Food Science. See Special Study Opportunities, Chapter XI of the Calendar.

### 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.
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   - At least 1.00 must be from additional science electives (1.50 if MCS*3010 is chosen as a Restricted Elective)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS*1080</td>
<td>0.50</td>
<td>Physics for Life Sciences</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: [http://www.bsc.uoguelph.ca/revisedds](http://www.bsc.uoguelph.ca/revisedds)

### Semester 2 - Winter

<table>
<thead>
<tr>
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<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>0.50</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>MATH*2080</td>
<td>0.50</td>
<td>Elements of Calculus II</td>
</tr>
<tr>
<td>PHYS*1070</td>
<td>0.50</td>
<td>Physics for Life Sciences II</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
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### Summer Semester

**Off**

### Semester 4 - Winter

<table>
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<tbody>
<tr>
<td>FOOD*2100</td>
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<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>CHEM*2880</td>
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<td>Physical Chemistry</td>
</tr>
<tr>
<td>COOP*1401</td>
<td>0.50</td>
<td>Introduction to Co-operative Education</td>
</tr>
<tr>
<td>FOOD*2150</td>
<td>0.50</td>
<td>Introduction to Nutritional and Food Science</td>
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<td>MICR*2420</td>
<td>0.50</td>
<td>Introduction to Microbiology</td>
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### Semester 6 - Winter

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>FOOD*3040</td>
<td>0.50</td>
<td>Food Chemistry I</td>
</tr>
<tr>
<td>FOOD*3170</td>
<td>0.50</td>
<td>Food Processing II</td>
</tr>
<tr>
<td>FOOD*3260</td>
<td>0.50</td>
<td>Industrial Microbiology</td>
</tr>
<tr>
<td>FOOD*3700</td>
<td>0.50</td>
<td>Sensory Evaluation of Foods</td>
</tr>
<tr>
<td>0.50 electives</td>
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</tbody>
</table>

### Semester 8 - Winter

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>FOOD*4270</td>
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<td>Food Product Development II</td>
</tr>
<tr>
<td>2.00 electives</td>
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</tr>
</tbody>
</table>

**Notes:**

See Notes and Credit Summary in Food Science 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, including the following 3.50 credits:

- 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 Geomatics

And 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

### 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, spreadsheet use and data management, the student should select CIS*1200 as early in the program as possible.

**Major (Honours Program)**

B.Sc. students who were not admitted directly into the Human Kinetics major from high school and subsequently wish to transfer to the specialization must apply directly to the Department of Human Health and Nutritional Sciences by the last day of classes in the winter semester.

To be eligible after first year, applicants must have successfully completed 4.0 science credits in a B.Sc. specialization with an average of 70% or better in BIOL*1080, BIOL*1080 and BIOL*1090. For students with a 65-69.9% average in these three courses, admission to the major will be competitive based on available spaces.

Students wishing to transfer after second year or third year must have an average of 70% or better in their last two semesters (total of best 4.00 science credits). For students with a 65-69.9%, admission to the major will be competitive based on available spaces.

All decisions regarding transfers will be made by the end of June.

To complete the major, a minimum of 20.00 credits are required.

### Semester 1

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>BIOL*1080</td>
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<tr>
<td>CHEM*1040</td>
<td>0.50</td>
<td>General Chemistry I</td>
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<tr>
<td>MATH*1080</td>
<td>0.50</td>
<td>Elements of Calculus I</td>
</tr>
<tr>
<td>PHYS*1080</td>
<td>0.50</td>
<td>Physics for Life Sciences</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at [http://www.bsc.uoguelph.ca/revisedds](http://www.bsc.uoguelph.ca/revisedds).

### Semester 2

<table>
<thead>
<tr>
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<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1070</td>
<td>0.50</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>0.50</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>PHYS*1070</td>
<td>0.50</td>
<td>Physics for Life Sciences II</td>
</tr>
<tr>
<td>0.50 Arts or social science electives</td>
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<td></td>
</tr>
</tbody>
</table>

### Semester 3

<table>
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<tr>
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<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>HK*2270</td>
<td>0.50</td>
<td>Principles of Human Biomechanics</td>
</tr>
<tr>
<td>MBO*2040</td>
<td>0.50</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>STAT*2040</td>
<td>0.50</td>
<td>Statistics I</td>
</tr>
<tr>
<td>0.50 Arts or Social Science electives</td>
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<td></td>
</tr>
</tbody>
</table>

### Semester 4

<table>
<thead>
<tr>
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<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Principles of Human Biomechanics</td>
</tr>
<tr>
<td>MCB*2050</td>
<td>0.50</td>
<td>Molecular Biology of the Cell</td>
</tr>
<tr>
<td>NUTR*3210</td>
<td>0.50</td>
<td>Fundamentals of Nutrition</td>
</tr>
<tr>
<td>0.50 electives</td>
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</tr>
</tbody>
</table>

### Semester 6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>HK*3401</td>
<td>0.75</td>
<td>Human Anatomy: Dissection</td>
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<tr>
<td>HK*3501</td>
<td>0.75</td>
<td>Human Anatomy: Prosection</td>
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<tr>
<td>0.50 electives</td>
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### Semester 7

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<tr>
<td>HK*3600</td>
<td>0.75</td>
<td>Applied Human Kinetics I</td>
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<tr>
<td>HK*3810</td>
<td>0.75</td>
<td>Human Physiology II - Integrated Systems</td>
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<tr>
<td>NUTR*3360</td>
<td>0.50</td>
<td>Lifestyle Genomics</td>
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<tr>
<td>HK*3401</td>
<td>0.75</td>
<td>Human Anatomy: Dissection (if registered in HK*3401 in semester 5)</td>
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<tr>
<td>HK*3501</td>
<td>0.75</td>
<td>Human Anatomy: Prosection (if registered in HK*3501 in semester 5)</td>
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### Semester 8

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<td>HK*4550</td>
<td>0.50</td>
<td>Human Cardio-respiratory Physiology</td>
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<tr>
<td>NUTR*4210</td>
<td>0.50</td>
<td>Nutrition, Exercise and Energy Metabolism</td>
</tr>
<tr>
<td>1.50 electives or restricted electives</td>
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Last Revision: August 17, 2017
### Restricted Electives
1. 2.00 credits of Approved Arts and Social Science electives.
2. 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).

### Credit Summary (20.00 Total Credits)
- **4.00 - First year science core**
- 9.75 - Required science courses semesters 3 - 8
- 1.00 - Restricted elective (# 2 in restricted elective list)
- 1.25 - Approved Science electives
- 2.00 - Approved Arts and/or Social Science electives (#1 in restricted electives list)
- 2.00 - Free electives - any approved electives for B.Sc. students.

Of the total credits required, students are required to complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

### Marine and Freshwater Biology (MFB)

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

The Marine and Freshwater Biology major capitalizes on Guelph's recognized excellence in aquatic research and provides a broad perspective on aquatic environments based on the physical as well as the biological sciences. In this major, students will build upon core courses in ecology, evolution, genetics, and physiology of aquatic biota as they study freshwater and marine environments and work with aquatic organisms experimentally in the field and in the lab. They will have the opportunity to perform independent research projects under a variety of field and laboratory conditions to enhance their learning experience. The major prepares students for post-graduate work in the aquatic sciences, and provides a sound scientific background for students wishing to pursue careers in academia, government service, private sector (e.g., NGOs, fisheries, aquaculture, biotechnology, consulting), conservation, education and research.

#### Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major may wish to 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*1080 [0.50] Physics for Life Sciences
- 0.50 Arts or Social Science electives

**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*1070 [0.50] Physics for Life Sciences II
- 0.50 Arts or Social Science electives

**Semester 3**
- BIOL*2060 [0.50] Ecology
- BIOL*2400 [0.50] Evolution
- ZOO*2090 [0.50] Vertebrate Structure and Function
- 1.00 electives*

**Semester 4**
- BIOL*2580 [0.50] Introduction to Biochemistry
- MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
- STAT*2230 [0.50] Biostatistics for Integrative Biology
- ZOO*2700 [0.50] Invertebrate Morphology & Evolution
- 0.50 electives*

**Semester 5**
- BIOL*3450 [0.50] Introduction to Aquatic Environments
- ZOO*3600 [0.50] Comparative Animal Physiology I
- ZOO*3610 [0.25] Lab Studies in Animal Physiology I
- ZOO*3700 [0.50] Integrative Biology of Invertebrates

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

**Semester 6**
- BIOL*3060 [0.50] Populations, Communities & Ecosystems
- ZOO*3050 [0.50] Developmental Biology
- ZOO*3620 [0.50] Comparative Animal Physiology II
- ZOO*3630 [0.25] Lab Studies in Animal Physiology II

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

**Semester 7**
- BIOL*4350 [0.50] Limnology of Natural and Polluted Waters
- IBIO*4600 [1.00] Integrative Marine and Freshwater Research

1.00 electives

**Semester 8**
- BIOL*4010 [0.50] Adapational Physiology
- ZOO*4330 [0.50] Biology of Fishes
- ZOO*4570 [0.50] Marine Ecological Processes

1.00 electives

* CIS*1200 is recommended for those needing to improve their computer skills

### Electives

At least 1.00 credits of Arts and/or Social Science electives are required. The list of approved Arts and Social Science electives for B.Sc. students is available at: [http://www.bsc.uoguelph.ca/Approved_electives.shtml#Arts](http://www.bsc.uoguelph.ca/Approved_electives.shtml#Arts)

**Credit Summary (20.00 Total Credits)**
- **4.00 - First year science core**
- 10.00 - Required science courses semesters 3 - 8
- 2.00 - Approved science electives
- 1.00 - Arts and/or Social Science electives
- 3.00 - Free electives - any approved elective for B.Sc. Students

Of the total credits required, students are required to complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

### Mathematical Science (MSCI)

#### Department of Mathematics & Statistics, College of Engineering and Physical Sciences

#### Major (Honours Program)

Knowledge of Mathematics and Statistics is crucial for understanding our world. This unique program provides a core of both mathematics and statistics with a choice of a Mathematics stream or a Statistics stream. This major also requires the completion of an area of emphasis as listed. Students are encouraged to speak with a Program Counsellor when choosing courses for the selected stream and area of emphasis.

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major may wish to 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, 0.50 credits in Computing and Information Science, and an additional 2.50 credits in an area of emphasis.

**Semester 1**
- CHEM*1040 [0.50] General Chemistry I
- MATH*1160 [0.50] Linear Algebra 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
  - 1.00 credits from: IPS*1510, or (MATH*2080, PHYS*1010) or (MATH*1200, PHYS*1080)*

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at: [http://www.bsc.uoguelph.ca/revisedss](http://www.bsc.uoguelph.ca/revisedss)

**Semester 2**
- CHEM*1050 [0.50] General Chemistry II
- STAT*2040 [0.50] Statistics 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
  - 1.00 credits from: IPS*1510, or (MATH*2080, PHYS*1010) or (MATH*1200, PHYS*1010)**

**Semester 3**
- CIS*1500 [0.50] Introduction to Programming
- MATH*2200 [0.50] Advanced Calculus I
- STAT*3100 [0.50] Introductory Mathematical Statistics I
- 1.00 electives or restricted electives

**Semester 4**
- MATH*2130 [0.50] Numerical Methods
- STAT*2050 [0.50] Statistics II
- 1.50 electives or restricted electives (CIS*2500 recommended)

**Semester 5**
- 2.50 electives or restricted electives

**Semester 6**
- 2.50 electives or restricted electives

**Semester 7**
- 2.50 electives or restricted electives

**Semester 8**
- MATH*4440 [0.50] Case Studies in Mathematics and Statistics
- 2.00 electives or restricted electives
1.00 credits of Approved Arts and/or Social Science electives

Real Analysis

The Analysis and Design of Computer Algorithms

Advanced Calculus II

Fluid Mechanics

Robotic Systems

Engineering Systems Analysis

Introductory Microeconomics

Engineering Mechanics I

2.50 credits from an Area of Emphasis

Data Structures

Evolution

Data Base Systems and Concepts

Electric Circuits

Software for Legacy Systems

Intermediate Microeconomics

Applied Bioinformatics

Engineering Systems Analysis

Populations, Communities & Ecosystems

Advanced Topics in Microeconomics

Evolution

Methods in Evolutionary Biology

Conservation Biology

Thermodynamics

Electronic Devices

Population Genetics

Linear Algebra I

Applied Differential Equations

Advanced Calculus I

Wildlife Conservation and Management

Applied Regression Analysis

Game Theory

Signal Processing

Ecology

*** BIOL*1070 and BIOL*1090 are recommended if taking either the BINF or the BBM Area of Emphasis

RESTRICTED ELECTIVES

1. 1.00 credits of Approved Arts and/or Social Science electives

2. 5.50 credits from either the Mathematics Stream or the Statistics Stream as follows:

3. 2.50 credits from an Area of Emphasis

Mathematics Stream:

MATH*2210 [0.50] Advanced Calculus II
MATH*2270 [0.50] Applied Differential Equations
MATH*3160 [0.50] Linear Algebra II
MATH*3200 [0.50] Real Analysis

0.50 additional credits in MATH at 3000 level or above

3.00 additional credits in MATH or STAT at 3000 level or above of which at least 1.50 credits must be MATH at the 4000 level

Statistics Stream:

STAT*3110 [0.50] Introductory Mathematical Statistics II
STAT*3240 [0.50] Applied Regression Analysis

0.50 additional credits in MATH at 3000 level or above

1.00 additional credits in MATH or STAT at 2000 level or above

1.00 additional credits in MATH or STAT at 3000 level or above of which at least 1.50 credits must be STAT at the 4000 level

AREAS OF EMPHASIS

BIOMATHEMATICAL OR BIOSTATISTICAL MODELLING (BBM)

The following credits must be taken:

BIOL*2400 [0.50] Ecology
BIOL*2400 [0.50] Evolution
BIOL*2500 [0.50] Populations, Communities & Ecosystems

0.50 additional credits in MATH at 3000 level or above

1.00 additional credits in MATH or STAT at 3000 level or above

3.00 additional credits in MATH or STAT at 3000 level or above of which at least 1.50 credits must be STAT at the 4000 level

BIOMATHEMATICAL OR BIOSTATISTICAL MODELLING (BBM)

The following credits must be taken:

BIOL*2060 [0.50] Ecology

0.50 additional credits in MATH at 3000 level or above

1.00 additional credits in MATH or STAT at 3000 level or above

3.00 additional credits in MATH or STAT at 3000 level or above of which at least 1.50 credits must be STAT at the 4000 level

COMPUTER SCIENCE (CS)

The following credits must be taken:

CIS*2430 [0.50] Object Oriented Programming
CIS*2500 [0.50] Intermediate Programming
CIS*2520 [0.50] Data Structures

at least 1.00 credits from:

CIS*3110 [0.50] Operating Systems I
CIS*3190 [0.50] Software for Legacy Systems
CIS*3490 [0.50] The Analysis and Design of Computer Algorithms
CIS*3530 [0.50] Data Base Systems and Concepts

Note: CIS*2750 is recommended in addition to the Area of Emphasis requirements for students interested in Computer Science

ECONOMICS (ECON)

The following credits must be taken:

ECON*1050 [0.50] Introductory Microeconomics
ECON*1100 [0.50] Introductory Macroeconomics
ECON*2310 [0.50] Intermediate Microeconomics

at least 1.00 credits from:

ECON*3100 [0.50] Game Theory
ECON*3710 [0.50] Advanced Microeconomics
ECON*4710 [0.50] Advanced Topics in Microeconomics

Note: ECON*1050 and ECON*1100 are approved Arts or Social Science electives for B.Sc. students

ENERGY AND MASS TRANSFER (EMT)

The following credits must be taken:

ENGG*1210 [0.50] Engineering Mechanics I
ENGG*2230 [0.50] Fluid Mechanics
ENGG*2400 [0.50] Engineering Systems Analysis
ENGG*3260 [0.50] Thermodynamics
ENGG*3430 [0.50] Heat and Mass Transfer

Note: No more than 3.00 credits in ENGG courses may be taken.

ELECTRICITY AND SYSTEMS (EAS)

The following credits must be taken:

ENGG*1210 [0.50] Engineering Mechanics I
ENGG*2400 [0.50] Engineering Systems Analysis
ENGG*2450 [0.50] Electric Circuits

at least 1.00 credits from:

ENGG*3410 [0.50] Systems and Control Theory
ENGG*3450 [0.50] Electronic Devices
ENGG*4460 [0.50] Robotic Systems

Note: No more than 3.00 credits in ENGG courses may be taken.

SIGNAL PROCESSING (SP)

The following credits must be taken:

ENGG*1210 [0.50] Engineering Mechanics I
ENGG*2400 [0.50] Engineering Systems Analysis
ENGG*2450 [0.50] Electric Circuits
ENGG*3390 [0.50] Signal Processing
ENGG*4660 [0.50] Medical Image Processing

Note: No more than 3.00 credits in ENGG courses may be taken.

INDIVIDUALIZED (IN)

It is required that 2.5 credits are taken from approved Science electives for B.Sc. students where 1.00 credits must be at the 3000 level or above.

Credit Summary (20.00 Total Credits)

5.00 - First year science credits

3.00 - Required science courses semesters 3 – 8

8.00 - Restricted electives (Stream and Area of Emphasis)

1.00 - Arts and/or Social Science electives (# in restricted elective list)

3.00 - Free electives - any approved elective for B.Sc. students. (Could be less if restricted electives do not count as science)

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

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. CIS*2050 and CIS*3000 cannot be counted toward this minor. This minor cannot be combined with a major in Mathematics, Statistics, or Bachelor of Computing program.

Mathematics (MATH)

Department of Mathematics and Statistics, College of Engineering and Physical Sciences

Knowledge of mathematics is crucial for understanding our world. The Minor in Mathematics is designed to provide considerable flexibility for students to pursue their own mathematical interests, whether they be in the concepts of "pure" mathematics or techniques and applications. Students minoring in Mathematics will develop skills that are valued in many sectors such as business, education, government, and industry.

Minor (Honours Program)

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

(MATH*1080 or MATH*1200)*

(MATH*1210 or MATH*2080)**

MATH*1160 [0.50] Linear Algebra I
MATH*2200 [0.50] Advanced Calculus I
STAT*2040 [0.50] Statistics I

1.00 additional Mathematics credits at the 2000 level or above.

1.50 additional Mathematics credits at the 3000 or 4000 level.

* IPS*1500 can count toward this 0.50 credit

** IPS*1510 can count toward this 0.50 credit

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 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 may wish to consult the Faculty Advisor.

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*1080 [0.50] Physics for Life Sciences

0.50 Arts or Social Science electives
Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found 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*1070 [0.50] Physics for Life Sciences

0.50 Arts or Social Science electives

Semester 3
BIOL*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
BIOL*3560 [0.50] Structure and Function in Biochemistry
MBG*3050 [0.50] Molecular Biology of the Cell
MICR*3230 [0.50] Methods in Microbial Culture and Physiology

0.50 electives
0.50 Arts or Social Science electives

Semester 5
MBG*3080 [0.50] Bacterial Genetics
MICR*3240 [0.50] Microbial Diversity

1.50 electives or restricted electives

Semester 6
MBG*3350 [0.75] Laboratory Methods in Molecular Biology I
MICR*3360 [0.50] Microbial Adaptation
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 Electives
1. A minimum of 2.00 credits of Arts and/or Social Science electives are required. The list of approved Arts and Social Science electives for B.S.c. students is available at: http://www.bsc.uoguelph.ca/Approved_electives.shtml#arts

2. 3.50 restricted elective credits of which 1.00 credits must be at the 4000 level.

   BIOC*4540 [0.75] Enzymology
   BIOC*4580 [0.50] Membrane Biochemistry
   ENS*3290 [0.50] Waterborne Disease Ecology
   FOOD*3230 [0.75] Food Microbiology
   FOOD*3240 [0.50] Food Microbiology
   FOOD*3260 [0.50] Industrial Microbiology
   FOOD*3270 [0.50] Industrial Microbiology
   FOOD*4400 [0.50] Dairy Processing
   MCB*3010 [0.50] Dynamics of Cell Function and Signaling
   MCB*4500 [1.00] Research Project in Molecular & Cellular Biology I
   MCB*4510 [1.00] Research Project in Molecular & Cellular Biology II
   MCB*4600 [0.50] Topics in Molecular and Cellular Biology
   MICR*3090 [0.50] Mycology
   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*4280 [0.50] Microbial Ecology
   MICR*4330 [0.50] Microbial Ecology
   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

Credit Summary (20.00 Total Credits)

4.00 - First year science core

6.25 - Required course science courses semesters 3 - 8
3.50 - Restricted electives (#2 in restricted electives list)
2.25 - Approved Science electives
2.00 - Approved Arts and/or Social Science electives (#1 in restricted electives list)
2.00 - Free electives - any approved electives for B.Sc. students.

Of the total credits required, students are required to complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

Minor (Honours Program)
The minor in Microbiology consists of the following 5.00 credits including:

   BIOC*3560 [0.50] Structure and Function in Biochemistry
   MICR*2420 [0.50] Introduction to Microbiology
   MICR*2430 [0.50] Methods in Microbial Culture and Physiology

A minimum of 2.50 credits from:

   FOOD*3230 [0.75] Food Microbiology
   FOOD*3240 [0.50] Food Microbiology
   FOOD*3260 [0.50] Industrial Microbiology
   FOOD*3270 [0.50] Industrial Microbiology
   MBG*3080 [0.50] Bacterial Genetics
   MBG*3350 [0.75] Laboratory Methods in Molecular Biology I
   MICR*3090 [0.50] Mycology
   MICR*3220 [0.50] Plant Microbiology
   MICR*3230 [0.50] Immunology
   MICR*3260 [0.50] Microbial Adaptation
   MICR*3330 [0.50] World of Viruses
   MICR*3420 [0.50] Microbial Diversity
   MICR*3430 [0.50] Microbiology Methods II

1.00 credits from:

   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*4520 [0.50] Microbial Cell Biology
   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 4 and courses BIOL*1070, BIOL*1080, BIOL*1090 and MICR*2430. Students in the co-op program must also complete COOP*1100. COOP*1100 is taken in semester 3. 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.

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*1080 [0.50] Physics for Life Sciences

0.50 Arts or Social Science electives
Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found 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*1070 [0.50] Physics for Life Sciences

0.50 Arts or Social Science electives
Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at http://www.bsc.uoguelph.ca/revisedss

Summer Semester
No academic semester or work term

Semester 3 - Fall
BIOC*2580 [0.50] Introduction to Biochemistry
COOP*1000 [0.00] Introduction to Co-operative Education
MBG*2040 [0.50] Foundations in Molecular Biology and Genetics
MICR*2420 [0.50] Introduction to Microbiology

0.50 Arts or Social Science electives

2017-2018 Undergraduate Calendar

Last Revision: August 17, 2017
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 may wish to consult the Faculty Advisor.

**Major (Honours Program)**

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

**Semester 1**
- BIOI*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*1080 [0.50] Physics for Life Sciences

**Semester 2**
- BIOI*1070 [0.50] Discovering Biodiversity
- BIOI*1080 [0.50] Biological Concepts of Health
- CHEM*1050 [0.50] General Chemistry II
- PHYS*1085 [0.50] Physics for Life Sciences II

**Semester 3**
- BIOI*2580 [0.50] Introduction to Biochemistry
- MBG*2400 [0.50] Foundations in Molecular Biology and Genetics
- MCB*2420 [0.50] Introduction to Microbiology
- STAT*2045 [0.50] Statistics I

**Semester 4**
- BIOI*3560 [0.50] Structure and Function in Biochemistry
- MCB*2050 [0.50] Molecular Biology of the Cell
- MCB*2430 [0.50] Methods in Microbial Culture and Physiology
- STAT*2050 [0.50] Statistics II

**Semester 5**
- MCB*4500 [1.00] Research Project in Molecular & Cellular Biology I
- MCB*4510 [1.00] Research Project in Molecular & Cellular Biology II
- MCB*4520 [1.00] Research Project in Molecular & Cellular Biology III
- MCB*4530 [1.00] Research Project in Molecular & Cellular Biology IV

**Semester 6**
- MCB*4540 [1.00] Research Project in Molecular & Cellular Biology V
- MCB*4550 [1.00] Research Project in Molecular & Cellular Biology VI
- MCB*4560 [1.00] Research Project in Molecular & Cellular Biology VII
- MCB*4570 [1.00] Research Project in Molecular & Cellular Biology VIII

**Semester 7**
- MCB*4580 [1.00] Research Project in Molecular & Cellular Biology IX
- MCB*4590 [1.00] Research Project in Molecular & Cellular Biology X
- MCB*4600 [1.00] Research Project in Molecular & Cellular Biology XI
- MCB*4610 [1.00] Research Project in Molecular & Cellular Biology XII

**Semester 8**
- MCB*4620 [1.00] Research Project in Molecular & Cellular Biology XIII
- MCB*4630 [1.00] Research Project in Molecular & Cellular Biology XIV
- MCB*4640 [1.00] Research Project in Molecular & Cellular Biology XV
- MCB*4650 [1.00] Research Project in Molecular & Cellular Biology XVI

**Restricted Electives**
- BIOL*3200 [0.50] Biomedical Physiology
- BOT*3310 [0.50] Plant Growth and Development
- HK*2810 [0.50] Human Physiology I - Concepts and Principles
- ZOO*3600 [0.50] Comparative Animal Physiology I
- MCB*4500 [1.00] Research Project in Molecular & Cellular Biology I
- MCB*4510 [1.00] Research Project in Molecular & Cellular Biology II
- MCB*4520 [1.00] Research Project in Molecular & Cellular Biology III
- MCB*4530 [1.00] Research Project in Molecular & Cellular Biology IV
- MCB*4540 [1.00] Research Project in Molecular & Cellular Biology V
- MCB*4550 [1.00] Research Project in Molecular & Cellular Biology VI
- MCB*4560 [1.00] Research Project in Molecular & Cellular Biology VII
- MCB*4570 [1.00] Research Project in Molecular & Cellular Biology VIII
- MCB*4580 [1.00] Research Project in Molecular & Cellular Biology IX
- MCB*4590 [1.00] Research Project in Molecular & Cellular Biology X
- MCB*4600 [1.00] Research Project in Molecular & Cellular Biology XI
- MCB*4610 [1.00] Research Project in Molecular & Cellular Biology XII
- MCB*4620 [1.00] Research Project in Molecular & Cellular Biology XIII
- MCB*4630 [1.00] Research Project in Molecular & Cellular Biology XIV
- MCB*4640 [1.00] Research Project in Molecular & Cellular Biology XV
- MCB*4650 [1.00] Research Project in Molecular & Cellular Biology XVI
- MCB*4660 [1.00] Research Project in Molecular & Cellular Biology XVII
- MCB*4670 [1.00] Research Project in Molecular & Cellular Biology XVIII

**Credit Summary (20.00 Total Credits)**
- 4.00 - First year science core
- 6.25 - Required science courses semesters 3 - 8
- 3.50 - Restricted electives (# 2 in restricted electives list)
- 2.25 - Approved Science electives
- 2.00 - Approved Arts and/or Social Science electives
- 2.00 - Free electives - any approved electives for B.Sc. students.

**Molecular Biology and Genetics (MBG)**

Department of Molecular and Cellular Biology, College of Biological Science
MBG*4110 [0.50] Epigenetics
MBG*4160 [0.50] Plant Breeding
MBG*4240 [0.50] Applied Molecular Genetics in Medicine and Biotechnology
MBG*4270 [0.50] DNA Replication, Recombination and Repair
MBG*4300 [0.50] Plant Molecular Genetics
MCB*3010 [0.50] Dynamics of Cell Function and Signaling
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

Credit Summary (20.00 Total Credits)

4.00 - First year science core
7.75 - Required science courses semesters 3 - 8
3.00 - Restricted electives (#2 and 3 in restricted electives list)
1.25 - Approved science electives
2.00 - Arts and/or Social Science electives (#1 in the restricted electives list)
2.00 - Free electives - any approved elective for B.Sc. Students

Of the total credits required, students are required to complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

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
MBG*2050 [0.50] Molecular Biology of the Cell

A minimum of 4.00 credits from:

BIOL*3560 [0.50] Structure and Function in Biochemistry
BIOL*3020 [0.50] Population Genetics
BIOL*3300 [0.50] Applied Bioinformatics
MBG*2400 [0.50] Fundamentals of Plant and Animal Genetics
MBG*3040 [0.50] Molecular Biology of the Gene
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*3350 [0.75] Laboratory Methods in Molecular Biology I
MBG*3660 [0.50] Genomics
MBG*4030 [0.50] Animal Breeding Methods and Applications
MBG*4040 [0.50] Genetics and Molecular Biology of Development
MBG*4110 [0.50] Epigenetics
MBG*4160 [0.50] Plant Breeding
MBG*4240 [0.50] Applied Molecular Genetics in Medicine and Biotechnology
MBG*4270 [0.50] DNA Replication, Recombination and Repair
MBG*4300 [0.50] Plant Molecular Genetics
MCB*3010 [0.50] Dynamics of Cell Function and Signaling
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 Engineering and Physical Sciences.

Major (Honours Program)
The major will require the completion of 20.00 credits as indicated below.

Semester 1

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL*1090 [0.50]</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1040 [0.50]</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>IPS*1500 [1.00]</td>
<td>Integrated Mathematics and Physics I</td>
</tr>
<tr>
<td>NANO*1000 [0.50]</td>
<td>Introduction to Nanoscience</td>
</tr>
</tbody>
</table>

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](http://www.bsc.uoguelph.ca/revisedss)

Semester 2

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>CHEM*1050 [0.50]</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>IPS*1510 [1.00]</td>
<td>Integrated Mathematics and Physics II</td>
</tr>
<tr>
<td>MATH*1160 [0.50]</td>
<td>Linear Algebra I</td>
</tr>
</tbody>
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One of

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL*1070 [0.50]</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1080 [0.50]</td>
<td>Biological Concepts of Health</td>
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<table>
<thead>
<tr>
<th>Semester 3</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM*2060 [0.50]</td>
<td>Structure and Bonding</td>
</tr>
<tr>
<td>MATH*2270 [0.50]</td>
<td>Applied Differential Equations</td>
</tr>
<tr>
<td>NANO*2000 [0.50]</td>
<td>Synthesis and Characterization of Nanomaterials I</td>
</tr>
<tr>
<td>PHYS*2330 [0.50]</td>
<td>Electricity and Magnetism I</td>
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</tbody>
</table>

One of

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM*2820 [0.50]</td>
<td>Thermodynamics and Kinetics</td>
</tr>
<tr>
<td>PHYS*2240 [0.50]</td>
<td>Thermal Physics</td>
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<table>
<thead>
<tr>
<th>Semester 4</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM*2070 [0.50]</td>
<td>Structure and Spectroscopy</td>
</tr>
<tr>
<td>NANO*2100 [0.50]</td>
<td>Synthesis and Characterization of Nanomaterials II</td>
</tr>
<tr>
<td>PHYS*2310 [0.50]</td>
<td>Mechanics</td>
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1.00 electives*

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<thead>
<tr>
<th>Semester 5</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM*3860 [0.50]</td>
<td>Quantum Chemistry</td>
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<tr>
<td>PHYS*3230 [0.50]</td>
<td>Quantum Mechanics I</td>
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<tr>
<td>NANO*3500 [0.50]</td>
<td>Thin Film Science</td>
</tr>
<tr>
<td>NANO*3600 [0.50]</td>
<td>Computational Methods in Materials Science</td>
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</table>

1.00 electives

<table>
<thead>
<tr>
<th>Semester 6</th>
<th>Credits</th>
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<tbody>
<tr>
<td>NANO*3200 [0.50]</td>
<td>Nanolithographic Techniques</td>
</tr>
<tr>
<td>NANO*3300 [0.50]</td>
<td>Spectroscopy of Nanomaterials</td>
</tr>
</tbody>
</table>

1.50 electives

<table>
<thead>
<tr>
<th>Semester 7</th>
<th>Credits</th>
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<tbody>
<tr>
<td>NANO*4110 [0.50]</td>
<td>Biological Nanomaterials</td>
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<tr>
<td>NANO*4700 [0.50]</td>
<td>Concepts in Quantum Computing</td>
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1.50 electives

<table>
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<tr>
<th>Semester 8</th>
<th>Credits</th>
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<tbody>
<tr>
<td>NANO*4200 [0.50]</td>
<td>Topics in Nanomaterials</td>
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</table>

2.00 electives

* To take PHYS*3230 in semester 5, PHYS*2340 must be selected as an elective in semester 4.

Note: In semesters 7 and 8, the student must select to do either NANO*4900 or NANO*4910.

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

Chemistry: Inorganic

<table>
<thead>
<tr>
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<th>Credits</th>
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<tbody>
<tr>
<td>CHEM*2480</td>
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<tr>
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<td>CHEM*4620</td>
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<td>Semester 8</td>
<td>Credits</td>
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<tr>
<td>CHEM*2700</td>
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Chemistry: Organic

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<tr>
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<td>CHEM*3760</td>
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<tr>
<td>Semester 7</td>
<td>Credits</td>
</tr>
<tr>
<td>CHEM*4730</td>
<td></td>
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<tr>
<td>Semester 8</td>
<td>Credits</td>
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<tr>
<td>CHEM<em>2480, CHEM</em>4720</td>
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Chemistry: Physical/Analytical

<table>
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<tr>
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<th>Credits</th>
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<tbody>
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<td>CHEM*2480</td>
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<tr>
<td>Semester 5</td>
<td>Credits</td>
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<td>CHEM*3860</td>
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<tr>
<td>Semester 6</td>
<td>Credits</td>
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<tr>
<td>CHEM<em>3430 or CHEM</em>3870</td>
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<tr>
<td>Semester 7</td>
<td>Credits</td>
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<tr>
<td>CHEM*3440</td>
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<td>Semester 8</td>
<td>Credits</td>
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<td>CHEM<em>3430 or CHEM</em>3870</td>
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Engineering

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<tr>
<td>Semester 5</td>
<td>Credits</td>
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<tr>
<td>ENGG<em>2410, ENGG</em>3450</td>
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<tr>
<td>Semester 6</td>
<td>Credits</td>
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<tr>
<td>ENGG*4080</td>
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Mathematics and Statistics

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<th>Credits</th>
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<td>Semester 5</td>
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<tr>
<td>STAT*3100</td>
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<td>Semester 6</td>
<td>Credits</td>
</tr>
<tr>
<td>MATH*2130</td>
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<tr>
<td>Semester 7</td>
<td>Credits</td>
</tr>
<tr>
<td>MATH<em>3160, MATH</em>4240</td>
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Physics

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<th>Credits</th>
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<tr>
<td>Semester 5</td>
<td>Credits</td>
</tr>
<tr>
<td>MATH<em>2200, PHYS</em>3130</td>
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<tr>
<td>Semester 6</td>
<td>Credits</td>
</tr>
<tr>
<td>PHYS*3000</td>
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### Nanoscience (NANO:C)

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

**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. Students are eligible to participate in a maximum two (2) work terms commencing in the summer and must follow the academic work schedule as outlined in the Co-operative Education & Career Services website: [https://www.recruitguelph.ca/cces/](https://www.recruitguelph.ca/cces/).

#### Credit Summary (20.00 Total Credits)

4.50 - First year science credits

8.00 - Required science courses semesters 3 – 8

0.50 or 1.00- Restricted electives (either NANO 4900 (1.00) or NANO 4910 (0.50))

2.50 to 3.00 - Approved Science electives (depending on restricted elective chosen above)

1.00 - Arts and/or Social Science electives

3.00 - Free electives - any approved elective for B.Sc. students. (could be less if restricted electives do not count as science)

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

**Semester 1 - Fall**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
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<tbody>
<tr>
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<tr>
<td>CHEM*1040</td>
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<tr>
<td>IPS*1500</td>
<td>1.00</td>
</tr>
<tr>
<td>NANO*1000</td>
<td>0.50</td>
</tr>
</tbody>
</table>

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/revsedss](http://www.bsc.uoguelph.ca/revsedss)

**Semester 2 - Winter**

<table>
<thead>
<tr>
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<tr>
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<tr>
<td>IPS*1510</td>
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<td>MATH*1160</td>
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<tr>
<td>BIOL*1070</td>
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<td>BIOL*1080</td>
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**Semester 3 - Fall**

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<td>CHEM*2820</td>
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<td>PHYS*2240</td>
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**Semester 4 - Winter**

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<td>NANO*2100</td>
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<tr>
<td>PHYS*2310</td>
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<tr>
<td>1.00 electives*</td>
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**Summer Semester**

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**Semester 5 - Fall**

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<tr>
<td>NANO*3500</td>
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<td>CHEM*3860</td>
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<td>PHYS*3230</td>
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**Winter Semester**

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**Semester 6 - Fall**

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<tbody>
<tr>
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#### Credit Summary (20.00 Total Credits)

4.50 - First year science credits

8.00 - Required science courses semesters 3 – 8

0.50 or 1.00- Restricted electives (either NANO 4900 (1.00) or NANO 4910 (0.50))

2.50 to 3.00 - Approved Science electives (depending on restricted elective chosen above)

1.00 - Arts and/or Social Science electives

3.00 - Free electives - any approved elective for B.Sc. students. (could be less if restricted electives do not count as science)

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

### Neuroscience (NEUR)

Departments of Biomedical Sciences (Ontario Veterinary College), Human Health and Nutritional Sciences (College of Biological Science), Molecular & Cellular Biology (College of Biological Science), and Psychology (College of Social and Applied Human Science).

**Major (Honours Program)**

This Honours program provides a foundation in the natural sciences and an opportunity to develop advanced knowledge of nervous system structure and function, and the skills required for independent inquiry within neuroscience. The specialization is unique in its emphasis on integrative/interdisciplinary problem solving. Through the use of electives, students may structure a program that emphasizes molecular and biomedical neuroscience, behavioural and cognitive neuroscience, or comparative neuroscience.

The major prepares students for professional programs in health science (medical, physiotherapy, pharmacy, veterinary medicine, nursing), post-graduate degrees in neuroscience research, and provides a strong foundation for students wishing to pursue careers in the pharmaceutical and biotechnology industries, public health, teaching, and scientific publishing & journalism.

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

#### Credit Summary (20.00 Total Credits)

4.50 - First year science credits

8.00 - Required science courses semesters 3 – 8

0.50 or 1.00- Restricted electives (either NANO 4900 (1.00) or NANO 4910 (0.50))

2.50 to 3.00 - Approved Science electives (depending on restricted elective chosen above)

1.00 - Arts and/or Social Science electives

3.00 - Free electives - any approved elective for B.Sc. students. (could be less if restricted electives do not count as science)

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

Note: 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 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.

Note: In semesters 7 and 8, the student must select to do either NANO*4900 or NANO*4910.

### Mathematics (MATH)

College of Social and Applied Human Sciences

#### Degree Programs, Bachelor of Science (B.Sc.)

#### 2017-2018 Undergraduate Calendar
NEUR*2000 [0.50] Introduction to Neuroscience

One of:

- STAT*2040 [0.50] Statistics I
- PSYC*1010 [0.50] Making Sense of Data in Psychological Research

0.50 Arts or Social Science elective

Semester 4

- BIOM*3000 [0.50] Functional Mammalian Neuroanatomy
- MCB*2050 [0.50] Molecular Biology of the Cell
- PHYS*2030 [0.50] Biophysics of Excitable Cells

1.00 electives or restricted electives

Note: 0.50 credits in physiology from restricted elective list # 3 must be taken before registering in BIOM*3090 in semester 6.

Semester 5

- NEUR*3100 [0.50] Molecular Biology of Neurodevelopmental and Degenerative Disease
- PSYC*3270 [0.50] Cognitive Neuroscience
- PSYC*3410 [0.50] Behavioural Neuroscience II

1.00 electives or restricted electives

Note: 0.50 credits in physiology from restricted elective list # 3 must be taken before registering in BIOM*3090 in semester 6.

Semester 6

- BIOM*3090 [0.50] Principles of Pharmacology
- NEUR*3500 [0.50] Techniques in Neuroscience

1.50 electives or restricted electives

Semester 7

- NEUR*4000 [0.50] Current Issues in Neuroscience

- NEUR*4100 [0.50] Neuropharmacology

1.50 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. *Indicates courses that require additional prerequisites.

1. A minimum of 0.50 credits of Critical thinking/ Philosophy / Ethics from:

   - BIOM*3210 [0.50] Critical Thinking in the Health Sciences
   - PHIL*2100 [0.50] Critical Thinking
   - PHIL*2110 [0.50] Formal Logic
   - PHIL*2120 [0.50] Ethics
   - PHIL*2180 [0.50] Philosophy of Science
   - PHIL*2240 [0.50] Knowledge and Belief

   Note: if a PHIL course is completed from this list, students are required to take an additional 0.50 credit approved science course as an elective to ensure the total science requirement is met.

2. A minimum of 0.50 credits of Developmental biology

   - BIOM*3040 [0.75] Medical Embryology
   - MCB*3040 [0.50] Molecular Biology of the Gene
   - MCB*4040 [0.50] Genetics and Molecular Biology of Development
   - ZOO*3050 [0.50] Developmental Biology

3. A minimum of 0.50 credits of Physiology

   - BIOM*3200 [1.00] Biomedical Physiology
   - HK*2810 [1.00] Human Physiology I - Concepts and Principles
   - ZOO*3600 [0.50] Comparative Animal Physiology I

4. A minimum of 1.00 credits of Independent Study

   This requirement can be met by taking a literature study or research course. For students who are interested in graduate studies, a research course is recommended.

   *Indicates courses that have additional prerequisites.

   ** faculty advisor will determine if this course is an eligible science elective, depending on the instructor and topic

   - BIOM*4500 [0.50] Literature-based Research in Biomedical Sciences
   - BIOM*4510 [1.00] Research in Biomedical Sciences
   - BIOM*4521/2 [2.00] Research in Biomedical Sciences
   - 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
   - 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
   - MCB*4500 [1.00] Research Project in Molecular & Cellular Biology I *

   MCB*4510 [1.00] Research Project in Molecular & Cellular Biology II
   - NEUR*4600 [0.50] Topics in Molecular and Cellular Biology
   - NEUR*4401/2 [1.00] Research in Neurosciences
   - NEUR*4450 [1.00] Research in Neurosciences
   - PSYC*3240 [0.50] Independent Research Project **
   - PSYC*4240 [0.50] Advanced Independent Research Project **
   - PSYC*4870 [0.50] Honours Thesis I **
   - PSYC*4880 [1.00] Honours Thesis II **

5. A minimum of 0.50 credits of additional statistics or experimental design

   NEUR*2360 [0.50] Psychological Methods and Statistics
   - STAT*2050 [0.50] Statistics II

Lists of recommended electives

The following lists contain recommended electives for students wishing to emphasize particular areas in neuroscience.

*Indicates courses that require additional prerequisites.

Psychology

- PSYC*2330 [0.50] Principles of Learning
- PSYC*2390 [0.50] Sensation and Perception
- PSYC*2650 [0.50] Cognitive Psychology
- PSYC*3030 [0.50] Neurochemical Basis of Behaviour *
- PSYC*3100 [0.50] Evolutionary Psychology *
- PSYC*3330 [0.50] Memory and Attention *
- PSYC*3410 [0.50] Behavioural Neuroscience II
- PSYC*4470 [0.50] Advanced Topics in Behavioural and Cognitive Neuroscience
- PSYC*4750 [0.50] Seminar in Motivation and Emotion

Computational, Modeling and Statistics

- CIS*1500 [0.50] Introduction to Programming
- CIS*2500 [0.50] Intermediate Programming *
- MATH*1160 [0.50] Linear Algebra I
- MATH*2080 [0.50] Elements of Calculus II
- MATH*2270 [0.50] Applied Differential Equations *
- MATH*3510 [0.50] Biomathematics *
- PSYC*3250 [0.50] Psychological Measurement *
- PSYC*3320 [0.50] Conducting Statistical Analyses in Psychology *
- PSYC*3340 [0.50] Research Methods in Psychology *
- STAT*3240 [0.50] Applied Regression Analysis *

Biological Science

- BIOC*3560 [0.50] Structure and Function in Biochemistry
- BIOC*4580 [0.50] Membrane Biochemistry *
- BIOM*4070 [0.50] Biomedical Histology *
- MBG*3050 [0.50] Human Genetics
- MCB*3010 [0.50] Dynamics of Cell Function and Signaling
- MCB*4010 [0.50] Advanced Cell Biology
- ZOO*3000 [0.50] Comparative Histology

Health & Disease

- BIOM*3040 [0.75] Medical Embryology *
- BIOM*4030 [0.50] Endocrine Physiology *
- BIOM*4050 [0.50] Biomedical Aspects of Aging *
- HK*3100 [0.50] Neuromuscular Physiology *
- HK*3810 [0.75] Human Physiology II - Integrated Systems *
- HK*4070 [0.50] Clinical Biomechanics *
- TOX*4000 [0.50] Medical Toxicology *

Credit Summary (20.00 Total Credits)

4.00 – First year science core

7.00 – Required science courses semester 3-8

3.00 – Restricted elective (#1,2,3,4,5 in restricted electives list)

2.00 – Approved Science elective*

0.50 - Required arts and social science elective (PSYC*1000)

1.00 – Arts and/or Social Science electives

2.50 – Free electives

Of the 20 total credits required, students must complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

*2.50 Approved Science Electives if a PHIL*XXXX course is selected for restricted electives #1

Minor (Honours Program)

A minor in Neuroscience requires a minimum of 5.00 credits including:

- NEUR*2000 [0.50] Introduction to Neuroscience
- NEUR*3100 [0.50] Molecular Biology of Neurodevelopmental and Degenerative Disease
- PSYC*1000 [0.50] Introduction to Psychology
- PSYC*2330 [0.50] Principles of Learning

0.50 credits from:
X. Degree Programs, Bachelor of Science (B.Sc.)

2017-2018 Undergraduate Calendar

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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.

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, spreadsheet 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 may wish to consult the Faculty Advisor. A total of 20.00 credits is required.

Semester 1

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1080</td>
<td>0.50</td>
<td>Biological Concepts of Health</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>0.50</td>
<td>General Chemistry 1</td>
</tr>
<tr>
<td>MATH*1080</td>
<td>0.50</td>
<td>Elements of Calculus I</td>
</tr>
<tr>
<td>PHYS*1080</td>
<td>0.50</td>
<td>Physics for Life Sciences</td>
</tr>
</tbody>
</table>

0.50 Arts or Social Science electives

Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found at http://www.bsc.uoguelph.ca/revisedss.

Semester 2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1070</td>
<td>0.50</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>BIOL*1090</td>
<td>0.50</td>
<td>Introduction to Molecular and Cellular Biology</td>
</tr>
<tr>
<td>CHEM*1050</td>
<td>0.50</td>
<td>General Chemistry II</td>
</tr>
<tr>
<td>PHYS*1070</td>
<td>0.50</td>
<td>Physics for Life Sciences II</td>
</tr>
</tbody>
</table>

0.50 arts or social science electives

Semester 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*2580</td>
<td>0.50</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>MBG*2040</td>
<td>0.50</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>STAT*2040</td>
<td>0.50</td>
<td>Statistics I</td>
</tr>
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</table>

0.50 electives or restricted electives

Semester 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*3560</td>
<td>0.50</td>
<td>Structure and Function in Biochemistry</td>
</tr>
<tr>
<td>HK*2810</td>
<td>0.50</td>
<td>Human Physiology I - Concepts and Principles</td>
</tr>
<tr>
<td>MCB*2050</td>
<td>0.50</td>
<td>Molecular Biology of the Cell</td>
</tr>
<tr>
<td>NUTR*3210</td>
<td>0.50</td>
<td>Fundamentals of Nutrition</td>
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</table>

0.50 arts or social science electives

Semester 5

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>HK*3810</td>
<td>0.75</td>
<td>Human Physiology II - Integrated Systems</td>
</tr>
<tr>
<td>NUTR*3330</td>
<td>0.50</td>
<td>Micronutrients, Phytochemicals and Health</td>
</tr>
<tr>
<td>NUTR*3360</td>
<td>0.50</td>
<td>Lifestyle Genomics</td>
</tr>
<tr>
<td>NUTR*3390</td>
<td>0.75</td>
<td>Applied Nutritional and Nutraceutical Sciences I</td>
</tr>
</tbody>
</table>

Semester 6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOM*3090</td>
<td>0.50</td>
<td>Principles of Pharmacology</td>
</tr>
<tr>
<td>NUTR*4090</td>
<td>0.50</td>
<td>Functional Foods and Nutraceuticals</td>
</tr>
<tr>
<td>NUTR*4320</td>
<td>0.50</td>
<td>Nutrition and Metabolic Control of Disease</td>
</tr>
<tr>
<td>NUTR*4330</td>
<td>0.75</td>
<td>Applied Nutritional and Nutraceutical Sciences II</td>
</tr>
</tbody>
</table>

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

Semester 7

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUTR*4210</td>
<td>0.50</td>
<td>Nutrition, Exercise and Energy Metabolism</td>
</tr>
<tr>
<td>NUTR*4510</td>
<td>0.50</td>
<td>Toxicology, Nutrition and Food</td>
</tr>
</tbody>
</table>

1.50 electives or restricted electives

Semester 8

2.50 electives or restricted electives

Restricted Electives

1. 2.00 credits of Approved Arts and Social Science electives

2. 1.00 credits from the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>HK*4230</td>
<td>0.50</td>
<td>Advanced Study in Human Health and Nutritional Sciences</td>
</tr>
<tr>
<td>HK*4340</td>
<td>0.50</td>
<td>Genomics: Exercise and Disease</td>
</tr>
<tr>
<td>HK*4360</td>
<td>1.00</td>
<td>Research in Human Health and Nutritional Sciences</td>
</tr>
<tr>
<td>HK*4371/2</td>
<td>1.00</td>
<td>Research in Human Health and Nutritional Sciences II</td>
</tr>
<tr>
<td>HK*4510</td>
<td>1.00</td>
<td>Teaching, Learning &amp; Knowledge Transfer</td>
</tr>
<tr>
<td>HK*4512</td>
<td>1.00</td>
<td>Teaching, Learning &amp; Knowledge Transfer II</td>
</tr>
<tr>
<td>HK*4460</td>
<td>0.50</td>
<td>Regulation of Human Metabolism</td>
</tr>
<tr>
<td>NUTR*4360</td>
<td>0.50</td>
<td>Current Issues in Nutrigenomics</td>
</tr>
<tr>
<td>PATH*3610</td>
<td>0.50</td>
<td>Principles of Disease</td>
</tr>
</tbody>
</table>

Credit Summary (20.00 Total Credits)

4.00 - First year science core
9.25 - Required science courses semesters 3 - 8
1.00 - Restricted electives (#2 in restricted electives list)
1.75 - Approved science electives
2.00 - Approved Arts and/or Social Science electives (#1 in restricted electives list)
2.00 - Free electives - any approved electives for B.Sc. students.

Of the total credits required, students are required to complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

Minor (Honours Program)

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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*2580</td>
<td>0.50</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>NUTR*3210</td>
<td>0.50</td>
<td>Fundamentals of Nutrition</td>
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<tr>
<td>NUTR*3330</td>
<td>0.50</td>
<td>Micronutrients, Phytochemicals and Health</td>
</tr>
<tr>
<td>NUTR*4090</td>
<td>0.50</td>
<td>Functional Foods and Nutraceuticals</td>
</tr>
<tr>
<td>STAT*2040</td>
<td>0.50</td>
<td>Statistics I</td>
</tr>
</tbody>
</table>

At least 0.50 credits from:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*3080</td>
<td>0.50</td>
<td>Agricultural Animal Physiology (restricted to ABIO majors)</td>
</tr>
<tr>
<td>BIOM*3200</td>
<td>1.00</td>
<td>Biomedical Physiology</td>
</tr>
<tr>
<td>HK*2810</td>
<td>0.50</td>
<td>Human Physiology I - Concepts and Principles</td>
</tr>
<tr>
<td>ZOO*3600</td>
<td>0.50</td>
<td>Comparative Animal Physiology I</td>
</tr>
</tbody>
</table>

and 2.00 credits from:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSC*3170</td>
<td>0.50</td>
<td>Nutrition of Fish and Crustacea</td>
</tr>
<tr>
<td>ANSC*3180</td>
<td>0.50</td>
<td>Wildlife Nutrition</td>
</tr>
<tr>
<td>ANSC*4260</td>
<td>0.50</td>
<td>Beef Cattle Nutrition</td>
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<tr>
<td>ANSC*4270</td>
<td>0.50</td>
<td>Dairy Cattle Nutrition</td>
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<td>ANSC*4280</td>
<td>0.50</td>
<td>Poultry Nutrition</td>
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<tr>
<td>ANSC*4290</td>
<td>0.50</td>
<td>Swine Nutrition</td>
</tr>
<tr>
<td>ANSC*4560</td>
<td>0.50</td>
<td>Pet Nutrition</td>
</tr>
<tr>
<td>EQU*4020</td>
<td>0.50</td>
<td>Advanced Equine Nutrition</td>
</tr>
<tr>
<td>FOOD*2010</td>
<td>0.50</td>
<td>Principles of Food Science</td>
</tr>
<tr>
<td>HK*3810</td>
<td>0.75</td>
<td>Human Physiology II - Integrated Systems</td>
</tr>
<tr>
<td>HK*4230</td>
<td>0.50</td>
<td>Advanced Study in Human Health and Nutritional Sciences</td>
</tr>
<tr>
<td>HK*4340</td>
<td>0.50</td>
<td>Genomics: Exercise and Disease</td>
</tr>
<tr>
<td>HK*4360</td>
<td>1.00</td>
<td>Research in Human Health and Nutritional Sciences</td>
</tr>
<tr>
<td>HK*4371/2</td>
<td>1.00</td>
<td>Research in Human Health and Nutritional Sciences II</td>
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<td>HK*4510</td>
<td>1.00</td>
<td>Teaching, Learning &amp; Knowledge Transfer</td>
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<tr>
<td>HK*4512</td>
<td>1.00</td>
<td>Teaching, Learning &amp; Knowledge Transfer II</td>
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<tr>
<td>HK*4460</td>
<td>0.50</td>
<td>Regulation of Human Metabolism</td>
</tr>
<tr>
<td>NUTR*3390</td>
<td>0.75</td>
<td>Applied Nutritional and Nutraceutical Sciences I</td>
</tr>
<tr>
<td>NUTR*4210</td>
<td>0.50</td>
<td>Nutrition, Exercise and Energy Metabolism</td>
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<tr>
<td>NUTR*4320</td>
<td>0.50</td>
<td>Nutrition and Metabolic Control of Disease</td>
</tr>
<tr>
<td>NUTR*4330</td>
<td>0.75</td>
<td>Applied Nutritional and Nutraceutical Sciences II</td>
</tr>
</tbody>
</table>
NUTR*4360 [0.50] Current Issues in Nutrigenomics
NUTR*4510 [0.50] Toxicology, Nutrition and Food

Physical Science (PSCI)

College of Engineering and Physical Sciences

Major (Honours Program)

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major may wish to 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*1080, (1 of PHYS*1010, PHYS*1070, PHYS*1130))*
   1.00 - Mathematical Science [(MATH*1080, MATH*2080) or (MATH*1200, MATH*1210)]
   * IPS*1500 can be taken instead of PHYS*1080 and MATH*1200, and IPS*1510 can be taken instead of PHYS*1010 and 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
PHYS*1080 [0.50] Physics for Life Sciences
One of:
   MATH*1080 [0.50] Elements of Calculus I
   MATH*1200 [0.50] Calculus I
   * IPS*1500 can be taken instead of PHYS*1080 and MATH*1200.
   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 lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found 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
   IPS*1510 can be taken instead of PHYS*1010 and MATH*1210.
   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

Credit Summary (20.00 Total Credits)

4.00 - First year science credits
8.00 - Subject area core semesters 3 – 8 (including STAT 2040 and CIS 1200 or CIS 1500)
4.00 - Approved Science electives
2.00 - Arts and/or Social Science electives (#1 in restricted elective list)
2.00 - Free electives - any approved elective for B.Sc. students. (could be less if restricted electives do not count as science)

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

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 Engineering and Physical Sciences

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major may wish to 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 20.00 credits. At least 1.00 credits must be from Arts and/or Social Science courses.

Semester 1*

CHEM*1040 [0.50] General Chemistry I
IPS*1500 [1.00] Introduction to Programming
MATH*1160 [0.50] Linear Algebra 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

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 this 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
CIS*1500 [0.50] Introduction to Programming
IPS*1510 [1.00] Integrated Mathematics and Physics 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

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 this subject should be completed according to the revised schedule of studies available at: http://www.bsc.uoguelph.ca/revisedss

Semester 3

MATH*2200 [0.50] Advanced Calculus I
MATH*2270 [0.50] Applied Differential Equations
PHYS*2240 [0.50] Thermal Physics
PHYS*2330 [0.50] Electricity and Magnetism I
0.50 Arts or Social Science electives

Semester 4

PHYS*2180 [0.50] Experimental Techniques in Physics
PHYS*2310 [0.50] Mechanics
PHYS*2340 [0.50] Electricity and Magnetism II
1.00 electives

2017-2018 Undergraduate Calendar

Last Revision: August 17, 2017
Semester 5
NANO*3600 [0.50] Computational Methods in Materials Science
PHYS*3130 [0.50] Mathematical Physics
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3400 [0.50] Advanced Mechanics
0.50 electives

Semester 6
PHYS*3000 [0.50] Optics: Fundamentals and Applications
PHYS*3510 [0.50] Intermediate Laboratory
PHYS*4040 [0.50] Quantum Mechanics II
PHYS*4300 [0.50] Inquiry in Physics
One of:
  MATH*3260 [0.50] Complex Analysis
  0.50 electives

Semester 7+
PHYS*4500 [0.50] Advanced Physics Laboratory
PHYS*4180 [0.50] Advanced Electromagnetic Theory
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 **

Semester 8+
One of:
  PHYS*4002 [0.50] Research in Physics
  0.50 electives
  2.00 electives **
+ students going on to graduate school in physics should take PHYS*4001/2, PHYS*4120, PHYS*4130, PHYS*4150, 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.

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
ENV*3060 [0.50] Groundwater
GEOG*3420 [0.50] Remote Sensing of the Environment
MATH*3200 [0.50] Real Analysis
PHYS*3170 [0.50] Radioactivity and Radiation Interactions
PHYS*4070 [0.50] Clinical Applications of Physics in Medicine
PHYS*4540 [0.50] Molecular Biophysics
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

Credit Summary (20.00 Total Credits)
5.00 - First year science credits
8.50 - Required science courses semesters 3 – 8
1.50 - Restricted electives (1.00 credits from List A and 0.50 credits from List B, some restricted electives from List B do not count as science electives towards degree therefore may need additional science electives)
1.00 or 1.50 - Approved Science electives (depending on restricted electives chosen)
1.00 - Arts and/or Social Science electives
2.50 - 3.00 - Free electives - any approved elective for B.Sc. students, could be less if restricted electives do not count as science

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

Minor (Honours Program)
A minor in Physics requires 5.00 credits in interdisciplinary physical science or physics courses including:
PHYS*2180 [0.50] Experimental Techniques in Physics
PHYS*2310 [0.50] Mechanics
PHYS*2330 [0.50] Electricity and Magnetism I
PHYS*2340 [0.50] Electricity and Magnetism II
A maximum of 1.00 credits from the following courses may be used towards the minor:
PHYS*1010 [0.50] Introductory Electricity and Magnetism
PHYS*1070 [0.50] Physics for Life Sciences II
PHYS*1080 [0.50] Physics for Life Sciences
PHYS*1130 [0.50] Physics with Applications
IPS*1510 [1.00] Integrated Mathematics and Physics II
A minimum of 1.00 credits are required at the 3000 or 4000 level.

Note: PHYS*1300, PHYS*1600 and PHYS*1810 may not be taken for credit toward this minor.

Physics (Co-op) (PHYS:C)
Department of Physics, College of Engineering and Physical Sciences
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, successfully completed work terms are required. Students are eligible to participate in a maximum two (2) work terms commencing in the summer and must follow the academic work schedule as outlined in the Co-operative Education & Career Services website: https://www.recruitguelph.ca/recruit/cecs/.

Major (Honours Program)
This major requires the completion of 20.00 credits.

Semester 1 - Fall
CHEM*1040 [0.50] General Chemistry I
IPS*1500 [1.00] Integrated Mathematics and Physics I
MATH*1160 [0.50] Linear Algebra 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 Cell 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/revisedhs.

Semester 2 - Winter
CHEM*1050 [0.50] General Chemistry II
CIS*1500 [0.50] Introduction to Programming
IPS*1510 [1.00] Integrated Mathematics and Physics 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 Cell Biology

Semester 3 - Fall
COOP*1100 [0.00] Introduction to Co-operative Education
MATH*2200 [0.50] Advanced Calculus I
MATH*2270 [0.50] Applied Differential Equations
PHYS*2240 [0.50] Thermal Physics
PHYS*2330 [0.50] Electricity and Magnetism I
0.50 Arts or Social Science electives*

Semester 4 - Winter
PHYS*2180 [0.50] Experimental Techniques in Physics
PHYS*2310 [0.50] Mechanics
PHYS*2340 [0.50] Electricity and Magnetism II
One of:
  CIS*2500 [0.50] Intermediate Programming
  0.50 electives
  0.50 electives

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

Semester 5 - Fall
NANO*3600 [0.50] Computational Methods in Materials Science
PHYS*3130 [0.50] Mathematical Physics
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3400 [0.50] Advanced Mechanics
0.50 electives

Winter Semester
COOP*2000 [0.00] Co-op Work Term II ++
(8-month work term in conjunction with COOP*3000)

Summer Semester
COOP*3000 [0.00] Co-op Work Term III ++
(8-month work term in conjunction with COOP*2000)

Semester 6 - Fall +
PHYS*4180 [0.50] Advanced Electromagnetic Theory
One of:
  CIS*2520 [0.50] Data Structures
  0.50 electives**

Last Revision: August 17, 2017
2017-2018 Undergraduate Calendar
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 may wish to consult the Faculty Advisor. The major requires the completion of 20.00 credits.

Semester 1
BIOL*1070 [0.50] Discovering Biodiversity
CHEM*1040 [0.50] General Chemistry I
MATH*1080 [0.50] Elements of Calculus I
PHYS*1080 [0.50] Physics for Life Sciences

Semester 2
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1050 [0.50] General Chemistry II
PHYS*1070 [0.50] Physics for Life Sciences II

One of:
CIS*1200 [0.50] Introduction to Computing
CIS*1500 [0.50] Introduction to Programming
MATH*2080 [0.50] Elements of Calculus II

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

Semester 4
MCB*2050 [0.50] Molecular Biology of the Cell
STAT*2040 [0.50] Statistics I

One of:
AGR*2050 [0.50] Agroecology
BIOL*2060 [0.50] Ecology

Semester 5
BOT*3410 [0.50] Plant Anatomy

Semester 6
BOT*3310 [0.50] Plant Growth and Development
BOT*3710 [0.50] Plant Diversity and Evolution

Semester 7

Semester 8

Program Requirements
1. Students must declare an area of emphasis in one of the 4 following areas: Applied Plant Science, Botany, Plant Biotechnology, Plant Environmental Science or Unspecialized.

2. Students must complete at least 5.00 credits from within their area of emphasis

Restricted Electives
1. A minimum of 1.50 credits of Arts and Social Science electives
2. 5.00 credits from within their area of emphasis from the lists below

Note: Restricted electives indicated with * are non-science electives. If non-science restricted electives are chosen students are reminded that they will still be responsible for meeting the minimum requirement of 16.00 credits in science and that the credit summary may vary from what is specified below.

If non-science restricted electives are chosen, students are reminded that they will still be responsible for meeting the minimum of 16.00 credits in science and that the credit summary may vary from what is specified below.

Note: Restricted electives indicated with ** require other restricted electives as prerequisites. Students should consult the most recent undergraduate calendar for specific requirements.

‡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
**Area of Emphasis**

**Applied Plant Science (APSC)**

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<th>Description</th>
</tr>
</thead>
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<tr>
<td>CROP*4240</td>
<td>0.50</td>
<td>Weed Science</td>
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<tr>
<td>ENVS*2060</td>
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<td>Soil Science</td>
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<td>ENVS*3210</td>
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<td>Plant Pathology</td>
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<tr>
<td>ENVS*4100</td>
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<td>Integrated Management of Invasive Insect Pests **</td>
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‡ 3.00 credits from:

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<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Description</th>
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<tbody>
<tr>
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<td>Research Methods in Agricultural Science</td>
</tr>
<tr>
<td>CROP*3300</td>
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<td>Grain Crops</td>
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<td>CROP*3310</td>
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<td>Protein and Oilsse Crops</td>
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<td>Managed Grasslands</td>
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<td>CROP*4220</td>
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<td>Cropping Systems **</td>
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<td>Plant Health and the Environment</td>
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<td>ENVS*2340</td>
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<td>Current Issues in Agriculture and Landscape Management</td>
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<td>ENVS*3020</td>
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<td>Pesticides and the Environment</td>
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<tr>
<td>ENVS*3080</td>
<td>0.50</td>
<td>Soil and Water Conservation **</td>
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<td>ENVS*3140</td>
<td>0.50</td>
<td>Management of Turfgrass Diseases **</td>
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<tr>
<td>ENVS*3310</td>
<td>0.50</td>
<td>Soil Biodiversity and Ecosystem Function **</td>
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<tr>
<td>ENVS*4090</td>
<td>0.50</td>
<td>Soil Management</td>
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<td>HORT*2450</td>
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<td>Introduction to Turfgrass Science</td>
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<td>HORT*3010</td>
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<td>Annual, Perennial and Indoor Plants - Identification and Use</td>
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<td>Management of Turfgrass Insect Pests and Weeds **</td>
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<td>HORT*3150</td>
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<td>Principles and Applications of Plant Propagation</td>
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<td>HORT*3270</td>
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<td>Medicinal Plants</td>
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<td>HORT*3280</td>
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<td>Wine-Grape Culture</td>
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<td>HORT*4200</td>
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<td>HORT*4300</td>
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<td>HORT*4420</td>
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<td>Fruit Crops</td>
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<tr>
<td>HORT*4450</td>
<td>0.50</td>
<td>Advanced Turfgrass Science **</td>
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<td>LARC*2240</td>
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<td>Plants in the Landscape</td>
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<tr>
<td>MBG*2400</td>
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<td>Fundamentals of Plant and Animal Genetics</td>
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<tr>
<td>MBG*3100</td>
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<td>Plant Genetics</td>
</tr>
<tr>
<td>MBG*4160</td>
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<td>Plant Breeding</td>
</tr>
<tr>
<td>OAGR*2070</td>
<td>1.00</td>
<td>Introduction to Organic Agriculture</td>
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<tr>
<td>OAGR*4050</td>
<td>1.00</td>
<td>Design of Organic Production Systems</td>
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<tr>
<td>PBIO*3110</td>
<td>0.50</td>
<td>Crop Physiology</td>
</tr>
<tr>
<td>PBIO*3750</td>
<td>0.50</td>
<td>Plant Tissue Culture</td>
</tr>
<tr>
<td>PBIO*4150</td>
<td>0.50</td>
<td>Molecular and Cellular Aspects of Plant-Microbe Interactions</td>
</tr>
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</table>

**Molecular and Cellular Aspects of Plant-Microbe Interactions**

‡ 3.00 credits from:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGR*3450</td>
<td>0.50</td>
<td>Research Methods in Agricultural Science</td>
</tr>
<tr>
<td>MBG*3300</td>
<td>0.50</td>
<td>Plant Molecular Genetics</td>
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<td>MICR*2420</td>
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<td>Introduction to Microbiology</td>
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<td>MICR*3090</td>
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<td>Mycology</td>
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<td>MICR*3220</td>
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<td>Plant Microbiology</td>
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<td>PBIO*3110</td>
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<td>Crop Physiology</td>
</tr>
<tr>
<td>PBIO*3750</td>
<td>0.50</td>
<td>Plant Tissue Culture</td>
</tr>
</tbody>
</table>
Statistics plays a fundamental role in virtually all scientific disciplines, including biology, physics, chemistry, medicine, epidemiology, kinesiology, and toxicology. Students minoring in Statistics will develop practical skills in data visualization and analysis, statistical computational, technical writing and communication in a variety of applications areas, preparing them well for careers in the modern workplace.

Students may declare this minor in any semester.

Major (Honours Program)
A total of 5.00 credits is required to complete the minor, including:

(MATH*1080 or MATH*1200)*
(MATH*1210 or MATH*2080)**
MATH*1160 [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 at the 2000 level or above
* IPS*1500 can count toward this 0.50 credit
** IPS*1510 can count toward this 0.50 credit

Note: students may not count MATH*1030 toward a minor in Statistics

Theoretical Physics (THPY)

Department of Physics, College of Engineering and Physical Sciences

Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major may wish to 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 20.00 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
IPS*1500 [1.00] Integrated Mathematics and Physics I
MATH*1160 [0.50] Linear Algebra 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

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
CIS*1500 [0.50] Introduction to Programming
IPS*1510 [1.00] Integrated Mathematics and Physics 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

Note: students who have taken physics courses other than IPS*1500 or PHYS*1080 in Semester 1 and IPS*1510 or PHYS*1090 in Semester 2, may proceed to semester 3 with the permission of the Department of Physics

Semester 3
MATH*2200 [0.50] Advanced Calculus I
MATH*2270 [0.50] Applied Differential Equations
PHYS*2240 [0.50] Thermal Physics
PHYS*2330 [0.50] Electricity and Magnetism I
0.50 Arts or Social Science electives

Semester 4
MATH*2210 [0.50] Advanced Calculus II
PHYS*2180 [0.50] Experimental Techniques in Physics
PHYS*2310 [0.50] Mechanics
PHYS*2340 [0.50] Electricity and Magnetism II
0.50 electives*

Semester 5
NANO*3600 [0.50] Computational Methods in Materials Science
PHYS*3130 [0.50] Mathematical Physics
PHYS*3230 [0.50] Quantum Mechanics I
PHYS*3400 [0.50] Advanced Mechanics
0.50 electives*

Semester 6
PHYS*3300 [0.50] Optics: Fundamentals and Applications

PHYS*3510 [0.50] Intermediate Laboratory
PHYS*4040 [0.50] Quantum Mechanics II
PHYS*4300 [0.50] Inquiry in Physics
0.50 electives*

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
0.50 electives*

Semester 8
MATH*3260 [0.50] Complex Analysis
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
0.50 electives*

*Restricted Electives
Students must complete 2.00 credits from the following list:
CIS*2500 [0.50] Intermediate Programming
MATH*2130 [0.50] Numerical Methods
MATH*3100 [0.50] Differential Equations II
MATH*3130 [0.50] Abstract Algebra
MATH*3160 [0.50] Linear Algebra II
MATH*3200 [0.50] Real Analysis
MATH*3240 [0.50] Operations Research

Credit Summary (20.00 Total Credits)
5.00 - First year science credits
11.00 - Required science courses semesters 3 – 8
2.00 - Restricted electives
1.00 - Arts and/or Social Science electives
1.00 - Free electives - any approved elective for B.Sc. students. , could be less if restricted electives do not count as science

Of the total credits required, students are required to complete 16.00 credits in science of which 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

Wildlife Biology and Conservation (WBC)

Department of Integrative Biology, College of Biological Science

The core of this major will provide students with an integrated foundation in three disciplines necessary to understand the origins, interactions, and protection of biological diversity: evolution, ecology, and conservation biology. After the second semester, the student has the opportunity to take a wide variety of electives, including courses that meet his/her specific interests within one or two of these disciplines. The program offers a sound scientific background in preparation for careers in resource management, conservation, ecological consulting, teaching, and government service. This major also qualifies students for post-graduate work in ecology, evolutionary biology, environmental sciences, or wildlife management.

Major (Honours Program)
Students may enter this major in Semester 1 or any semester thereafter. A student wishing to declare the major may wish to 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*1080 [0.50] Physics for Life Sciences
0.50 Arts or Social Science electives
Students lacking Grade 12 or 4U Biology, Chemistry or Physics should follow the revised schedule of study for this major found 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*1070 [0.50] Physics for Life Sciences II
0.50 Arts or Social Science electives

Semester 3
BIOC*2580 [0.50] Introduction to Biochemistry

Last Revision: August 17, 2017

2017-2018 Undergraduate Calendar
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<th>Semester</th>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
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<td><strong>Semester 4</strong></td>
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<tr>
<td></td>
<td>MBG*2040 Foundations in Molecular Biology and Genetics</td>
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<td>BIOL*2060 Ecology</td>
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<td>BIOL*2400 Evolution</td>
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<td></td>
<td>STAT*2230 Biostatistics for Integrative Biology</td>
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<td><strong>Semester 5</strong></td>
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<td>BIOL*3010 Laboratory and Field Work in Ecology</td>
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<td>BIOL*4150 Wildlife Conservation and Management</td>
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<td><strong>Semester 6</strong></td>
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<td>BIOL*3040 Methods in Evolutionary Biology</td>
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<td>BIOL*3060 Populations, Communities &amp; Ecosystems</td>
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<td>BIOL*3130 Conservation Biology</td>
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<td></td>
<td>BIOL*4110 Ecological Methods</td>
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<td>BIOL*4150 Wildlife Conservation and Management</td>
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<td></td>
<td>BIOL*4500 Natural Resource Policy Analysis</td>
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<td><strong>Restricted Electives</strong></td>
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<td>Note: For students considering graduate research programs, BIOL<em>4110 may be substituted by an independent research course (1.00 credits minimum). Course options include: (IBIO</em>4500 and BIOL<em>4510), IBIO</em>4521/IBIO*4522.</td>
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**Credit Summary (20.00 Total Credits)**

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<th>Semester</th>
<th>Course</th>
<th>Credits</th>
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<td>Climate Change Biology</td>
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<td>FARE*2700 Survey of Natural Resource Economics</td>
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<td>GEOG*1220 Human Impact on the Environment</td>
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<td>GEOG*2480 Mapping and GIS</td>
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<td>GEOG*3480 GIS and Spatial Analysis</td>
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<td>GEOG*4230 Environmental Impact Assessment</td>
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<td>GEOG*4480 Applied Geomatics</td>
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<td>MCB*2050 Molecular Biology of the Cell</td>
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<td>ZOO*3630 Lab Studies in Animal Physiology II</td>
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<td>ZOO*3700 Integrative Biology of Invertebrates</td>
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<td>ZOO*4070 Animal Behaviour</td>
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<td>ZOO*4910 Integrative Vertebrate Biology</td>
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<td>ZOO*4920 Lab Studies in Ornithology</td>
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<td>ZOO*4950 Lab Studies in Mammalogy</td>
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<td><strong>Field Courses</strong></td>
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<td>BIOL*4410 Field Ecology</td>
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<td>BIOL*4610 Arctic Ecology</td>
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<td>BIOL*4700 Field Biology</td>
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<td>BIOL*4800 Field Biology</td>
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<td>BIOL*4900 Field Biology</td>
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**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 may wish to 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, while the remaining 14.00 credits may be at any appropriate level.
**Foundations in Molecular Biology and Genetics**

**Biostatistics for Integrative Biology**

**Invertebrate Morphology & Evolution**

*0.50 electives or restricted electives *

#### Semester 5

- **ZOO*3000** [0.50] Comparative Histology
- **ZOO*3600** [0.50] Comparative Animal Physiology I
- **ZOO*3610** [0.25] Lab Studies in Animal Physiology I
- **ZOO*3700** [0.50] Integrative Biology of Invertebrates

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

#### Semester 6

- **BIOL*3060** [0.50] Populations, Communities & Ecosystems
- **ZOO*3620** [0.50] Comparative Animal Physiology II
- **ZOO*3630** [0.25] Lab Studies in Animal Physiology II

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

#### 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

* CIS*1200 is recommended for those needing to improve their computer skills.

**Restricted Electives must include:**

1. A minimum of 1.00 credits of Arts and/or Social Science electives are required. The list of approved Arts and Social Science electives for B.Sc. students is available at: [http://www.bsc.uoguelph.ca/Approved_electives.shtml](http://www.bsc.uoguelph.ca/Approved_electives.shtml#arts)

2. A minimum of 0.50 credits from:
   - **ZOO*4330** [0.50] Biology of Fishes
   - **ZOO*4920** [0.25] Lab Studies in Ornithology
   - **ZOO*4940** [0.25] Lab Studies in Herpetology
   - **ZOO*4950** [0.25] Lab Studies in Mammalogy

3. 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.

**Credit Summary (20.00 Total Credits)**

- 4.00 - First year science core
- 8.00 - Required science courses semesters 3 - 8
- 1.00 - Restricted electives (# 2, and 3 in restricted electives list)
- 3.00 - Approved Science electives
- 1.00 - Arts and/or Social Science electives (#1 in restricted electives)
- 3.00 - Free electives - any approved elective for B.Sc. students

Of the total credits required, students are required to complete 16.00 credits in science of which a minimum of 2.00 credits must be at the 4000 level and an additional 4.00 credits must be at the 3000 or 4000 level.

**Minor (Honours Program)**

Students in majors other than Zoology, Biodiversity, Wildlife Biology & Conservation and Marine & Freshwater Biology 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*2060** [0.50] Ecology
- **BIOL*2400** [0.50] Evolution
- **BIOL*3060** [0.50] Populations, Communities & Ecosystems
- **ZOO*2090** [0.50] Vertebrate Structure and Function
- **ZOO*2700** [0.50] Invertebrate Morphology & Evolution
- **ZOO*3000** [0.50] Comparative Histology
- **ZOO*3050** [0.50] Developmental Biology
- **ZOO*3600** [0.50] Comparative Animal Physiology I
- **ZOO*3610** [0.25] Lab Studies in Animal Physiology I
- **ZOO*3620** [0.50] Comparative Animal Physiology II
- **ZOO*3630** [0.25] Lab Studies in 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*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.