2020-2021 Undergraduate Calendar

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2020-2021 academic year, including the Summer Semester 2020, the Fall Semester 2020 and the Winter Semester 2021.

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:

• Universities Canada

Contact Information:

University of Guelph
Guelph, Ontario, Canada
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https://www.uoguelph.ca

Revision Information:

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 4, 2020</td>
<td>Initial Publication</td>
</tr>
<tr>
<td>July 7, 2020</td>
<td>Second Publication</td>
</tr>
<tr>
<td>July 28, 2020</td>
<td>Third Publication</td>
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Disclaimer

University of Guelph 2020

The information published in this Undergraduate Calendar outlines the rules, regulations, curricula, programs and fees for the 2020-2021 academic year, including the Summer Semester 2020, the Fall Semester 2020 and the Winter Semester 2021.

The University reserves the right to change without notice any information contained in this calendar, including but not limited to that related to tuition and other fees, standards of admission, course delivery or format, continuation of study, and the offering or requirements for the granting of, degrees or diplomas in any or all of its programs. The publication of this calendar does not bind the University to the provision of courses, programs, schedules of study, or facilities as listed herein.

The University will not be liable for any failure or delay in performance arising out of any cause or causes beyond its reasonable control. Such causes may include but are not limited to fire, strike, lock-out, inability to procure materials or trades, war, mass-casualty event, flood, local, regional or global outbreak of disease or other public health emergency, social distancing or quarantine restriction, legislative or regulatory requirements, unusually severe weather, failure of public utility or common carrier, or attacks or other malicious act, including but not limited to attacks on or through the internet, or any internet service, telecommunications provider or hosting facility.

In March 2020 the World Health Organization declared a global pandemic of the virus leading to COVID-19. The Governments of Canada, the Province of Ontario, and local Governments responded to the pandemic with legislative amendments, controls, orders, by-laws, requests and requirements (collectively, the “Governmental Response”). It is uncertain how long the pandemic, and the related Governmental Response, will continue, and it is unknown whether there may be a resurgence of the virus leading to COVID-19 or any mutation thereof (collectively, the “Virus”) and resulting or supplementary renewed Government Response. Without limiting the foregoing paragraph, the University shall not be liable for costs associated with any failure or delay in performance arising out of:

a. the continued spread of the Virus;

b. the continuation of or renewed Governmental Response to control the spread of the Virus; and

c. a University decision, made on an organization-wide basis and in good faith, to control the spread of the Virus, even if exceeding the then current specific Governmental Response.

In particular, the COVID-19 pandemic may necessitate a revision of the format of course offerings such that courses are offered in whole or in part on an alternate delivery model to in-person classes. Tuition and mandatory fees have been set regardless of the method of instruction and will not be refunded in the event instruction occurs remotely for any part of the academic year.

Dates or times of performance including the Schedule of Dates may be extended as appropriate and the University will notify students promptly of the existence and nature of such delay and shall, so far as practicable, use reasonable efforts to minimize and mitigate any such delay or non-performance.

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 Training, Colleges and Universities, and Statistics Canada, for statistical and planning purposes, and is disclosed to other individuals or organizations in accordance with the Office of Registartorial 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 Colleges and Universities

The University of Guelph is required to disclose personal information such as characteristics and educational outcomes to the Minister of Colleges and Universities under s. 15 of the Ministry of Training, Colleges and Universities 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 Training, Colleges and Universities Act, authorizing the collection and use of personal information from colleges and universities by the Minister 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 Colleges and Universities website: https://www.ontario.ca/page/ministry-colleges-universities (English) or https://www.ontario.ca/fr/page/ministere-des-colleges-et-universites (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. An update on Institutional and Ministry of Training, Colleges and Universities Act Notice of Disclosure Activities is posted at https://www.ontario.ca/page/ministry-colleges-universities

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 Colleges and Universities 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 the Ministry 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 website 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, the student’s 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 the student's 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.

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 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 in Environmental Sciences
[B.Sc.(Env.)]

Program Information

Objectives of the Program
The Environmental Sciences program is designed to provide a strong interdisciplinary grounding in specific environmental sciences including the socioeconomic context in which environmental issues are resolved. There is an emphasis on management and decision-making skills for the application of scientific knowledge to environmental problems, and the evaluation of appropriate environmental policies. A practical perspective based on defining and resolving problems is central to the program, and this is often done in the context of group work. Substantial emphasis is placed on communication skills, including the development of competence in both written and oral presentations. These skills will be progressively developed in core courses from the first to the fourth year. Students in the final year of their program will be expected to take part in more intensive communication skill development. Graduates will seek employment in a range of fields, from government agencies to private industry and research.

Academic Counselling
General information on the degree program is available from the Program Counsellor. Advising for each major is available through the assigned faculty advisor responsible for the major. Students are encouraged to seek the advice of the faculty advisors when choosing restricted electives and planning course selections.

Degree
The degree granted for the successful completion of this honours program will be the Bachelor of Science in Environmental Sciences--B.Sc.(Env.).

Continuation of Study
Students are advised to consult the regulations for Continuation of Study in Section VIII--Undergraduate Degree Regulations and Procedures of this Calendar.

Conditions for Graduation
In order to graduate from the B.Sc.(Env.) program, students must successfully complete a minimum of 20.00 credits including all the stated course requirements for the program. As well, students must achieve a cumulative average of 60% or higher over all course attempts.

Environmental Sciences (Co-op)
A 5-year Honours Program in Environmental Sciences is offered as a Co-operative Education Program. This option is offered within the B.Sc. (Env.) degree and is available to all majors. The course requirements are the same as those listed for the regular B.Sc. (Env.) program, by the Co-operative Education Program and as outlined in the Continuation of Study policy (Section VIII--Undergraduate Degree Regulations & Procedures). 3 co-op work terms (COOP*1000, COOP*2000, COOP*3000) are required. An optional 4th co-op work term (COOP*4000) is available. COOP*1100 must be completed during semester 2.

Environmental Sciences Co-op Work Term Schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Winter</th>
<th>Summer</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Academic Term 1</td>
<td>Academic Term 2</td>
<td>Off</td>
</tr>
<tr>
<td>2</td>
<td>Academic Term 3</td>
<td>COOP*1000</td>
<td>Academic Term 4</td>
</tr>
<tr>
<td>3</td>
<td>COOP*2000</td>
<td>Academic Term 5</td>
<td>COOP*3000</td>
</tr>
<tr>
<td>4</td>
<td>Academic Term 6</td>
<td>Academic Term 7</td>
<td>COOP*4000 (Optional)</td>
</tr>
<tr>
<td>5</td>
<td>Academic Term 8</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Since some of the course requirements in the degree program (core or major) are not offered each semester, careful planning and program consultation with the Faculty co-op Advisor is essential. In particular, students are encouraged to seek advice when choosing for their Summer academic semester.

The Environmental Sciences Program
The degree in Environmental Sciences consists of a minimum of 20.00 credits, as follows:

1. 7.00 Environmental Sciences Core
2. 8.50 - 11.00 Environmental Sciences prescribed and restricted electives according to major.
3. free electives*

Within these courses, students must include at least 6.00 credits at the 3000 or 4000 level, and no program may include more than 7.00 credits at the 1000 level.

* There are not specific subject requirements for the elective courses, however, you may NOT select the following: BIOL*1500, BOT*1200, CHEM*1100, CIS*1000, ENVS*1060, GEOE*1100, MICR*1020, MBG*1100, PHYS*1600.

Please note that not all courses in the "One of:" options are available each semester (F, W, S). Students are encouraged to seek advice from the appropriate advisor when selecting and scheduling courses.

First Year Curriculum
The first year courses have been selected to provide students with sufficient background and knowledge to enter any one of the Environmental Sciences majors.

Semester 1
BIOL*1070 [0.50] Discovering Biodiversity
CHEM*1040 [0.50] General Chemistry I
ENVS*1030 [1.00] Introduction to Environmental Sciences
MATH*1080 [0.50] Elements of Calculus I

Semester 2
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1050 [0.50] General Chemistry II
FARE*1040 [1.00] Into Environmental Economics, Law & Policy
GEOG*1300 [0.50] Introduction to the Biophysical Environment

Note: Co-op students must select COOP*1100 Introduction to Co-operative Education

Environmental Sciences Core
In addition to the common first year curriculum, students are required to take the following core Environmental Sciences courses in the semesters recommended in the schedule of studies:

ENVS*4001 [0.50] Project in Environmental Sciences
ENVS*4002 [0.50] Project in Environmental Sciences

One of:
ECON*2100 [0.50] Economic Growth and Environmental Quality
FARE*2700 [0.50] Survey of Natural Resource Economics
GEOG*2210 [0.50] Environment and Resources

A required statistics course is prescribed by the student's choice of major.

Environmental Sciences Majors
Ecology
Environment and Resource Management
Environmental Economics and Policy
Environmental Sciences

Requirements for each of these majors are described in the detailed schedules of studies below.

Ecology (ECOL)

Department of Integrative Biology, College of Biological Science
This program provides a solid foundation in the principles of ecology, training in both pure and applied aspects of ecology and an introduction to economic, legal and policy issues related to the management of the environment. From the 2nd year on, students increasingly augment the core in ecology and policy with extensive restricted electives choices that allow the student to tailor the program to their interests. The major provides a sound science background for careers in conservation, resource management, ecological consulting, or nature interpretation used in teaching, government, non-government or the private sector, or for further post-graduate training in fundamental ecology, environmental biology and environmental management or policy.

Major

Semester 1
BIOL*1070 [0.50] Discovering Biodiversity
CHEM*1040 [0.50] General Chemistry I
ENVS*1030 [1.00] Introduction to Environmental Sciences
MATH*1080 [0.50] Elements of Calculus I

Semester 2
BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1050 [0.50] General Chemistry II
FARE*1040 [1.00] Into Environmental Economics, Law & Policy
GEOG*1300 [0.50] Introduction to the Biophysical Environment

Semester 3
BIOL*2060 [0.50] Ecology

One of:
PHYS*1080 [0.50] Physics for Life Sciences
PHYS*1300 [0.50] Fundamentals of Physics

One of:
ECON*2100 [0.50] Economic Growth and Environmental Quality
FARE*2700 [0.50] Survey of Natural Resource Economics

1.00 electives or restricted electives

Note: Students lacking 4U physics or equivalent must take PHYS*1300. Students with 4U physics or equivalent must take PHYS*1080. PHYS*1130 may be substituted for PHYS*1080.

Note: GEOG*2210 may be substituted for ECON*2100 or FARE*2700 and would be taken in semester 4.
Semester 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOC*2580</td>
<td>0.50</td>
<td>Introduction to Biochemistry</td>
</tr>
<tr>
<td>BIOL*2400</td>
<td>0.50</td>
<td>Evolution</td>
</tr>
<tr>
<td>MBG*2040</td>
<td>0.50</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>STAT*2230</td>
<td>0.50</td>
<td>Biostatistics for Integrative Biology</td>
</tr>
</tbody>
</table>

0.50 electives or restricted electives

Semester 5

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>BIOL*3010</td>
<td>0.50</td>
<td>Laboratory and Field Work in Ecology</td>
</tr>
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</table>

One of:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>BOT*2100</td>
<td>0.50</td>
<td>Life Strategies of Plants</td>
</tr>
<tr>
<td>ZOO*3600</td>
<td>0.50</td>
<td>Comparative Animal Physiology I</td>
</tr>
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</table>

One of:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOT*3410</td>
<td>0.50</td>
<td>Plant Anatomy</td>
</tr>
<tr>
<td>ZOO*2090</td>
<td>0.50</td>
<td>Vertebrate Structure and Function</td>
</tr>
</tbody>
</table>

1.00 electives or restricted electives

Note: ZOO*2700 may be substituted for BOT*3410 or ZOO*2090 and would be taken in semester 6.

Semester 6

<table>
<thead>
<tr>
<th>Course Code</th>
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</thead>
<tbody>
<tr>
<td>BIOL*3060</td>
<td>0.50</td>
<td>Populations, Communities &amp; Ecosystems</td>
</tr>
<tr>
<td>BIOL*3130</td>
<td>0.50</td>
<td>Conservation Biology</td>
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</table>

1.50 electives or restricted electives

Semester 7

<table>
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<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENVS*4001</td>
<td>0.50</td>
<td>Project in Environmental Sciences</td>
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</table>

2.00 electives or restricted electives

Semester 8

<table>
<thead>
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<th>Course Code</th>
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</thead>
<tbody>
<tr>
<td>ENVS*4002</td>
<td>0.50</td>
<td>Project in Environmental Sciences</td>
</tr>
</tbody>
</table>

2.00 electives or restricted electives

Note: See note in semester 7.

Restricted Electives

Students are required to take 5.50 restricted credits in Ecology as noted below. Of these, at least 1.00 credits must be at the 4000 level.

1. A minimum of 0.50 credits from:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*4150</td>
<td>0.50</td>
<td>Wildlife Conservation and Management</td>
</tr>
<tr>
<td>CIS*1500</td>
<td>0.50</td>
<td>Introduction to Programming</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>
<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*4480</td>
<td>1.00</td>
<td>Applied Geomatics *</td>
</tr>
</tbody>
</table>

* Additional prerequisites are required.

2. Students in the Ecology Major are required to take an additional 5.00 restricted elective credits from the following lists. Some courses may require other courses from the list as prerequisites.

Ecology

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Course Title</th>
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<tbody>
<tr>
<td>ANSC*3180</td>
<td>0.50</td>
<td>Wildlife Nutrition</td>
</tr>
<tr>
<td>BIOL*3450</td>
<td>0.50</td>
<td>Introduction to Aquatic Environments</td>
</tr>
<tr>
<td>BIOL*3670</td>
<td>0.50</td>
<td>Introduction to Wildlife Rehabilitation</td>
</tr>
<tr>
<td>BIOL*3680</td>
<td>0.50</td>
<td>Wildlife Rehabilitation: Caring for Sick, Injured, and Orphaned Wildlife</td>
</tr>
<tr>
<td>BOT*3050</td>
<td>0.50</td>
<td>Plant Functional Ecology</td>
</tr>
<tr>
<td>ENVS*2030</td>
<td>0.50</td>
<td>Meteorology and Climatology</td>
</tr>
<tr>
<td>ENVS*3010</td>
<td>0.50</td>
<td>Climate Change Biology</td>
</tr>
<tr>
<td>ENVS*3270</td>
<td>0.50</td>
<td>Forest Biodiversity</td>
</tr>
<tr>
<td>ENVS*3290</td>
<td>0.50</td>
<td>Waterborne Disease Ecology</td>
</tr>
<tr>
<td>ENVS*4350</td>
<td>0.50</td>
<td>Forest Ecology</td>
</tr>
<tr>
<td>GEOG*2000</td>
<td>0.50</td>
<td>Geomorphology</td>
</tr>
<tr>
<td>GEOG*2110</td>
<td>0.50</td>
<td>Climate and the Biophysical Environment</td>
</tr>
<tr>
<td>GEOG*3000</td>
<td>0.50</td>
<td>Fluvial Processes</td>
</tr>
<tr>
<td>GEOG*3610</td>
<td>0.50</td>
<td>Environmental Hydrology</td>
</tr>
<tr>
<td>NUTR*3210</td>
<td>0.50</td>
<td>Fundamentals of Nutrition</td>
</tr>
<tr>
<td>ZOO*4570</td>
<td>0.50</td>
<td>Marine Ecological Processes</td>
</tr>
</tbody>
</table>

Conservation

<table>
<thead>
<tr>
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<th>Credits</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*4120</td>
<td>0.50</td>
<td>Evolutionary Ecology</td>
</tr>
<tr>
<td>BIOL*4150</td>
<td>0.50</td>
<td>Wildlife Conservation and Management</td>
</tr>
<tr>
<td>BIOL*4350</td>
<td>0.50</td>
<td>Limnology of Natural and Polluted Waters</td>
</tr>
<tr>
<td>ENVS*2040</td>
<td>0.50</td>
<td>Plant Health and the Environment</td>
</tr>
<tr>
<td>ENVS*2330</td>
<td>0.50</td>
<td>Current Issues in Ecosystem Science and Biodiversity</td>
</tr>
<tr>
<td>ENVS*3000</td>
<td>0.50</td>
<td>Nature Interpretation</td>
</tr>
<tr>
<td>ENVS*3010</td>
<td>0.50</td>
<td>Climate Change Biology</td>
</tr>
<tr>
<td>GEOG*2480</td>
<td>0.50</td>
<td>Mapping and GIS</td>
</tr>
<tr>
<td>GEOG*3020</td>
<td>0.50</td>
<td>Global Environmental Change</td>
</tr>
<tr>
<td>GEOG*3110</td>
<td>0.50</td>
<td>Biotic and Natural Resources</td>
</tr>
<tr>
<td>GEOG*3210</td>
<td>0.50</td>
<td>Management of the Biophysical Environment</td>
</tr>
<tr>
<td>GEOG*3480</td>
<td>0.50</td>
<td>GIS and Spatial Analysis</td>
</tr>
</tbody>
</table>

Credit Summary (20.00 Total Credits)

7.00 credits - Environmental Sciences core
5.00 credits - Ecology Required courses
5.50 credits - Ecology Restricted electives
2.50 credits - Free electives

Students are reminded that 6.00 credits of their B.Sc. (Env.) degree must be at the 3000-4000 level.

Students are encouraged to seek advice on their choices from their faculty advisor. With prior approval, students may be able to use courses not on these lists towards their Ecology restrictive electives.

Ecology (ECOL/C)

Department of Integrative Biology, College of Biological Science

This program provides a solid foundation in the principles of ecology, training in both pure and applied aspects of ecology and an introduction to economic, legal, and policy issues related to the management of the environment. From the 2nd year on, students increasingly augment the core in ecology and policy with extensive restricted elective choices that allow the student to tailor the program to their interests. The major provides a sound science background for careers in conservation, resource management, ecological consulting, or nature interpretation used in teaching, government, non-government or the private sector; or for further post-graduate training in fundamental ecology, environmental biology and environmental management or policy.

Program Requirements

The Co-op program in Ecology is a four and a half year program including four work terms. Students must complete a Fall, Winter and Summer work term, and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.uofr.ca/co-op). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Ecology Academic and Co-op Work Term Schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Winter</th>
<th>Summer</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Academic Semester 1</td>
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<td>2</td>
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<td>COOP*2000 Work Term II</td>
<td>Academic Semester 5</td>
<td>COOP*3000 Work Term III</td>
</tr>
<tr>
<td>4</td>
<td>Academic Semester 6</td>
<td>Academic Semester 7</td>
<td>COOP*4000 Work Term IV</td>
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<td>5</td>
<td>Academic Semester 8</td>
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To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Revision: 2020-2021 Undergraduate Calendar
Credit Summary (21.50 Total Credits)*
7.00 - Environmental Sciences core
5.00 - Ecology Required courses
5.50 - Ecology Restricted electives
2.50 - Free electives
1.50 - Co-op Work Terms

Note: A minimum of three Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *COOP*4000 is optional and if completed the total number of credits will equal 22.00.

Students are reminded that 6.00 credits of their B.Sc. (Env.) degree must be at the 3000-4000 level.

Students are encouraged to seek advice on their choices from their faculty advisor. With prior approval, students may be able to use courses not on these lists towards their Ecology restrictive electives.

The recommended program sequence is outlined below.

**Major**

**Semester 1 - Fall**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL*1070</td>
<td>0.50</td>
<td>Discovering Biodiversity</td>
</tr>
<tr>
<td>CHEM*1040</td>
<td>0.50</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>ENVS*1030</td>
<td>1.00</td>
<td>Introduction to Environmental Sciences</td>
</tr>
<tr>
<td>MATH*1080</td>
<td>0.50</td>
<td>Elements of Calculus I</td>
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**Semester 2 - Winter**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</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>COOP*1100</td>
<td>0.00</td>
<td>Introduction to Co-operative Education</td>
</tr>
<tr>
<td>FARE*1040</td>
<td>1.00</td>
<td>Intro to Environmental Economics, Law &amp; Policy</td>
</tr>
<tr>
<td>GEOG*1300</td>
<td>0.50</td>
<td>Introduction to the Biophysical Environment</td>
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**Semester 3 - Fall**

<table>
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<tr>
<th>Course</th>
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<tbody>
<tr>
<td>BIOL*2060</td>
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One of:

<table>
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<tr>
<th>Course</th>
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<tbody>
<tr>
<td>PHYS*1080</td>
<td>0.50</td>
<td>Physics for Life Sciences</td>
</tr>
<tr>
<td>PHYS*1300</td>
<td>0.50</td>
<td>Fundamentals of Physics</td>
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One of:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ECON*2100</td>
<td>0.50</td>
<td>Economic Growth and Environmental Quality</td>
</tr>
<tr>
<td>FARE*2700</td>
<td>0.50</td>
<td>Survey of Natural Resource Economics</td>
</tr>
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</table>

1.00 electives or restricted electives

Note: Students lacking 4U physics or equivalent must take PHYS*1080. Students with 4U physics or equivalent must take PHYS*1080. PHYS*1130 may be substituted for PHYS*1080.

Note: GEOS*2210 may be substituted for ECON*2100 or FARE*2700 and would be taken in semester 4.

**Winter Semester**

<table>
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<tr>
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**Semester 4 - Summer**

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<tr>
<td>BIOC*2580</td>
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<td>Introduction to Biochemistry</td>
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2.00 electives or restricted electives

**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**

<table>
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<tbody>
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<td>Evolution</td>
</tr>
<tr>
<td>MBG*2040</td>
<td>0.50</td>
<td>Foundations in Molecular Biology and Genetics</td>
</tr>
<tr>
<td>STAT*2230</td>
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<td>Biostatistics for Integrative Biology</td>
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</tbody>
</table>

1.00 electives or restricted electives

**Summer Semester**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</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**

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</thead>
<tbody>
<tr>
<td>BIOL*3010</td>
<td>0.50</td>
<td>Laboratory and Field Work in Ecology</td>
</tr>
<tr>
<td>ENVS*4001</td>
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<td>Project in Environmental Sciences</td>
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One of:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOT*2100</td>
<td>0.50</td>
<td>Life Strategies of Plants</td>
</tr>
<tr>
<td>ZOO*3600</td>
<td>0.50</td>
<td>Comparative Animal Physiology I</td>
</tr>
</tbody>
</table>

One of:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOT*3410</td>
<td>0.50</td>
<td>Plant Anatomy</td>
</tr>
<tr>
<td>ZOO*2090</td>
<td>0.50</td>
<td>Vertebrate Structure and Function</td>
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</table>

0.50 electives or restricted electives

Note: ZOO*2700 may be substituted for BOT*3410 or ZOO*2090 and would be taken in semester 7.

**Semester 7 - Winter**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>BIOL*3060</td>
<td>0.50</td>
<td>Populations, Communities &amp; Ecosystems</td>
</tr>
<tr>
<td>BIOL*3130</td>
<td>0.50</td>
<td>Conservation Biology</td>
</tr>
<tr>
<td>ENVS*4002</td>
<td>0.50</td>
<td>Project in Environmental Sciences</td>
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</table>

1.00 electives or restricted electives

Note: See note in semester 6.

**Summer Semester (Optional)**

<table>
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<th>Course</th>
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<tbody>
<tr>
<td>COOP*4000</td>
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<td>Co-op Work Term IV</td>
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**Semester 8 - Fall**

2.50 electives or restricted electives

**Restricted Electives**

Students are required to take 5.50 restricted credits in Ecology as noted below. Of these, at least 1.00 credits must be at the 4000 level.

1. A minimum of 0.50 credits from:

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>BIOL*4150</td>
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<td>Wildlife Conservation and Management</td>
</tr>
<tr>
<td>CIS*1500</td>
<td>[0.50]</td>
<td>Introduction to Programming</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>
<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*4480</td>
<td>[1.00]</td>
<td>Applied Geomatics</td>
</tr>
</tbody>
</table>

* Additional prerequisites are required.

2. Students in the Ecology Major are required to take an additional 5.00 restricted elective credits from the following lists. Some courses may require other courses from the list as prerequisites.

**Ecology**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>ANSC*3180</td>
<td>[0.50]</td>
<td>Wildlife Nutrition</td>
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<tr>
<td>BIOL*3450</td>
<td>[0.50]</td>
<td>Introduction to Aquatic Environments</td>
</tr>
<tr>
<td>BIOL*3670</td>
<td>[0.50]</td>
<td>Introduction to Wildlife Rehabilitation</td>
</tr>
<tr>
<td>BIOL*3680</td>
<td>[0.50]</td>
<td>Wildlife Rehabilitation: Caring for Sick, Injured, and Orphaned Wildlife</td>
</tr>
<tr>
<td>BOT*3050</td>
<td>[0.50]</td>
<td>Plant Functional Ecology</td>
</tr>
<tr>
<td>ENVS*2030</td>
<td>[0.50]</td>
<td>Meteorology and Climatology</td>
</tr>
<tr>
<td>ENVS*3010</td>
<td>[0.50]</td>
<td>Climate Change Biology</td>
</tr>
<tr>
<td>ENVS*3270</td>
<td>[0.50]</td>
<td>Forest Biodiversity</td>
</tr>
<tr>
<td>ENVS*3290</td>
<td>[0.50]</td>
<td>Waterborne Disease Ecology</td>
</tr>
<tr>
<td>ENVS*4350</td>
<td>[0.50]</td>
<td>Forest Ecology</td>
</tr>
<tr>
<td>GEOG*2000</td>
<td>[0.50]</td>
<td>Geomorphology</td>
</tr>
<tr>
<td>GEOG*2110</td>
<td>[0.50]</td>
<td>Climate and the Biophysical Environment</td>
</tr>
<tr>
<td>GEOG*3000</td>
<td>[0.50]</td>
<td>Fluvial Processes</td>
</tr>
<tr>
<td>GEOG*3610</td>
<td>[0.50]</td>
<td>Environmental Hydrology</td>
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<tr>
<td>NUTR*3210</td>
<td>[0.50]</td>
<td>Fundamentals of Nutrition</td>
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<tr>
<td>ZOO*4570</td>
<td>[0.50]</td>
<td>Marine Ecological Processes</td>
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<tr>
<td>BIOL*4120</td>
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<td>Evolutionary Ecology</td>
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<td>BIOL*4150</td>
<td>[0.50]</td>
<td>Wildlife Conservation and Management</td>
</tr>
<tr>
<td>BIOL*4350</td>
<td>[0.50]</td>
<td>Limnology of Natural and Polluted Waters</td>
</tr>
<tr>
<td>ENVS*2040</td>
<td>[0.50]</td>
<td>Plant Health and the Environment</td>
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<tr>
<td>ENVS*2330</td>
<td>[0.50]</td>
<td>Current Issues in Ecosystem Science and Biodiversity</td>
</tr>
<tr>
<td>ENVS*3000</td>
<td>[0.50]</td>
<td>Nature Interpretation</td>
</tr>
<tr>
<td>ENVS*3010</td>
<td>[0.50]</td>
<td>Climate Change Biology</td>
</tr>
<tr>
<td>GEOG*2480</td>
<td>[0.50]</td>
<td>Mapping and GIS</td>
</tr>
<tr>
<td>GEOG*3020</td>
<td>[0.50]</td>
<td>Global Environmental Change</td>
</tr>
<tr>
<td>GEOG*3110</td>
<td>[0.50]</td>
<td>Biotic and Natural Resources</td>
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<tr>
<td>GEOG*3210</td>
<td>[0.50]</td>
<td>Management of the Biophysical Environment</td>
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<tr>
<td>GEOG*3480</td>
<td>[0.50]</td>
<td>GIS and Spatial Analysis</td>
</tr>
<tr>
<td>GEOG*4110</td>
<td>[1.00]</td>
<td>Environmental Systems Analysis</td>
</tr>
<tr>
<td>GEOG*4230</td>
<td>[0.50]</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>GEOG*4480</td>
<td>[1.00]</td>
<td>Applied Geomatics</td>
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**Policy, Law, and Management**

<table>
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<tr>
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<th>Credits</th>
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<tbody>
<tr>
<td>BIOL*4500</td>
<td>[0.50]</td>
<td>Natural Resource Policy Analysis</td>
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<tr>
<td>ECON*2100</td>
<td>[0.50]</td>
<td>Economic Growth and Environmental Quality</td>
</tr>
<tr>
<td>FARE*2700</td>
<td>[0.50]</td>
<td>Survey of Natural Resource Economics</td>
</tr>
<tr>
<td>GEOG*2210</td>
<td>[0.50]</td>
<td>Environment and Resources</td>
</tr>
<tr>
<td>GEOG*4210</td>
<td>[0.50]</td>
<td>Environmental Governance</td>
</tr>
<tr>
<td>GEOG*4220</td>
<td>[0.50]</td>
<td>Local Environmental Management</td>
</tr>
<tr>
<td>PHIL*2070</td>
<td>[0.50]</td>
<td>Philosophy of the Environment</td>
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<tr>
<td>POLS*3370</td>
<td>[0.50]</td>
<td>Environmental Politics and Governance</td>
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**Independent Research and Field Courses**

<table>
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<th>Course</th>
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<td>BIOL*4700</td>
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<td>Field Biology</td>
</tr>
<tr>
<td>BIOL*4810</td>
<td>[0.25]</td>
<td>Field Biology</td>
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<tr>
<td>ENVS*4410</td>
<td>[0.50]</td>
<td>Introduction to Advanced Independent Research</td>
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<td>ENVS*4420</td>
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<td>Advanced Independent Research</td>
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<td>Advanced Independent Research</td>
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<tr>
<td>IBIO*4500</td>
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<td>Research in Integrative Biology I</td>
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<tr>
<td>IBIO*4510</td>
<td>[1.00]</td>
<td>Research in Integrative Biology II</td>
</tr>
<tr>
<td>IBIO*4521</td>
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<td>Thesis in Integrative Biology</td>
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</table>

* Additional prerequisites are required.
Students lacking 4U Physics or equivalent must take PHYS*1300.

### List A
- ENVS*2330 [0.50] Current Issues in Ecosystem Science and Biodiversity
- ENVS*2040 [0.50] Plant Health and the Environment

### List B
- PHYS*1070 [0.50] Physics for Life Sciences II
- PHYS*1080 [0.50] Physics for Life Sciences
- PHYS*1300 [0.50] Fundamentals of Physics

### Credit Summary (20.00 Total Credits)
- 7.00 credits - Environmental Sciences core
- 4.50 credits - Required Courses for the Major
- 5.50 credits - Restricted Electives
- 3.00 credits - Free electives
Students are encouraged to seek advice from their faculty advisor and are reminded that 6.00 credits of their B.Sc.(Env.) degree must be at the 3000-4000 level. With prior approval, students may be able to use courses not on Lists C, D, E, or F toward their restricted electives.

**Environmental Sciences (ENVS:C)**

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

This major combines a foundation in the breadth of environmental science while giving students practical experience in integrating the basic science in environmental problem solving. The integration of biophysical sciences with real-world applications provides students with a unique skill set for engaging with current and future environmental issues. The many opportunities in the major for experiential learning and independent research give students an ability to collect, analyze and interpret environmental data, and propose solutions that account for both the biophysical science and the socio-economic context.

The second year core curriculum develops a cross-disciplinary understanding of the biophysical environment, while the third and fourth years allow students to engage more deeply with issues of interest to them. Students will graduate from this major ready to address diverse problems such as pollinator conservation, soil and water conservation, greenhouse gas mitigation, plant disease management and chemical movement in the environment. It provides a solid background for careers in environmental protection, resource management and research, in both the public and private sectors.

**Program Requirements**

The Co-op program in Environmental Sciences is a four and a half year program including four work terms. Students must complete a Fall, Winter and Summer work term, and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Environmental Sciences Academic and Co-op Work Term Schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Winter</th>
<th>Summer</th>
</tr>
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<tbody>
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<td>Academic Semester 1</td>
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<td></td>
<td>COOP*1100</td>
<td>COOP*1000 Work Term I</td>
<td>Academic Semester 4</td>
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<tr>
<td>2</td>
<td>COOP*2000 Work Term II</td>
<td>Academic Semester 5</td>
<td>COOP*3000 Work Term III</td>
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To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

**Credit Summary (21.50 Total Credits)**

7.00 - Environmental Sciences core

4.50 - Required Courses for the Major

5.50 - Restricted Electives

3.00 - Free electives

1.50 - Co-op Work Terms

**Note:** A minimum of three Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *COOP*4000 is optional and if completed the total number of credits will equal 22.00.

Students are encouraged to seek advice from their faculty advisor and are reminded that 6.00 credits of their B.Sc.(Env.) degree must be at the 3000-4000 level. With prior approval, students may be able to use courses not on Lists C, D, E or F toward their restricted electives. The recommended program sequence is outlined below.

**Major**

**Semester 1 - Fall**

- BIOL*1070 [0.50] Discovering Biodiversity
- CHEM*1040 [0.50] General Chemistry I
- ENVS*1030 [1.00] Introduction to Environmental Sciences
- MATH*1080 [0.50] Elements of Calculus I

**Semester 2 - Winter**

- BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
- CHEM*1050 [0.50] General Chemistry II
- COOP*1100 [0.00] Introduction to Co-operative Education
- FARE*1040 [1.00] Intro to Environmental Economics, Law & Policy
- GEOG*1300 [0.50] Introduction to the Biophysical Environment

**Semester 3 - Fall**

- ENVS*2030 [0.50] Meteorology and Climatolgy
- ENVS*2060 [0.50] Soil Science
- ENVS*2240 [0.50] Fundamentals of Environmental Geology

1.00 electives or restricted electives

**Winter Semester**

- COOP*1000 [0.50] Co-op Work Term I

**Semester 4 - Summer**

- STAT*2040 [0.50] Statistics I

2.00 electives or restricted electives

**Fall Semester**

- COOP*2000 [0.50] Co-op Work Term II

**Semester 5 - Winter**

- BIOL*2060 [0.50] Ecology
- ENVS*2080 [0.50] Introduction to Environmental Microbiology
- ENVS*2310 [0.50] Introduction to Biogeochemistry

1.00 electives or restricted electives

**Summer Semester**

- COOP*3000 [0.50] Co-op Work Term III

**Semester 6 - Fall**

- ENVS*4001 [0.50] Project in Environmental Sciences

One of:

- ECON*2100 [0.50] Economic Growth and Environmental Quality
- FARE*2700 [0.50] Survey of Natural Resource Economics
- GEOG*2210 [0.50] Environment and Resources

1.50 electives or restricted electives

Students wishing to register in BIOL*4350 must substitute BIOL*3450 in Semester 6 for ENVS*3150 in Semester 7.

**Semester 7 - Winter**

- ENVS*3150 [0.50] Aquatic Systems
- ENVS*4002 [0.50] Project in Environmental Sciences

1.50 electives or restricted electives

**Summer Semester - (Optional)**

- COOP*4000 [0.50] Co-op Work Term IV

**Semester 8 - Fall**

2.50 electives or restricted electives

**Restricted Electives**

Students must take a total of 6.50 restricted elective credits as prescribed by the following lists.

Students must take 0.50 credits from each of List A & B.

**List A**

One of:

- ENVS*2330 [0.50] Current Issues in Ecosystem Science and Biodiversity
- ENVS*2040 [0.50] Plant Health and the Environment

**List B**

One of:

- PHYS*1070 [0.50] Physics for Life Sciences II
- PHYS*1080 [0.50] Physics for Life Sciences
- PHYS*1300 [0.50] Fundamentals of Physics

Students lacking 4U Physics or equivalent must take PHYS*1300.

Students are required to choose a minimum of 5.50 credits from Lists C, D, E, and F. Students must take a minimum of 1.50 credits from List C, a minimum of 1.00 credits from List D, and students may not count more than 1.00 credits from List F towards their restricted electives. Students should note that many restricted electives, particularly in List D, require other courses as prerequisites. Students should consult the most recent Undergraduate Calendar for specific requirements.

**List C**

Students must take a minimum of 1.50 credits from the following list:

- BIOL*3130 [0.50] Conservation Biology
- CHEM*3360 [0.50] Environmental Chemistry and Toxicology
- ENVS*2120 [0.50] Introduction to Environmental Stewardship
- ENVS*2210 [0.50] Apiculture and Honey Bee Biology
- ENVS*2230 [0.50] Communications in Environmental Science
- ENVS*3000 [0.50] Nature Interpretation
- ENVS*3010 [0.50] Climate Change Biology
- ENVS*3020 [0.50] Pesticides and the Environment
- ENVS*3040 [0.50] Natural Chemicals in the Environment
- ENVS*3050 [0.50] Microclimatology
- ENVS*3060 [0.50] Groundwater
- ENVS*3080 [0.50] Soil and Water Conservation
- ENVS*3090 [0.50] Insect Diversity and Biology
- ENVS*3180 [0.50] Sedimentary Environments
X. Degree Programs, Bachelor of Science in Environmental Sciences [B.Sc.(Env.)]

ENVS*3210 [0.50] Plant Pathology
ENVS*3220 [0.50] Terrestrial Chemistry
ENVS*3230 [0.50] Agroforestry Systems
ENVS*3250 [0.50] Forest Health and Disease
ENVS*3270 [0.50] Forest Biodiversity
ENVS*3290 [0.50] Waterborne Disease Ecology
ENVS*3300 [0.50] Introduction to Controlled Environment Systems
ENVS*3310 [0.50] Soil Biodiversity and Ecosystem Function
ENVS*3340 [0.50] Environmental Data Analysis
ENVS*3370 [0.50] Terrestrial Ecosystem Ecology
MICR*3220 [0.50] Plant Microbiology
TOX*2000 [0.50] Principles of Toxicology

List D

Students must take a minimum of 1.00 credits from the following list:

BIOL*4350 [0.50] Limnology of Natural and Polluted Waters
ENVS*4000 [0.50] Toxicological Risk Assessment
ENVS*4030 [0.50] Ecolology
ENVS*4070 [0.50] Pollinator Conservation
ENVS*4090 [0.50] Soil Management
ENVS*4100 [0.50] Integrated Management of Invasive Insect Pests
ENVS*4160 [0.50] Soil and Nutrient Management
ENVS*4180 [0.50] Insecticide Biological Activity and Resistance
ENVS*4190 [0.50] Biological Activity of Herbicides
ENVS*4210 [0.50] Meteorological and Environmental Instrumentation
ENVS*4230 [0.50] Biology of Aquatic Insects
ENVS*4260 [0.50] Field Entomology
ENVS*4320 [1.00] Laboratory and Field Methods in Soil Biodiversity
ENVS*4350 [0.50] Forest Ecology
ENVS*4360 [0.50] Glacial Environments
ENVS*4370 [0.50] Natural and Anthropogenic Compounds in the Environment
ENVS*4390 [1.00] Soil Variability and Land Evaluation
PBIO*4290 [0.50] Cannabis Production
PBIO*4530 [0.50] Plants and Environmental Pollution

List E

ENVS*4410 [0.50] Introduction to Advanced Independent Research
ENVS*4420 [0.50] Advanced Independent Advanced Independent Research
ENVS*4430 [1.00] Advanced Independent Research
ENVS*4510 [0.50] Topics in Environmental Sciences

List F

Students may count up to 1.00 credits from the following list towards their 6.50 credit restricted electives.

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

Environmental Economics and Policy (EEP)

This major provides the foundation for applying science and economics to environmental issues to produce effective environmental policy. Students gain an understanding of the policy tools and market mechanisms for managing our natural resources effectively. Knowledge and skills learned in this major will enable students to identify, prioritize and solve environmental problems by integrating both scientific and economic theories and data. Equipped with the ability to look at current topics from the perspectives of economics, politics and environmental sciences, students have a number of interesting career opportunities in the public, private and NGO sectors. At the same time, the major fully prepares students to move onto professional and research graduate programs.

Major

Semester 1

BIOL*1070 [0.50] Discovering Biodiversity
CHEM*1040 [0.50] General Chemistry I
ENVS*1030 [1.00] Introduction to Environmental Sciences
MATH*1080 [0.50] Elements of Calculus I

Semester 2

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1050 [0.50] General Chemistry II
FARE*1040 [1.00] Intro to Environmental Economics, Law & Policy
GEOG*1300 [0.50] Introduction to the Biophysical Environment

Semester 3

ECON*1100 [0.50] Introductory Macroeconomics
FARE*2700 [0.50] Survey of Natural Resource Economics
1.50 electives or restricted electives

Semester 4

ECON*2310 [0.50] Intermediate Microeconomics
ECON*2410 [0.50] Intermediate Macroeconomics
ECON*2770 [0.50] Introductory Mathematical Economics

One of:
ECON*2740 [0.50] Economic Statistics
STAT*2040 [0.50] Statistics I

0.50 electives or restricted electives

Note: Students interested in the Statistics and Environmental Risk Assessment sequence in their restricted electives should choose STAT*2040 to satisfy the statistics requirement in the ENVS core.

Semester 5

ECON*2100 [0.50] Economic Growth and Environmental Quality
ECON*3740 [0.50] Introduction to Econometrics
1.50 electives or restricted electives

Semester 6

FARE*3170 [0.50] Cost-Benefit Analysis
2.00 electives or restricted electives

Semester 7

ECON*4930 [0.50] Environmental Economics
ENVS*4001 [0.50] Project in Environmental Sciences
FARE*4290 [0.50] Land Economics
1.00 electives or restricted electives

Semester 8

ENVS*4002 [0.50] Project in Environmental Sciences
FARE*4310 [0.50] Resource Economics
1.50 restricted electives or electives

Restricted Electives

Students in the Environmental Economics and Policy major are required to complete 6.00 credits in restricted electives. 2.50 restricted elective credits must be in FARE or ECON courses at the 3000 or 4000 level.

Courses in the following lists may be taken to satisfy the restricted electives requirement. Courses are grouped to assist students select programs of study aimed at different educational and career paths.

List A

Students must select a minimum of 2.50 credits from the following lists:

1. Quantitative Methods, Research and Graduate Studies

ECON*3100 [0.50] Game Theory
ECON*3710 [0.50] Advanced Microeconomics
ECON*4640 [0.50] Advanced Econometrics
ECON*4700 [0.50] Advanced Mathematical Economics
ECON*4710 [0.50] Advanced Topics in Microeconomics
ECON*4750 [0.50] Topics in Public Economics
FARE*4500 [0.50] Decision Science
FARE*4550 [0.50] Independent Studies I
FARE*4560 [0.50] Independent Studies II

2. Policy Analysis

ECON*2650 [0.50] Introductory Development Economics
ECON*3500 [0.50] Urban Economics
ECON*3580 [0.50] Economics of Regulation
ECON*3610 [0.50] Public Economics
ECON*3620 [0.50] International Trade
ECON*4830 [0.50] Economic Development
ECON*4880 [0.50] Topics in International Economics
EDRD*2650 [0.50] Introduction to Planning and Environmental Law
FARE*2410 [0.50] Agri-food Markets and Policy
FARE*3250 [0.50] Food and International Development
FARE*4000 [0.50] Agricultural and Food Policy
FARE*4210 [0.50] World Agriculture, Food Security and Economic Development
FARE*4550 [0.50] Independent Studies I
FARE*4560 [0.50] Independent Studies II
POL*3370 [0.50] Environmental Politics and Governance

List B

Students must select a minimum of 1.00 credits from the following lists:

1. Remote Sensing, Geographical Information Systems and Spatial Analysis

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

2. Statistics and Environmental Risk Assessment

STAT*2050 [0.50] Statistics I
STAT*3510 [0.50] Environmental Risk Assessment

Note: Students interested in this sequence should take ECON*2740 to satisfy the statistics requirement in the ENVS core.
### Earth Sciences
- ENVS*2030 [0.50] Meteorology and Climatology
- ENVS*2060 [0.50] Soil Science
- ENVS*2310 [0.50] Introduction to Biogeochemistry
- ENVS*3060 [0.50] Groundwater

### Ecology and Conservation Biology
- BIOL*2060 [0.50] Ecology
- 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*2330 [0.50] Current Issues in Ecosystem Science and Biodiversity

### Toxicology and Environmental Chemistry
- ENVS*3020 [0.50] Pesticides and the Environment
- ENVS*3040 [0.50] Natural Chemicals in the Environment
- ENVS*3220 [0.50] Terrestrial Chemistry
- TOX*2000 [0.50] Principles of Toxicology
- TOX*3360 [0.50] Environmental Chemistry and Toxicology

**Credit Summary (20.00 Total Credits)**
- 7.00 credits - Environmental Sciences core
- 5.00 credits - Environmental Economics and Policy required courses
- 6.00 credits - Environmental Economics and Policy restricted electives
- 2.00 credits - Free electives

### Environmental Economics and Policy (EEP:C)

#### Department of Food, Agricultural and Resource Economics, Ontario Agricultural College
This major provides the foundation for applying science and economics to environmental issues to produce effective environmental policy. Students gain an understanding of the policy tools and market mechanisms for managing our natural resources effectively. Knowledge and skills learned in this major will enable students to identify, prioritize and solve environmental problems by integrating both scientific and economic theories and data. Equipped with the ability to look at current topics from the perspectives of economics, politics and environmental sciences, students have a number of interesting career opportunities in the public, private and NGO sectors. At the same time, the major fully prepares students to move onto professional and research graduate programs.

#### Program Requirements
The Co-op program in Environmental Economics and Policy is a four and a half year program including four work terms. Students must complete a Fall, Winter and Summer work term, and must follow the academic schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program schedule with respect to adjusting this schedule.

Environmental Economics and Policy Academic and Co-op Term Schedule

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To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

**Credit Summary (21.50 Total Credits)**
- 7.00 - Environmental Sciences core
- 5.00 - Ecology Required courses
- 6.00 - Environmental Economics and Policy restricted electives
- 2.00 - Free electives
- 1.50 - Co-op Work Terms

**Note:** A minimum of three Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *COOP*4000 is optional and if completed the total number of credits will equal 22.00.

Students are reminded that 6.00 credits of their B.Sc. (Env.) degree must be at the 3000 or 4000 level.

The recommended program sequence is outlined below.

#### Major

##### Semester 1 - Fall
- BIOL*1070 [0.50] Discovering Biodiversity
- CHEM*1040 [0.50] General Chemistry I
- ENVS*1030 [1.00] Introduction to Environmental Sciences
- MATH*1080 [0.50] Elements of Calculus I

##### Semester 2 - Winter
- BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
- CHEM*1050 [0.50] General Chemistry II
- COOP*1100 [0.00] Introduction to Co-operative Education
- FARE*1040 [1.00] Intro to Environmental Economics, Law & Policy
- GEOG*1300 [0.50] Introduction to the Biophysical Environment

##### Semester 3 - Fall
- ECON*1100 [0.50] Introductory Macroeconomics
- FARE*2700 [0.50] Survey of Natural Resource Economics
- 1.50 electives or restricted electives

##### Winter Semester
- COOP*1000 [0.50] Co-op Work Term I

##### Semester 4 - Summer
- ECON*2310 [0.50] Intermediate Microeconomics
- ECON*2410 [0.50] Intermediate Macroeconomics
- ECON*2770 [0.50] Introductory Mathematical Economics

One of:
- ECON*2740 [0.50] Economic Statistics
- STAT*2040 [0.50] Statistics I

- 0.50 electives or restricted electives

**Note:** Students interested in the Statistics and Environmental Risk Assessment sequence in their restricted electives should choose STAT*2040 to satisfy the statistics requirement in the ENVS core. ECON*2740 may not be offered in the summer semester, so STAT*2040 should be taken if students wish to satisfy this program requirement in the summer semester.

##### Fall Semester
- COOP*2000 [0.50] Co-op Work Term II

##### Semester 5 - Winter
- ECON*3740 [0.50] Introduction to Econometrics
- FARE*3170 [0.50] Cost-Benefit Analysis
- 1.50 electives or restricted electives

##### Summer Semester
- COOP*3000 [0.50] Co-op Work Term III

##### Semester 6 - Fall
- ECON*2100 [0.50] Economic Growth and Environmental Quality
- ENVS*4001 [0.50] Project in Environmental Sciences
- 1.50 electives or restricted electives

##### Semester 7 - Winter
- ENVS*4002 [0.50] Project in Environmental Sciences
- FARE*4310 [0.50] Resource Economics
- 1.50 electives or restricted electives

##### Summer Semester (Optional)
- COOP*4000 [0.50] Co-op Work Term IV

##### Semester 8 - Fall
- ECON*4930 [0.50] Environmental Economics
- FARE*4290 [0.50] Land Economics
- 1.50 electives or restricted electives

### Restricted Electives
Students in the Environmental Economics and Policy major are required to complete 6.00 credits in restricted electives. 2.50 restricted elective credits must be in FARE or ECON courses at the 3000 or 4000 level.

Courses in the following lists may be taken to satisfy the restricted electives requirement. Courses are grouped to assist students select programs of study aimed at different educational and career paths.

**List A**

Students must select a minimum of 2.50 credits from the following lists:

1. **Quantitative Methods, Research and Graduate Studies**
   - ECON*3100 [0.50] Game Theory
   - ECON*3710 [0.50] Advanced Microeconomics
**Advanced Econometrics**

**ECON*4640 [0.50]** Advanced Econometrics

**ECON*4700 [0.50]** Advanced Mathematical Economics

**ECON*4710 [0.50]** Advanced Topics in Microeconomics

**ECON*4750 [0.50]** Topics in Public Economics

**FARE*4500 [0.50]** Decision Science

**FARE*4550 [0.50]** Independent Studies I

**FARE*4560 [0.50]** Independent Studies II

**2. Policy Analysis**

**ECON*2650 [0.50]** Introductory Development Economics

**ECON*3500 [0.50]** Urban Economics

**ECON*3580 [0.50]** Economics of Regulation

**ECON*3510 [0.50]** Public Economics

**ECON*3620 [0.50]** International Trade

**ECON*4830 [0.50]** Economic Development

**ECON*4880 [0.50]** Topics in International Economics

**EDRD*2650 [0.50]** Introduction to Planning and Environmental Law

**FARE*2410 [0.50]** Agri-food Markets and Policy

**FARE*3250 [0.50]** Food and International Development

**FARE*4000 [0.50]** Agricultural and Food Policy

**FARE*4210 [0.50]** World Agriculture, Food Security and Economic Development

**FARE*4550 [0.50]** Independent Studies I

**FARE*4560 [0.50]** Independent Studies II

**POLS*3370 [0.50]** Environmental Politics and Governance

**List B**

Students must select a minimum of 1.00 credits from the following lists:

1. **Remote Sensing, Geographical Information Systems and Spatial Analysis**
   - 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

2. **Statistics and Environmental Risk Assessment**
   - STAT*2050 [0.50] Statistics II
   - STAT*3510 [0.50] Environmental Risk Assessment

**Note:** Students interested in this sequence should take STAT*2040 rather than ECON*2740 to satisfy the statistics requirement in the ENVS core.

**3. Earth Sciences**

- **ENVS*2030 [0.50]** Meteorology and Climatology
- **ENVS*2060 [0.50]** Soil Science
- **ENVS*2310 [0.50]** Introduction to Biogeochemistry
- **ENVS*3060 [0.50]** Groundwater

**4. Ecology and Conservation Biology**

- **BIOL*2060 [0.50]** Ecology
- **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*2330 [0.50]** Current Issues in Ecosystem Science and Biodiversity

**5. Toxicology and Environmental Chemistry**

- **ENVS*3020 [0.50]** Pesticides and the Environment
- **ENVS*3040 [0.50]** Natural Chemicals in the Environment
- **ENVS*3220 [0.50]** Terrestrial Chemistry
- **TOX*2000 [0.50]** Principles of Toxicology
- **TOX*3360 [0.50]** Environmental Chemistry and Toxicology

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

The major focuses on environmental interactions and problem solving by developing an integrated biophysical environment - human environment perspective. In ERM, students will gain knowledge across the natural sciences, an understanding of how they interact, the skills (tools and techniques) needed to support decision making, as well as the methods of management and governance that are critical for environmental decision making. Beginning in first year students learn in the classroom and through hands-on work in labs and in the field. Students are expected to design and conduct experiments and problem solve using state-of-the-art computing and analytical tools. This major provides the knowledge, skills and methods an environmental scientist requires as environmental consultant, environmental manager, environmental and/or resource planner, geographic information systems analyst or to facilitate future graduate work.

**Environment and Resource Management (ERM)**

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

The major focuses on environmental interactions and problem solving by developing an integrated biophysical environment - human environment perspective. In ERM, students will gain knowledge across the natural sciences, an understanding of how they interact, the skills (tools and techniques) needed to support decision making, as well as the methods of management and governance that are critical for environmental decision making. Beginning in first year students learn in the classroom and through hands-on work in labs and in the field. Students are expected to design and conduct experiments and problem solve using state-of-the-art computing and analytical tools. This major provides the knowledge, skills and methods an environmental scientist requires as environmental consultant, environmental manager, environmental and/or resource planner, geographic information systems analyst or to facilitate future graduate work.

**Program Requirements**

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**Revision:**

**2020-2021 Undergraduate Calendar**
The Co-op program in Environment and Resource Management is a four and a half year program including four work terms. Students must complete a Fall, Winter and Summer work term, and must follow the academic work schedule as outlined below (also found on the Co-operative Education website: https://www.recruitguelph.ca/cecs/). Please refer to the Co-operative Education program policy with respect to adjusting this schedule.

Environment and Resource Management Academic and Co-op Work Term Schedule

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</table>

To be eligible to continue in the Co-op program, students must meet a minimum 70% cumulative average requirement after second semester, as well as meet all work term requirements. Please refer to the Co-operative Education program policy with respect to work term performance grading, work term report grading and program completion requirements.

For additional program information students should consult with their Co-op Co-ordinator and Co-op Faculty Advisor, listed on the Co-operative Education web site.

Credit Summary (21.50 Total Credits)*

7.00 - Environmental Sciences core

6.00 - Environment and Resource Management Required courses

2.00 - 2.50 - Environment and Resource Management Restricted electives, depending on course selection

4.00 - 4.50 - Free electives, depending on course selection

1.50 - Co-op Work Terms

Note: A minimum of three Co-op work terms including a Summer, Fall, and Winter are necessary to complete the Co-op requirement. *COOP*4000 is optional and if completed the total number of credits will equal 22.00.

Students are reminded that 6.00 credits of their B.Sc. degree must be at the 3000-4000 level.

Students are encouraged to seek advice on their choices from their faculty advisor. The recommended program sequence is outlined below.

Major

Semester 1 - Fall

BIOL*1070 [0.50] Discovering Biodiversity
CHEM*1040 [0.50] General Chemistry I
ENVS*1030 [1.00] Introduction to Environmental Sciences
MATH*1080 [0.50] Elements of Calculus I

Semester 2 - Winter

BIOL*1090 [0.50] Introduction to Molecular and Cellular Biology
CHEM*1050 [0.50] General Chemistry II
COOP*1100 [0.00] Introduction to Co-operative Education
FARE*1040 [1.00] Intro to Environmental Economics, Law & Policy
GEOG*1300 [0.50] Introduction to the Biophysical Environment

Semester 3 - Fall

ENVS*2120 [0.50] Introduction to Environmental Stewardship
GEOG*2000 [0.50] Geomorphology
GEOG*2480 [0.50] Mapping and GIS

1.00 electives or restricted electives

Note: FARE*2700 may be substituted for ECON*2100 and may be taken in Semester 3 or 6. GEOG*2460 may be substituted for STAT*2040 and may be taken in Semester 3 or 6.

Winter Semester

COOP*1000 [0.50] Co-op Work Term I

Semester 4 - Summer

ECON*2100 [0.50] Economic Growth and Environmental Quality
GEOG*2210 [0.50] Environment and Resources
STAT*2040 [0.50] Statistics I

1.00 electives or restricted electives

Fall Semester

COOP*2000 [0.50] Co-op Work Term II

Semester 5 - Winter

GEOG*2110 [0.50] Climate and the Biophysical Environment
GEOG*3480 [0.50] GIS and Spatial Analysis

1.50 electives or restricted electives

Summer Semester

COOP*3000 [0.50] Co-op Work Term III

Semester 6 - Fall

ENVS*4001 [0.50] Project in Environmental Sciences
GEOG*3000 [0.50] Fluvial Processes
GEOG*3110 [0.50] Biotic and Natural Resources
GEOG*3210 [0.50] Management of the Biophysical Environment

0.50 electives or restricted electives

Note: GEOG*3610 may be substituted for GEOG*3000 and would be taken in Semester 6.

Semester 7 - Winter

ENVS*4002 [0.50] Project in Environmental Sciences
2.00 electives or restricted electives

Summer Semester (Optional)

COOP*4000 [0.50] Co-op Work Term IV

Semester 8 - Fall

GEOG*4110 [1.00] Environmental Systems Analysis
GEOG*4210 [0.50] Environmental Governance
1.00 electives or restricted electives

Restricted Electives

1. A minimum of 2 of the following courses:
   - ENVS*4390 [1.00] Soil Variability and Land Evaluation
   - GEOG*4220 [0.50] Local Environmental Management
   - GEOG*4230 [0.50] Environmental Impact Assessment
2. An additional 1.00 credits in Geography (GEOG) at the 3000 level or higher.
2. An additional 1.00 credits in Geography (GEOG) at the 3000 level or higher.

Note: GEOG*3610 may be substituted for GEOG*3000 and would be taken in Semester 6.