Environmental Science

This section presents the requirements for programs in:

- Environmental Science B.Sc. Honours
- Environmental Science with Concentration in Chemistry B.Sc. Honours
- Environmental Science with Concentration in Earth Sciences B.Sc. Honours
- Environmental Science with Concentration in Ecology, Biodiversity and Conservation B.Sc. Honours
- Environmental Science with Concentration in Geomatics B.Sc. Honours
- Environmental Science B.Sc. Major

Program Requirements

Course Categories

The Environmental Science program description makes use of the following course categories:

- Approved Courses Outside the Faculties of Science and Engineering and Design (approved by the Environmental Science Institute)
- Approved Environmental Science Electives (approved by the Environmental Science Institute)
- Free Electives (see Academic Regulations for the B.Sc.)

Approved Science for Environmental Science

Courses approved by the Institute of Environmental Science include the following that comply with the Academic Regulations for the B.Sc.:

- Biochemistry
- Biology
- Computer Science
- Earth Science
- Environmental Science
- Geography
- Geomatics
- Mathematics and Statistics
- Physics

Prohibited and Restricted Courses

Technology, Society, Environment Studies (TSES) courses are not accepted as Science Continuation courses in these programs, but may be used as Approved Environmental Science Specialization courses or as free electives.

Environmental Science

B.Sc. Honours (20.0 credits)

A. Credits Included in the Major CGPA (11.5 credits)

1. 3.0 credits in:

<table>
<thead>
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<th>Course Code</th>
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<tr>
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<td>Environmental Science Seminar</td>
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<tr>
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<td>Environmental Science Field Methods</td>
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<td>ENSC 2001 [0.5]</td>
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<td>Methods and Analysis in Environmental Science</td>
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2. 1.0 credit from:

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<tr>
<td>ENSC 4906 [1.0]</td>
<td>Honours Research Project</td>
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<tr>
<td>ENSC 4909 [1.0]</td>
<td>Translational Approach to Indigenous Community Wellness</td>
</tr>
<tr>
<td>ENSC 4901 [0.5]</td>
<td>Directed Projects (and [0.5] credit Science faculty elective or science continuation at the 4000 level)</td>
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3. 2.0 credits in:

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<td>BIOL 2600 [0.5]</td>
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</tr>
<tr>
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</tr>
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<td>CHEM 2800 [0.5]</td>
<td>Foundations for Environmental Chemistry</td>
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<td>GEOG 3104 [0.5]</td>
<td>Principles of Biogeography</td>
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<td>GEOG 3106 [0.5]</td>
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<td>ERTH 2314 [0.5]</td>
<td>Sedimentation and Stratigraphy</td>
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<td>ERTH 2402 [0.5]</td>
<td>Climate Change: An Earth Sciences Perspective</td>
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<tr>
<td>ERTH 2403 [0.5]</td>
<td>Introduction to Oceanography</td>
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<tr>
<td>ERTH 3113 [0.5]</td>
<td>Geology of Human Origins</td>
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<tr>
<td>ERTH 3205 [0.5]</td>
<td>Physical Hydrogeology</td>
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<tr>
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6. 0.5 credit from:

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<td>Cell Biology and Biochemistry</td>
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<tr>
<td>BIOL 2107 [0.5]</td>
<td>Fundamentals of Genetics</td>
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7. 1.0 credit from Science Faculty Electives or Science Continuation Courses at the 4000 level

8. 2.0 credits from Science Faculty Electives or Science Continuation Courses

B. Credits Not Included in the Major CGPA (8.5 credits)

9. 1.0 credit in:

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10. 2.5 credits in:

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<tr>
<td>BIOL 1104 [0.5]</td>
<td>Foundations of Biology II</td>
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<tr>
<td>CHEM 1001 [0.5]</td>
<td>General Chemistry I</td>
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<tr>
<td>CHEM 1002 [0.5]</td>
<td>General Chemistry II</td>
</tr>
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<td>ERTH 1006 [0.5]</td>
<td>Exploring Planet Earth</td>
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</table>

11. 0.5 credit in:

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<th>Title</th>
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<tr>
<td>PHIL 2380 [0.5]</td>
<td>Introduction to Environmental Ethics</td>
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</tbody>
</table>

12. 1.5 credits in approved courses outside the faculties of Science and Engineering and Design (may include NSCI 1000)
13. 3.0 credits in free electives. 3.0

**Total Credits** 20.0

**Environmental Science with Concentration in Chemistry**

**B.Sc. Honours (20.0 credits)**

**A. Credits Included in the Major CGPA (13 credits)**

1. **3.0 credits in:** 
   - ENSC 1500 [0.5] Environmental Science Seminar
   - ENSC 2000 [0.5] Environmental Science Field Methods
   - ENSC 2001 [0.5] Earth Resources and Natural Hazards: Environmental Impacts
   - ENSC 2002 [0.5] Methods and Analysis in Environmental Science
   - ENSC 3000 [0.5] Environmental Science and Management: Theory and Practice
   - ENSC 3509 [0.5] Group Research in Environmental Science

2. **1.0 credit from:** 
   - ENSC 4906 [1.0] Honours Research Project
   - ENSC 4909 [1.0] Translational Approach to Indigenous Community Wellness

3. **2.0 credit in:** 
   - BIOL 2600 [0.5] Ecology
   - CHEM 2302 [0.5] Analytical Chemistry I
   - CHEM 2800 [0.5] Foundations for Environmental Chemistry
   - GEOG 2013 [0.5] Weather and Water

4. **1.0 credit from:** 
   - GEOG 3102 [0.5] Geomorphology
   - GEOG 3103 [0.5] Watershed Hydrology
   - GEOG 3104 [0.5] Principles of Biogeography
   - GEOG 3105 [0.5] Climate and Atmospheric Change
   - GEOG 3106 [0.5] Aquatic Science and Management
   - GEOG 3108 [0.5] Soil Properties

5. **0.5 credit from:** 
   - ERTH 2312 [0.5] Paleontology
   - ERTH 2314 [0.5] Sedimentation and Stratigraphy
   - ERTH 2402 [0.5] Climate Change: An Earth Sciences Perspective
   - ERTH 2403 [0.5] Introduction to Oceanography
   - ERTH 3113 [0.5] Geology of Human Origins
   - ERTH 3205 [0.5] Physical Hydrogeology
   - ERTH 3206 [0.5] Sedimentary Depositional Systems

6. **0.5 credit from:** 
   - BIOL 2107 [0.5] Fundamentals of Genetics
   - BIOL 2201 [0.5] Cell Biology and Biochemistry

7. **3.0 credits in:** 
   - CHEM 2203 [0.5] Organic Chemistry I
   - CHEM 2204 [0.5] Organic Chemistry II
   - CHEM 2303 [0.5] Analytical Chemistry II
   - CHEM 2501 [0.5] Introduction to Inorganic and Bioinorganic Chemistry

   - CHEM 3305 [0.5] Advanced Analytical Chemistry Laboratory
   - CHEM 3800 [0.5] The Chemistry of Environmental Pollutants

8. **1.5 credits in:** 
   - Organic focus:
     - CHEM 3201 [0.5] Advanced Organic Chemistry I
     - CHEM 3202 [0.5] Advanced Organic Chemistry II
     - CHEM 3205 [0.5] Experimental Organic Chemistry
   
   - Inorganic focus:
     - i) 1.0 credit in:
       - CHEM 3503 [0.5] Inorganic Chemistry I
       - CHEM 3504 [0.5] Inorganic Chemistry II
     - ii) 0.5 credit in CHEM at the 4000-level

9. **0.5 credit in:** 
   - CHEM 4800 [0.5] Atmospheric Chemistry

**B. Credits not included in the Major CGPA (7.0 credits)**

10. **1.5 credit in:** 
    - MATH 1007 [0.5] Elementary Calculus I
    - MATH 1107 [0.5] Linear Algebra I
    - STAT 2507 [0.5] Introduction to Statistical Modeling I

11. **2.5 credits in:** 
    - BIOL 1103 [0.5] Foundations of Biology I
    - BIOL 1104 [0.5] Foundations of Biology II
    - CHEM 1001 [0.5] General Chemistry I
    - CHEM 1002 [0.5] General Chemistry II
    - ERTH 1006 [0.5] Exploring Planet Earth

12. **0.5 credit in:** 
    - PHIL 2380 [0.5] Introduction to Environmental Ethics

13. **1.5 credits in** approved courses outside the faculties of Science and Engineering and Design (may include NSCI 1000)

14. **1.0 credit in** free elective

**Total Credits** 20.0

**Environmental Science with Concentration in Earth Sciences**

**B.Sc. Honours (20.0 credits)**

**A. Credits Included in the Major CGPA (11.5 credits)**

1. **3.0 credits from:** 
   - ENSC 1500 [0.5] Environmental Science Seminar
   - ENSC 2000 [0.5] Environmental Science Field Methods
   - ENSC 2001 [0.5] Earth Resources and Natural Hazards: Environmental Impacts
   - ENSC 2002 [0.5] Methods and Analysis in Environmental Science
   - ENSC 3000 [0.5] Environmental Science and Management: Theory and Practice
   - ENSC 3509 [0.5] Group Research in Environmental Science

2. **1.0 credit from:** 
   - ENSC 4906 [1.0] Honours Research Project
   - ENSC 4909 [1.0] Translational Approach to Indigenous Community Wellness

**Total Credits** 20.0
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<td>Erth 2104</td>
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**Environmental Science with Concentration in Ecology, Biodiversity and Conservation**

**B.Sc. Honours (20.0 credits)**

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<th>Course Code</th>
<th>Description</th>
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<td>[0.5] Environmental Science and Management: Theory and Practice</td>
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<td>Geog 2013</td>
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<td>Geog 3104</td>
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<td>Geog 3105</td>
<td>Climate and Atmospheric Change</td>
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<td>Paleontology</td>
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<tr>
<td></td>
<td>Erth 2314</td>
<td>Sedimentation and Stratigraphy</td>
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<tr>
<td></td>
<td>Erth 2402</td>
<td>Climate Change: An Earth Sciences Perspective</td>
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<tr>
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<td>Erth 2403</td>
<td>Introduction to Oceanography</td>
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<tr>
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<td>Erth 3113</td>
<td>Geology of Human Origins</td>
</tr>
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<td></td>
<td>Erth 3205</td>
<td>Physical Hydrogeology</td>
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<tr>
<td></td>
<td>Erth 3206</td>
<td>Sedimentary Depositional Systems</td>
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<tr>
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<td>Science faculty elective or science continuation at the 4000 level</td>
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</tr>
<tr>
<td>4.0</td>
<td>Biol 2001</td>
<td>Animals: Form and Function</td>
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<tr>
<td></td>
<td>Biol 2002</td>
<td>Plants: Form and Function</td>
</tr>
<tr>
<td></td>
<td>Biol 2201</td>
<td>Cell Biology and Biochemistry</td>
</tr>
</tbody>
</table>
### Environmental Science

**b. 0.5 credit from:**
- BIOL 2303 [0.5] Microbiology
- BIOL 3004 [0.5] Insect Diversity
- BIOL 3102 [0.5] Mycology

**c. 2.0 credits in a focus:**

#### Ecology focus:
1. **0.5 credit in:**
   - BIOL 3604 [0.5] Statistics for Biologists
2. **1.0 credit from:**
   - BIOL 3601 [0.5] Ecosystems and Environmental Change
   - BIOL 3602 [0.5] Conservation Biology
   - BIOL 3605 [0.5] Field Course I
   - BIOL 3606 [0.5] Field Course II
3. **0.5 credit BIOL at the 4000-level**

#### Microbiology/genetics focus:
1. **1.0 credit from:**
   - BIOL 3104 [0.5] Molecular Genetics
   - BIOL 4103 [0.5] Population Genetics
2. **0.5 credit from:**
   - BIOL 2303 [0.5] Microbiology
   - BIOL 3102 [0.5] Mycology
   - BIOL 3303 [0.5] Experimental Microbiology
3. **0.5 credit BIOL at the 4000-level**

**B. Credits Not Included in the Major CGPA (7.5 credits)**

8. **1.0 credit in:**
   - MATH 1007 [0.5] Elementary Calculus I
   - STAT 2507 [0.5] Introduction to Statistical Modeling I

9. **2.5 credits in:**
   - BIOL 1103 [0.5] Foundations of Biology I
   - BIOL 1104 [0.5] Foundations of Biology II
   - CHEM 1001 [0.5] General Chemistry I
   - CHEM 1002 [0.5] General Chemistry II
   - ERTH 1006 [0.5] Exploring Planet Earth

10. **0.5 credit in:**
    - PHIL 2380 [0.5] Introduction to Environmental Ethics

11. **0.5 credit from:**
    - BIOL 2107 [0.5] Fundamentals of Genetics

12. **1.5 credits in** approved courses outside the faculties of Science and Engineering and Design (may include NSCI 1000)

13. **1.5 credit in** free electives.

**Total Credits 20.0**

### Environmental Science with Concentration in Geomatics

**B.Sc. Honours (20.0 credits)**

**A. Credits Included in the Major CGPA (13.0 credits)**

1. **3.0 credits in:**
   - ENSC 1500 [0.5] Environmental Science Seminar
   - ENSC 2000 [0.5] Environmental Science Field Methods
   - ENSC 2001 [0.5] Earth Resources and Natural Hazards: Environmental Impacts
   - ENSC 2002 [0.5] Methods and Analysis in Environmental Science
   - ENSC 3000 [0.5] Environmental Science and Management: Theory and Practice
   - ENSC 3509 [0.5] Group Research in Environmental Science

2. **1.0 credit from:**
   - ENSC 4906 [1.0] Honours Research Project
   - ENSC 4909 [1.0] Translational Approach to Indigenous Community Wellness
   - ENSC 4901 [0.5] Directed Projects
   - GEOM 4005 [0.5] Directed Studies in Geomatics
   - and 0.5 credit 4000-level Approved Science for Environmental Science

3. **2.0 credit in:**
   - BIOL 2600 [0.5] Ecology
   - CHEM 2302 [0.5] Analytical Chemistry I
   - CHEM 2800 [0.5] Foundations for Environmental Chemistry
   - GEOG 2013 [0.5] Weather and Water

4. **1.0 credit from:**
   - GEOG 3102 [0.5] Geomorphology
   - GEOG 3103 [0.5] Watershed Hydrology
   - GEOG 3104 [0.5] Principles of Biogeography
   - GEOG 3105 [0.5] Climate and Atmospheric Change
   - GEOG 3106 [0.5] Aquatic Science and Management
   - GEOG 3108 [0.5] Soil Properties

5. **1.0 credit from:**
   - ERTH 2312 [0.5] Paleontology
   - ERTH 2314 [0.5] Sedimentation and Stratigraphy
   - ERTH 2402 [0.5] Climate Change: An Earth Sciences Perspective
   - ERTH 2403 [0.5] Introduction to Oceanography
   - ERTH 3113 [0.5] Geology of Human Origins
   - ERTH 3205 [0.5] Physical Hydrogeology
   - ERTH 3206 [0.5] Sedimentary Depositional Systems

6. **3.5 credits in:**
   - GEOM 1004 [0.5] Maps, Satellites and the Geospatial Revolution
   - GEOM 2005 [0.5] Introduction to Geospatial Programming
   - GEOM 2007 [0.5] Vector GIS: Points, Lines and Polygons
   - GEOM 2008 [0.5] Raster GIS: Pixels and Grids
   - GEOM 3002 [0.5] Introduction to Remote Sensing
   - GEOM 3005 [0.5] Geospatial Analysis
   - GEOM 3003 [0.5] Quantitative Geography

7. **1.5 credits from:**
   - GEOM 4001 [0.5] Special Topics in Geomatics
   - GEOM 4003 [0.5] Remote Sensing of the Environment
   - GEOM 4008 [0.5] Advanced Topics in Geographic Information Systems
   - GEOM 4009 [0.5] Custom Geomatics Applications

**B. Credits not included in the Major CGPA (7.0 credits)**

8. **1.5 credit in:**
   - MATH 1007 [0.5] Elementary Calculus I
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1103</td>
<td>Foundations of Biology I</td>
<td>0.5</td>
</tr>
<tr>
<td>BIOL 1104</td>
<td>Foundations of Biology II</td>
<td>0.5</td>
</tr>
<tr>
<td>CHEM 1001</td>
<td>General Chemistry I</td>
<td>0.5</td>
</tr>
<tr>
<td>CHEM 1002</td>
<td>General Chemistry II</td>
<td>0.5</td>
</tr>
<tr>
<td>ERTH 1006</td>
<td>Exploring Planet Earth</td>
<td>0.5</td>
</tr>
</tbody>
</table>

1. 0.5 credit in:

PHIL 2380 [0.5] Introduction to Environmental Ethics

11. 0.5 credit from:

BIOL 2107 [0.5] Fundamentals of Genetics

BIOL 2201 [0.5] Cell Biotechnology

**Total Credits**

20.0

### Environmental Science

#### B.Sc. Major (20.0 credits)

**A. Credits Included in the Major CGPA (10.0 credits)**

1. 2.5 credits in:

ENSC 1500 [0.5] Environmental Science Seminar

ENSC 2000 [0.5] Environmental Science Field Methods

ENSC 2001 [0.5] Earth Resources and Natural Hazards: Environmental Impacts

ENSC 2002 [0.5] Methods and Analysis in Environmental Science

ENSC 3000 [0.5] Environmental Science and Management: Theory and Practice

2. 2.0 credit in:

BIOL 2600 [0.5] Ecology

CHEM 2800 [0.5] Foundations for Environmental Chemistry

CHEM 2302 [0.5] Analytical Chemistry I

GEOG 2013 [0.5] Weather and Water

3. 1.0 credit from:

GEOG 3102 [0.5] Geomorphology

GEOG 3103 [0.5] Watershed Hydrology

GEOG 3104 [0.5] Principles of Biogeography

GEOG 3105 [0.5] Climate and Atmospheric Change

GEOG 3106 [0.5] Aquatic Science and Management

GEOG 3108 [0.5] Soil Properties

4. 1.0 credit from:

ERTH 2312 [0.5] Paleontology

ERTH 2314 [0.5] Sedimentation and Stratigraphy

ERTH 2402 [0.5] Climate Change: An Earth Sciences Perspective

ERTH 2403 [0.5] Introduction to Oceanography

ERTH 3113 [0.5] Geology of Human Origins

ERTH 3205 [0.5] Physical Hydrogeology

ERTH 3206 [0.5] Sedimentary Depositional Systems

5. 0.5 credit from:

BIOL 2107 [0.5] Fundamentals of Genetics

**B. Credits Not Included in the Major CGPA (10.0 credits)**

6. 1.0 credits from Science faculty electives or science continuation at the 4000 level

7. 2.0 credits from Science faculty electives or science continuation courses

**B. Credits Not Included in the Major CGPA (10.0 credits)**

1. 0.5 credit in:

MATH 1007 [0.5] Elementary Calculus I

STAT 2507 [0.5] Introduction to Statistical Modeling I

9. 2.5 credits in:

BIOL 1103 [0.5] Foundations of Biology I

BIOL 1104 [0.5] Foundations of Biology II

CHEM 1001 [0.5] General Chemistry I

CHEM 1002 [0.5] General Chemistry II

ERTH 1006 [0.5] Exploring Planet Earth

10. 0.5 credit in:

PHIL 2380 [0.5] Introduction to Environmental Ethics

11. 1.5 credits in approved courses outside the faculties of Science and Engineering and Design (may include NSCI 1000)

12. 4.5 credits in free electives.

**Total Credits**

20.0

### B.Sc. Regulations

The regulations presented in this section apply to all Bachelor of Science programs. In addition to the requirements presented here, students must satisfy the University regulations common to all undergraduate students including the process of Academic Continuation Evaluation (see the *Academic Regulations of the University* section of this Calendar).

**Breadth Requirement for the B.Sc.**

Students in a Bachelor of Science program must present the following credits at graduation:

1. 2.0 credits in Science Continuation courses not in the major discipline; **students completing a double major are considered to have completed this requirement providing they have 2.0 credits in Science Continuation courses in each of the two majors**;

2. 2.0 credits in courses outside of the faculties of Science and Engineering and Design (may include NSCI 1000)

In most cases, the requirements for individual B.Sc. programs, as stated in this Calendar, contain these requirements, explicitly or implicitly.

Students admitted to B.Sc. programs by transfer from another institution must present at graduation (whether taken at Carleton or elsewhere):

1. 2.0 credits in courses outside of the faculties of Science and Engineering and Design (may include NSCI 1000) if the student received fewer than 10.0 transfer credits; or,
2. 1.0 credit in courses outside of the faculties of Science and Engineering and Design (may include NSCI 1000) if the student received 10.0 or more transfer credits.

**Declared and Undeclared Students**

Degree students are considered "Undeclared" if they have been admitted to a degree, but have not yet selected and been accepted into a program within that degree. The status "Undeclared" is available only in the B.A. and B.Sc. degrees. Undeclared students must apply to enter a program upon or before completing 3.5 credits.

**Change of Program within the B.Sc. Degree**

To transfer to a program within the B.Sc. degree, applicants must normally be Eligible to Continue (EC) in the new program, by meeting the CGPA thresholds described in Section 3.1.9 of the Academic Regulations of the University.

Applications to declare or change programs within the B.Sc. degree must be made online through Carleton Central by completing a Change of Program Elements (COPE) application form within the published deadlines. Acceptance into a program, or into a program element or option, is subject to any enrolment limitations, and/or specific program, program element or option requirements as published in the relevant Calendar entry.

**Minors, Concentrations, and Specializations**

Students may add a Minor, Concentration, or Specialization by completing a Change of Program Elements (COPE) application form online through Carleton Central. Acceptance into a Minor, Concentration, or Specialization normally requires that the student be Eligible to Continue (EC) and is meeting the minimum CGPAs described in Section 3.1.9 of the Academic Regulations of the University, as well as being subject to any specific requirements of the intended Minor, Concentration, or Specialization as published in the relevant Calendar entry.

**Experimental Science Requirement**

Students in a B.Sc. degree program must present at graduation at least two full credits of Experimental Science chosen from two different departments or institutes from the list below:

**Approved Experimental Science Courses**

**Biochemistry**
- BIOC 2200 [0.5] Cellular Biochemistry
- BIOC 4001 [0.5] Methods in Biochemistry
- BIOC 4201 [0.5] Advanced Cell Culture and Tissue Engineering

**Biology**
- BIOL 1103 [0.5] Foundations of Biology I
- BIOL 1104 [0.5] Foundations of Biology II
- BIOL 2001 [0.5] Animals: Form and Function
- BIOL 2002 [0.5] Plants: Form and Function
- BIOL 2104 [0.5] Introductory Genetics
- BIOL 2200 [0.5] Cellular Biochemistry
- BIOL 2600 [0.5] Ecology

**Chemistry**
- CHEM 1001 [0.5] General Chemistry I
- CHEM 1002 [0.5] General Chemistry II
- CHEM 2103 [0.5] Physical Chemistry I
- CHEM 2203 [0.5] Organic Chemistry I
- CHEM 2204 [0.5] Organic Chemistry II
- CHEM 2302 [0.5] Analytical Chemistry I
- CHEM 2303 [0.5] Analytical Chemistry II
- CHEM 2800 [0.5] Foundations for Environmental Chemistry

**Earth Sciences**
- ERTH 1006 [0.5] Exploring Planet Earth
- ERTH 1009 [0.5] The Earth System Through Time
- ERTH 2102 [0.5] Mineralogy to Petrology
- ERTH 2404 [0.5] Engineering Geoscience
- ERTH 2802 [0.5] Field Geology I
- ERTH 3111 [0.5] Vertebrate Geology: Mammals, Reptiles, and Birds
- ERTH 3112 [0.5] Vertebrate Evolution: Fish and Amphibians
- ERTH 3204 [0.5] Mineral Deposits
- ERTH 3205 [0.5] Physical Hydrogeology
- ERTH 3806 [0.5] Structural Geology

**Food Sciences**
- FOOD 3001 [0.5] Food Chemistry
- FOOD 3002 [0.5] Food Analysis
- FOOD 3005 [0.5] Food Microbiology

**Geography**
- GEOG 1010 [0.5] Soil Properties
- GEOG 3108 [0.5] Geology

**Neuroscience**
- NEUR 3206 [0.5] Sensory and Motor Neuroscience
- NEUR 3207 [0.5] Systems Neuroscience
- NEUR 4600 [0.5] Advanced Lab in Neuroanatomy

**Physics**
- PHYS 1001 [0.5] Foundations of Physics I
- PHYS 1002 [0.5] Foundations of Physics II
- PHYS 1003 [0.5] Introductory Mechanics and Thermodynamics
- PHYS 1004 [0.5] Introductory Electromagnetism and Wave Motion
- PHYS 1007 [0.5] Elementary University Physics I
- PHYS 1008 [0.5] Elementary University Physics II
- PHYS 2202 [0.5] Wave Motion and Optics
- PHYS 2604 [0.5] Modern Physics I
- PHYS 3007 [0.5] Third Year Physics Laboratory: Selected Experiments and Seminars
- PHYS 3606 [0.5] Modern Physics II
- PHYS 3608 [0.5] Modern Applied Physics

**Course Categories for B.Sc. Programs**

**Science Geography Courses**
- GEOG 1010 [0.5] Global Environmental Systems
- GEOG 2006 [0.5] Introduction to Quantitative Research
- GEOG 2013 [0.5] Weather and Water
- GEOG 2014 [0.5] The Earth's Surface
- GEOG 3003 [0.5] Quantitative Geography
<table>
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<tr>
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<tbody>
<tr>
<td>GEOG 3010 [0.5]</td>
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<tr>
<td>GEOG 3104 [0.5]</td>
<td>Principles of Biogeography</td>
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<tr>
<td>GEOG 3105 [0.5]</td>
<td>Climate and Atmospheric Change</td>
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<tr>
<td>GEOG 3106 [0.5]</td>
<td>Aquatic Science and Management</td>
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<td>GEOG 3108 [0.5]</td>
<td>Soil Properties</td>
</tr>
<tr>
<td>GEOG 4000 [0.5]</td>
<td>Field Studies</td>
</tr>
<tr>
<td>GEOG 4005 [0.5]</td>
<td>Directed Studies in Geography</td>
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<tr>
<td>GEOG 4103 [0.5]</td>
<td>Water Resources Engineering</td>
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<tr>
<td>GEOG 4104 [0.5]</td>
<td>Microclimatology</td>
</tr>
<tr>
<td>GEOG 4108 [0.5]</td>
<td>Permafrost</td>
</tr>
</tbody>
</table>

### Science Faculty Electives

Science Faculty Electives are courses at the 1000-4000 level chosen from:

- BIOC (Biochemistry)
- BIOL (Biology) Biochemistry students may use BIOL 1010 and BIOL 2005 only as free electives.
- CHEM (Chemistry) except CHEM 1003, CHEM 1004 and CHEM 1007
- COMP (Computer Science) except COMP 1001
- ERTH (Earth Sciences) except ERTH 1010, ERTH 1011 and ERTH 2415. Earth Sciences students may use ERTH 2401, ERTH 2402, and ERTH 2403 only as free electives.
- Engineering
- FOOD (Food Science and Nutrition)
- GEOM (Geomatics)
- HLTH (Health Science)
- ISAP (Interdisciplinary Science Practice)
- MATH (Mathematics)
- NEUR (Neuroscience)
- PHYS (Physics) except PHYS 1901, PHYS 1902, PHYS 1905, PHYS 2903
- Science Geography (see list above)
- Science Psychology (see list above)
- STAT (Statistics)
- TSES (Technology, Society, Environment) Biology students may use these courses only as free electives.

### Advanced Science Faculty Electives

Advanced Science Faculty Electives are courses at the 2000-4000 level chosen from the Science Faculty Electives list above.

### Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)

All courses offered by the Faculty of Arts and Social Sciences, the Faculty of Public Affairs, and the Sprott School of Business are approved as Arts or Social Sciences courses EXCEPT FOR: All Science Geography courses (see list above), all Geomatics (GEOM) courses, all Science Psychology courses (see list above), NSCI 1000 may be used as an Approved Course Outside the Faculties of Science and Engineering and Design.

### Free Electives

Any course is allowable as a Free Elective providing it is not prohibited (see below). Students are expected to comply with prerequisite requirements and enrolment restrictions for all courses as published in this Calendar.

**Courses Allowable Only as Free Electives in any B.Sc. Program**

- PHYS (Physics), except PHYS 2903
- Science Geography Courses (see list above)
- Science Psychology Courses (see list above)
- STAT (Statistics)
- TSES (Technology, Society, Environment) except TSES 2305. Biology students may use these courses only as free electives. Integrated Science and Environmental Science students may include these courses in their programs but may not count them as part of the Science Sequence.
Students who did not request Co-op at the time they applied to Carleton can request Co-op after they begin their university studies. To view application instructions and deadlines, please visit carleton.ca/co-op.

To be admitted to Co-op, a student must successfully complete 5.0 or more credits that count towards their degree, meet the minimum CGPA requirement(s) for the student’s Co-op option, and fulfil any specified course prerequisites. To see the unique admission and continuation requirements for each Co-op option, please refer to the specific degree programs listed in the Undergraduate Calendar.

**Participation Requirements**

**COOP 1000**

Once a student has been given admission or continuation confirmation to the co-op option s/he must complete and pass COOP 1000 (a mandatory online 0.0 credit course). Students will have access to this course a minimum of two terms prior to their first work term and will be notified when to register.

**Communication with the Co-op Office**

Students must maintain contact with the co-op office during their job search and while on a work term. All email communication will be conducted via the students’ Carleton email account.

**Employment**

Although every effort is made to ensure a sufficient number of job postings for all students enrolled in the co-op option of their degree program, no guarantee of employment can be made. Carleton's co-op program operates a competitive job search process and is dependent upon current market conditions. Academic performance, skills, motivation, maturity, attitude and potential will determine whether a student is offered a job. It is the student's responsibility to actively conduct a job search in addition to participation in the job search process operated by the co-op office. Once a student accepts a co-op job offer (verbally or written), his/her job search will end and access to co-op jobs will be removed for that term. Students that do not successfully obtain a co-op work term are expected to continue with their academic studies. The summer term is the exception to this rule. Students should also note that hiring priority is given to Canadian citizens for co-op positions in the Federal Government of Canada.

**Registering in Co-op Courses**

Students will be registered in a Co-op Work Term course while at work. The number of Co-op Work Term courses that a student is registered in is dependent upon the number of four-month work terms that a student accepts. While on a co-op work term students may take a maximum of 0.5 credit throughout each four-month co-op work term. Courses must be scheduled outside of regular working hours.

Students must be registered as full-time before they begin their co-op job search. All co-op work terms must be completed before the beginning of the final academic term. Students may not finish their degree on a co-op work term.

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### Prohibited Courses

The following courses are not acceptable for credit in any B.Sc. program:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP 1001</td>
<td>Introduction to Computational Thinking for Arts and Social Science Students</td>
</tr>
<tr>
<td>MATH 0005</td>
<td>Precalculus: Functions and Graphs</td>
</tr>
<tr>
<td>MATH 0006</td>
<td>Precalculus: Trigonometric Functions and Complex Numbers</td>
</tr>
<tr>
<td>MATH 1009</td>
<td>Mathematics for Business</td>
</tr>
<tr>
<td>MATH 1119</td>
<td>Linear Algebra: with Applications to Business</td>
</tr>
<tr>
<td>MATH 1401</td>
<td>Elementary Mathematics for Economics I</td>
</tr>
<tr>
<td>MATH 1402</td>
<td>Elementary Mathematics for Economics II</td>
</tr>
</tbody>
</table>

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### Co-operative Education

For more information about how to apply for the Co-op program and how the Co-op program works please visit the Co-op website.

All students participating in the Co-op program are governed by the Undergraduate Co-operative Education Policy.

**Undergraduate Co-operative Education Policy**

**Admission Requirements**

Students can apply to Co-op in one of two ways: directly from high school, or after beginning a degree program at Carleton.

If a student applies to a degree program with a Co-op option from high school, their university grades will be reviewed two terms to one year prior to their first work term to ensure they meet the academic requirements after their first or second year of study. The time at which the evaluation takes place depends on the program of study. Students will automatically receive an admission decision via their Carleton email account.

Students who did not request Co-op at the time they applied to Carleton can request Co-op after they begin
Work Term Assessment and Evaluation
To obtain a Satisfactory grade for the co-op work term students must have:
1. A satisfactory work term evaluation by the co-op employer;
2. A satisfactory grade on the work term report.

Students must submit a work term report at the completion of each four-month work term. Reports are due on the 16th of April, August, and December and students are notified of due dates through their Carleton email account.

Workplace performance will be assessed by the workplace supervisor. Should a student receive an unsatisfactory rating from their co-op employer, an investigation by the co-op program manager will be undertaken. An unsatisfactory employer evaluation does not preclude a student from achieving an overall satisfactory rating for the work term.

Graduation with the Co-op Designation
In order to graduate with the co-op designation, students must satisfy all requirements for their degree program in addition to the requirements according to each co-op program (i.e. successful completion of three or four work terms).

Note: Participation in the co-op option will add up to one additional year for a student to complete their degree program.

Voluntary Withdrawal from the Co-op Option
Students may withdraw from the co-op option of their degree program during a study term ONLY. Students at work may not withdraw from the work term or the co-op option until s/he has completed the requirements of the work term.

Students are eligible to continue in their regular academic program provided that they meet the academic standards required for continuation.

Involuntary or Required Withdrawal from the Co-op Option
Students may be required to withdraw from the co-op option of their degree program for one or any of the following reasons:
1. Failure to achieve a grade of SAT in COOP 1000
2. Failure to pay all co-op related fees
3. Failure to actively participate in the job search process
4. Failure to attend all interviews for positions to which the student has applied
5. Declining more than one job offer during the job search process
6. Continuing a job search after accepting a co-op position
7. Dismissal from a work term by the co-op employer
8. Leaving a work term without approval by the Co-op manager
9. Receipt of an unsatisfactory work term evaluation
10. Submission of an unsatisfactory work term report

Standing and Appeals
The Co-op and Career Services office administers the regulations and procedures that are applicable to all co-op program options. All instances of a student's failure during a work term or other issues directly related to their participation in the co-op option will be reported to the academic department.

Any decision made by the Co-op and Career Services office can be appealed via the normal appeal process within the University.

International Students
All International Students are required to possess a Co-op Work Permit issued by Immigration, Refugees and Citizenship Canada before they can begin working. It is illegal to work in Canada without the proper authorization. Students will be provided with a letter of support to accompany their application. Students must submit their application for their permit before being permitted to view and apply for jobs on the Co-op Services database. Confirmation of a position will not be approved until a student can confirm they have received their permit. Students are advised to discuss the application process and requirements with the International Student Services Office.

B.Sc. Environmental Science: Co-op Admission and Continuation Requirements
- Maintain full-time status in each study term;
- Be eligible to work in Canada (for off-campus work);
- Have successfully completed COOP 1000.

In addition to the following:
1. Registered as a full-time student in the B.Sc. Honours Environmental Science program;
2. Successfully completed 5.0 or more credits;
3. Obtained an Overall CGPA of at least 6.50 and a Major CGPA of at least 8.00. These CGPAs must be maintained throughout the duration of the degree.

B.Sc. Honours Environmental Science students must successfully complete three (3) work terms to obtain the Co-op Designation.

Work Term Course: ENSC 3999

Work/Study Pattern:

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Legend
S: Study
W: Work

Admissions Information
Admission Requirements are for the 2024-25 year only, and are based on the Ontario High School System. Holding the minimum admission requirements only establishes eligibility for consideration. The cut-off averages for admission may be considerably higher than
the minimum. See also the General Admission and Procedures section of this Calendar. An overall average of at least 70% is normally required to be considered for admission. Some programs may also require specific course prerequisites and prerequisite averages and/or supplementary admission portfolios. Higher averages are required for admission to programs for which the demand for places by qualified applicants exceeds the number of places available. The overall average required for admission is determined each year on a program-by-program basis. Consult admissions.carleton.ca for further details.

Note: Courses listed as recommended are not mandatory for admission. Students who do not follow the recommendations will not be disadvantaged in the admission process.

Admissions Information
Admission requirements are based on the Ontario High School System. Prospective students can view the admission requirements through the Admissions website at admissions.carleton.ca. The overall average required for admission is determined each year on a program-by-program basis. Holding the minimum admission requirements only establishes eligibility for consideration; higher averages are required for admission to programs for which the demand for places by qualified applicants exceeds the number of places available. All programs have limited enrolment and admission is not guaranteed. Some programs may also require specific course prerequisites and prerequisite averages and/or supplementary admission portfolios. Consult admissions.carleton.ca for further details.

Note: If a course is listed as recommended, it is not mandatory for admission. Students who do not follow the recommendations will not be disadvantaged in the admission process.

Degrees
- B.Sc. (Honours)
- B.Sc. (Major)
- B.Sc.

Admission Requirements
B. Sc. Honours
First Year
The Ontario Secondary School Diploma (OSSD) or equivalent including a minimum of six 4U or M courses. For most programs including Biochemistry, Bioinformatics, Biotechnology, Chemistry, Combined Honours in Biology and Physics, Chemistry and Physics, Computational Biochemistry, Food Science, Nanoscience, Neuroscience and Biology, Neuroscience and Mental Health, and Psychology, the six 4U or M courses must include Advanced Functions, and two of Biology, Chemistry, Earth and Space Sciences, or Physics. (Calculus and Vectors is strongly recommended).

Specific Honours Admission Requirements
For the Honours programs in Earth Sciences, Environmental Science, Geomatics, Interdisciplinary Science and Practice, and Physical Geography, Calculus and Vectors may be substituted for Advanced Functions.

For the Honours programs in Physics and Applied Physics, and for double Honours in Mathematics and Physics, Calculus and Vectors is required in addition to Advanced Functions and one of 4U Physics, Chemistry, Biology, or Earth and Space Sciences. For all programs in Physics, 4U Physics is strongly recommended.

For Honours in Psychology, a 4U course in English is recommended.

For Honours in Environmental Science, a 4U course in Biology and Chemistry is recommended.

Advanced Standing
Applications for admission beyond first year will be assessed on their merits. Applicants must normally be Eligible to Continue in their year level, in addition to meeting the CGPA thresholds described in Section 3.1.9 of the Academic Regulations of the University. Advanced standing will be granted only for those subjects deemed appropriate for the program and stream selected.

B.Sc. Major and B.Sc.
First Year
The Ontario Secondary School Diploma (OSSD) or equivalent including a minimum of six 4U or M courses. The six 4U or M courses must include Advanced Functions and two of Calculus and Vectors, Biology, Chemistry, Earth and Space Science, or Physics (Calculus and Vectors is strongly recommended). For the B.Sc. Major in Physics, 4U Physics is strongly recommended.

Advanced Standing
Applications for admission beyond first year will be assessed on their merits. Applicants must normally be Eligible to Continue (EC) in their year level. Advanced standing will be granted only for those subjects deemed appropriate for the program and stream selected.

Co-op Option
Direct Admission to the First Year of the Co-op Option
Applicants must:

1. meet the required overall admission cut-off average and prerequisite course average. These averages may be higher than the stated minimum requirements;
2. be registered as a full-time student in the Bachelor of Science Honours program;
3. be eligible to work in Canada (for off-campus work placements).

Note that meeting the above requirements only establishes eligibility for admission to the program. The prevailing job market may limit enrolment in the co-op option.

Note: continuation requirements for students previously admitted to the co-op option and admission requirements for the co-op option after beginning the program are described in the Co-operative Education Regulations section of this Calendar.
Environmental Science (ENSC) Courses

**ENSC 1500 [0.5 credit]**

Environmental Science Seminar
The purpose and nature of the program; society's view on the natural and human-modified environment; major environmental issues and their scientific aspects; preparation and presentation of paper and seminars. Includes: Experiential Learning Activity
Prerequisite(s): enrolment in the Environmental Science program.
Lectures, seminars and workshops four hours a week.

**ENSC 2000 [0.5 credit]**

Environmental Science Field Methods
A field-based course introducing students to practical methods in environmental science. Topics will include earth sciences, geography, biology, and chemistry related aspects of environmental sciences and will focus on quantitative techniques to assess environmental impacts and management. A supplementary fee will apply.
Includes: Experiential Learning Activity
Prerequisite(s): ERTH 1006 and BIOL 1004 or BIOL 1104, CHEM 1001 and CHEM 1002 and permission of the Institute.
Field trips, lectures and workshops, seven hours per week (delivered on a single day and on up to two mandatory weekend trips).

**ENSC 2001 [0.5 credit]**

Earth Resources and Natural Hazards: Environmental Impacts
Environmental impact of mineral, energy and water resource exploitation and impact of hazardous Earth processes such as volcanic eruptions, earthquakes and others: their prediction and mitigation.
Lectures three hours per week.

**ENSC 2002 [0.5 credit]**

Methods and Analysis in Environmental Science
Study and application of qualitative and quantitative techniques in environmental science, including study design, data collection and assembly, database manipulation, data analysis, and critically evaluating scientific information.
Includes: Experiential Learning Activity
Prerequisite(s): STAT 2507 or permission from the Institute.
Lectures and seminars three hours a week.

**ENSC 3000 [0.5 credit]**

Environmental Science and Management: Theory and Practice
Theoretical and practical perspectives related to environmental science and management; Emphasis on real-world problems associated with human activities and development of solutions in natural and built environments; Hands-on experience with environmental monitoring and restoration. A supplementary fee will apply.
Includes: Experiential Learning Activity
Prerequisite(s): third-year standing in Environmental Science or permission of the Institute.
Field trips, lectures and workshops, 7 hours per week (delivered on a single day).

**ENSC 3106 [0.5 credit]**

Aquatic Science and Management
Fundamentals of aquatic science. The physical, chemical, and biotic aspects of lake, river, and estuary systems including human impacts, management and conservation.
Includes: Experiential Learning Activity
Also listed as GEOG 3106.
Prerequisite(s): third-year standing and a second year science or engineering course.
Workshop four hours per week.

**ENSC 3509 [0.5 credit]**

Group Research in Environmental Science
Major project relating to an issue involving environmental science; effective methods of team research and presentation of group work. May include field work during class time or on weekends.
Includes: Experiential Learning Activity
Prerequisite(s): third-year standing in the Honours Environmental Science program or permission of the Institute.
Lectures, seminars and workshops three hours a week.

**ENSC 3700 [0.5 credit]**

Topics in Environmental Science
Specific topics of current interest. Topics may vary from year to year.
Prerequisite(s): Third year standing in the Environmental Science program or permission of the Institute.
ENSC 3906 [0.5 credit]
Project Planning for Environmental Research
Independent or group study on the fundamentals of scientific investigation, which may include use of literature, learning of research techniques, and development of a research proposal, in consultation with a Faculty supervisor. May include directed reading, written assignments, tutorials, laboratory or field work. Includes: Experiential Learning Activity
Prerequisite(s): Good standing in third year Environmental Science and permission of the Institute.

ENSC 3999 [0.0 credit]
Co-operative Work Term
Practical experience for students enrolled in the Co-operative Option. To receive course credit a student must receive satisfactory evaluations from their work term employer. Written reports describing the work term project will be required. Graded Sat or Uns.
Includes: Experiential Learning Activity
Prerequisite(s): registration in the Environmental Science Co-operative Option and permission of the Institute. Four-month work term.

ENSC 4001 [0.5 credit]
Environmental Science Practicum
Experience working in the environmental science sector, applying academic training to practical environmental issues. Graded Sat/Uns.
Includes: Experiential Learning Activity
Prerequisite(s): fourth-year standing in the Environmental Science program.

ENSC 4002 [0.5 credit]
Environmental Decisions
The regulatory and scientific aspects of environmental management decisions, including risk analysis and mitigation, managing chronic and acute environmental impacts, and conservation of species and landscapes. Students will use real-world case studies to learn traditional and cutting-edge decision-making tools. Includes: Experiential Learning Activity
Prerequisite(s): third-year standing in any B.Sc. program or permission of the Institute.
Workshops three hours per week.

ENSC 4003 [0.5 credit]
Food Systems and the Environment
This course explores issues of food systems and their sustainability. We will discuss aspects of food systems, including production, distribution, consumption, waste management, and their impact on communities and the environment.
Includes: Experiential Learning Activity
Prerequisite(s): third year standing in B.Sc. or B.HSc. program or permission of the Institute.
Lecture three hours per week.

ENSC 4005 [0.5 credit]
Environmental Solutions and Sustainability Science
Focus on conceptualization and application of different knowledges and knowledge systems to complex, interdisciplinary real-world problems through an environmental lens. Development of skills and mindset needed to generate creative solutions that will be embraced by diverse publics and decision makers.
Includes: Experiential Learning Activity
Precludes additional credit for ENSC 4700A if taken in Winter term 2021 or Winter term 2022.
Prerequisite(s): Third year standing in B.Sc. programs in Environmental Science, Interdisciplinary Science and Practice, Earth Science, Biology, and Geography and B.A. programs in Biology and Geography, or permission of the Institute.
Lecture, seminar, or workshops three hours a week.

ENSC 4700 [0.5 credit]
Topics in Environmental Science
Prerequisite(s): third-year standing in the Environmental Science program or permission of the Institute.
Lectures and discussion three hours a week.

ENSC 4901 [0.5 credit]
Directed Projects
Independent or group study, for fourth-year students to explore a particular project, in consultation with a Faculty supervisor. May include directed reading, written assignments, tutorials, laboratory or field work.
Includes: Experiential Learning Activity
Prerequisite(s): permission of the Institute. Students normally may not offer more than 1.0 credit of Directed Special Studies in their program.
ENSC 4906 [1.0 credit]
Honours Research Project
An independent investigation into an aspect of environmental science supervised by a member of the faculty. Approval of the topic and the research schedule must be obtained from the project supervisor and the course coordinator before the last date for registration. Includes: Experiential Learning Activity
Prerequisite(s): fourth-year standing in the Honours Environmental Science program, a major CGPA 8.0 and permission of the Institute.

ENSC 4909 [1.0 credit]
Translational Approach to Indigenous Community Wellness
This course involves co-developing an Indigenous community-led process or product that addresses a current and specific mental health issue. Involves working in interdisciplinary groups with a community partner. Includes: Experiential Learning Activity.
Includes: Experiential Learning Activity
Also listed as ISAP 4909, MPAD 4906, NEUR 4906.
Precludes additional credit for ENSC 4906, ISAP 4906, ISAP 4907, ISAP 4908, NEUR 4905, NEUR 4907, NEUR 4908.
Prerequisite(s): Fourth-year standing with a minimum Major CGPA of 10.0 in the Honours Environmental Science program and permission of the instructor.
Seminars or workshops three hours a week. A field trip to the partner community is typically required.