



**FOR APPROVAL**

**PUBLIC**

**OPEN SESSION**

**TO:** UTSC Academic Affairs Committee

**SPONSOR:** Prof. William Gough, Vice-Principal Academic and Dean  
**CONTACT INFO:** 416-208-7027, vpdean.utsc@utoronto.ca

**PRESENTER:** Prof. Katherine Larson: Vice-Dean Teaching, Learning & Undergraduate Programs  
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**DATE:** March 16, 2021 for March 23, 2021

**AGENDA ITEM:** 4

**ITEM IDENTIFICATION:**

Major Modification: New Major and Major (Co-operative) programs in Environmental Chemistry (HSc), UTSC

**JURISDICTIONAL INFORMATION:**

University of Toronto Scarborough Academic Affairs Committee (AAC) “is concerned with matters affecting the teaching, learning and research functions of the Campus” (*AAC Terms of Reference, Section 4*). Under section 5.6 of its terms of reference, the Committee is responsible for approval of “Major and minor modifications to existing degree programs.” The AAC has responsibility for the approval of Major and Minor modifications to existing programs as defined by the University of Toronto Quality Assurance Process (*UTQAP, Section 3.1*).

**GOVERNANCE PATH:**

- 1. UTSC Academic Affairs Committee [For Approval] (March 23, 2021)**

**PREVIOUS ACTION TAKEN:**

No previous action in governance has been taken on this item.

## **HIGHLIGHTS:**

The Department of Physical and Environmental Sciences (DPES) at the University of Toronto Scarborough (UTSC) is proposing to introduce new Major and Major (Co-operative) programs in Environmental Chemistry (HBSc), where Specialist and Specialist (Co-operative) programs in Environmental Chemistry (HBSc) already exist.

The DPES and UTSC are widely recognized for their strength in Chemistry. In addition to the Specialist and Specialist (Co-operative) programs in Environmental Chemistry, students can also choose from the following programs:

- Specialist/Specialist (Co-operative) in Biological Chemistry (HBSc)
- Specialist/Specialist (Co-operative) in Chemistry (HBSc)
- Major/Major (Co-operative) in Biochemistry (HBSc)
- Major/Major (Co-operative) in Chemistry (HBSc)

The Specialist and Specialist (Co-operative) programs in Environmental Chemistry are limited enrolment programs that are highly structured, and very challenging. In addition to meeting National accreditation requirements of the Canadian Society of Chemistry, these programs include a rigorous CGPA enrolment requirement. As such, the programs primarily appeal to, and are suitable for, the DPES's strongest students.

The highly structured nature of the programs, as well as the enrolment requirements, may be acting as obstacles for some students who are interested in Environmental Chemistry. Moreover, some undergraduate students do not seek the depth of knowledge of the Specialist programs; instead, they are more inclined to explore multiple interests, as is evidenced by the growing number of students at UTSC who choose to complete a double Major, or Major and two Minors to satisfy their degree requirements.

The proposed Major and Major (Co-operative) programs will be excellent options for (1) students who are interested in the sub-discipline of Environmental Chemistry, but who do not want, or are not prepared for, the challenges of the Specialist programs, and (2) students who are interested in Environmental Chemistry, but who also want to pursue other academic interests at the undergraduate level.

Students that complete the proposed Major or Major (Co-operative) programs will achieve the level of expertise in Environmental Chemistry needed for graduate studies at the University of Toronto, and other universities, as well as for careers in government and industry (e.g., consulting, laboratory testing, and risk assessment). Environmental Chemistry is fundamental to topics related to air, water and soil quality, food production, environmental health, and ecosystem services. As such there is a growing need from governments and industry for students with a foundation and skills in Environmental Chemistry. Moreover, there is a particular need for students who have

gained a foundation in Environmental Chemistry combined with a foundation in fields such as environmental policy, environmental economics, conservation science, law, and public health policy. The proposed Major and Major (Co-operative) programs in Environmental Chemistry make it possible for students to pursue program combinations that allow for skill development beyond traditional, more focused academic pathways.

There has been extensive consultation regarding the proposed changes within the DPES. There has also been consultation with the Arts and Science Co-op Office and the Dean's Office. The proposal has been reviewed by, and received sign-off from, the Office of the Vice-Provost, Academic Programs. Feedback from all stakeholder groups have been incorporated into the proposal.

**FINANCIAL IMPLICATIONS:**

There are no net implications to the campus operating budget.

**RECOMMENDATION:**

Be It Resolved,

THAT the proposed Department of Physical and Environmental Sciences, undergraduate curriculum changes for the 2021-22 academic year, as detailed in the respective curriculum report, be approved.

**DOCUMENTATION PROVIDED:**

1. Major Modification: New Major/Major (Co-op) programs in Environmental Chemistry (HBS), dated March 1, 2021.

# University of Toronto

## Major Modification Proposal:

### Specialist or Major Where There is an Existing Major or Specialist

This template should be used to bring forward all proposals for major modifications of this type for governance approval under the University of Toronto's Quality Assurance Process.

<b>What is being proposed:</b> please specify exactly what is being proposed; e.g., a specialist or major where there is an existing major or specialist	(1) *Major program in Environmental Chemistry (HBSc); and (2) *Major (Co-operative) program in Environmental Chemistry (HBSc)  *New programs where Specialist and Specialist (Co-operative) programs in Environmental Chemistry (HBSc) already exist.
<b>Department/unit (if applicable):</b>	Physical and Environmental Sciences
<b>Faculty/academic division:</b>	University of Toronto Scarborough
<b>Dean's office contact:</b>	Annette Knott – annette.knott@utoronto.ca
<b>Proponent:</b>	Myrna Simpson – myrna.simpson@utoronto.ca
<b>Version date:</b> please update as you edit this proposal.	March 1, 2021

## 1 Summary

- Please provide a brief summary of what is being proposed, including a clear statement of the relationship of this to the existing specialist or major and the impetus behind the proposal.

This is a proposal to introduce two new Major programs, where Specialist and Specialist (Co-operative) programs in Environmental Chemistry already exist:

- (1) Major program in Environmental Chemistry; and
- (2) Major (Co-operative) program in Environmental Chemistry.

As with the Specialist and Specialist (Co-operative) programs in Environmental Chemistry, the proposed Major and Major (Co-operative) programs in Environmental Chemistry will lead to an Honours Bachelor of Science (HBSc) degree, and will be

housed in the Department of Physical and Environmental Sciences (DPES) at the University of Toronto Scarborough (UTSC).

The DPES and UTSC are widely recognized for their strength in Chemistry. In addition to the Specialist/Specialist (Co-operative) programs in Environmental Chemistry, students can also choose from the following programs:

- Specialist/Specialist (Co-operative) in Biological Chemistry (HBSc)
- Specialist/Specialist (Co-operative) in Chemistry (HBSc)
- Major/Major (Co-operative) in Biochemistry (HBSc)
- Major/Major (Co-operative) in Chemistry (HBSc)

To support these and other programs, the DPES offers a wide range of courses in Chemistry, Biological Chemistry, Environmental Chemistry, Environmental Sciences and Environmental Studies.

The Specialist programs in Environmental Chemistry (both non Co-op and Co-op) are limited enrolment programs that are highly structured, and very challenging. They are in-depth programs intended primarily for highly motivated students who are interested in pursuing graduate studies in Environmental Chemistry or careers as environmental chemists in government or industry. Some undergraduate students do not seek the depth of knowledge of the Specialist programs; instead, they are more inclined to explore multiple interests, as is evidenced by the growing number of students at UTSC who choose to complete a double Major, or Major and two Minors to satisfy their degree requirements.

The proposed Major and Major (Co-operative) programs will be excellent options for (1) students who are interested in the sub-discipline of Environmental Chemistry, but who do not want, or are not prepared for, the challenges of the Specialist programs, and (2) students who are interested in Environmental Chemistry, but who also want to pursue other academic interests at the undergraduate level.

Students that complete the proposed Major or Major (Co-operative) programs will achieve the level of expertise in Environmental Chemistry needed for graduate studies at the University of Toronto, and other universities, as well as for careers in government and industry (e.g., consulting, laboratory testing, and risk assessment).

## 2 Effective Date

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Fall 2021, for the 2021-22 academic year.

### 3 Academic Rationale

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- What are the academic reasons for the new major or specialist being proposed, and how does this fit with the unit's and division's academic plans?

Environmental Chemistry, like Biological Chemistry, is a sub-discipline of Chemistry. Students who are interested in Biological Chemistry at UTSC have the option of pursuing either Specialist/Specialist (Co-operative) programs or Major/Major (Co-operative) programs, which ensures that students are able to choose the program that best meets their academic strengths and goals, as well as their career aspirations. Students at UTSC who are interested in Environmental Chemistry, however, currently have only the option of pursuing a Specialist or a Specialist (Co-operative) program.

The Specialist and Specialist (Co-operative) programs in Environmental Chemistry were recently re-structured to meet the National accreditation requirements of the Canadian Society of Chemistry. In addition, a 2.0 CGPA enrolment requirement was added to the Specialist program (previously, an unlimited enrolment program), while the Specialist (Co-operative) program, in line with all Co-op programs at UTSC, has always included a 2.5 CGPA enrolment requirement. With the implementation of these changes, these programs primarily appeal to, and are suitable for, the Department's strongest students, but the highly structured nature of the programs, as well as the enrolment requirements, may be acting as obstacles for some students who are interested in Environmental Chemistry.

A separate concern is posed by the many students at UTSC who seek to explore multiple academic interests during their undergraduate studies, rather than focusing on a single area of study; this has resulted in strong growth in enrolments in double Majors, or in a Major and two Minors, for degree completion. Students who are interested in Environmental Chemistry, and who also seek to pursue other academic interests, currently do not have any Major or Minor program alternatives to the Specialist and Specialist (Co-operative) programs in Environmental Chemistry.

Nor can these students simply substitute a double Major in Chemistry and Environmental Science to achieve the same outcomes as the proposed Major and Major (Co-operative) programs in Environmental Chemistry, since these programs do not require students to complete courses that are specifically focused on, and critical to, Environmental Chemistry. For example, students selecting the Major or Major (Co-operative) program in Environmental Chemistry will gain a solid foundation in **environmental chemistry** through courses such as: CHMB55H3 (Environmental Chemistry), CHMC11H3 (Principles of Analytical Instrumentation), and CHMD16H3 (Environmental and Analytical Chemistry). Students enrolled in a Chemistry and Environmental Science double Major gain broad knowledge of chemistry and environmental science, which is not the same as environmental chemistry. Moreover,

students in the double Major have to create their own connections between the two areas of study.

The proposed Major and Major (Co-operative) programs in Environmental Chemistry will therefore fill a gap in DPES academic offerings, and will be excellent options for students who are interested in pursuing a program in the sub-discipline of Environmental Chemistry, but are not interested in, or prepared for the rigour of, the Specialist programs, or who want to combine their interest in Environmental Chemistry with an interest in another discipline or disciplines.

## 4 Need and Demand

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- Provide a brief description of the need and demand for the new specialist or major focusing, as appropriate, on student interest, societal need, employment opportunities for prospective graduates, accreditation requirements, etc.

### **Student Demand:**

The Program Supervisor for the Specialist and Specialist (Co-operative) programs in Environmental Chemistry has routinely requested feedback from students regarding their impressions of the programs, particularly when students are requesting to withdraw. In this feedback, the overarching themes include:

- The programs are not flexible, and do not allow students to take other courses of broader interest to them;
- The programs are too challenging in general, and they do not permit students to complete any Minor offerings;
- The programs are heavily weighted towards Chemistry courses, and students would like to have more opportunity to engage in Environmental Sciences courses and courses offered in other academic units;
- Students want to pursue a Major, which gives them the opportunity to explore other areas of interest through a second Major or two Minor offerings. In this way, they are better able to tailor their degree to their academic and career goals.

The proposed Major and Major (Co-operative) programs in Environmental Chemistry respond directly to all of these students concerns by providing excellent alternatives to the Specialist and Specialist (Co-operative) programs for students interested in developing a foundation in Environmental Chemistry, but for whom the Specialist programs do not fit with their academic strengths and goals, or are not aligned with their academic and career aspirations.

### **Societal Need:**

Environmental Chemistry is fundamental to topics related to air, water and soil quality, food production, environmental health, and ecosystem services. As such there is a growing need from governments and industry for students with a foundation and skills in Environmental Chemistry. Moreover, there is a particular need for students who have gained a foundation in Environmental Chemistry combined with a foundation in fields such as environmental policy, environmental economics, conservation science, law, and public health policy. The proposed Major and Major (Co-operative) programs in Environmental Chemistry make it possible for students to pursue program combinations that allow for skill development beyond traditional, more focused academic pathways.

At the same time, the proposed Major and Major (Co-operative) programs in Environmental Chemistry will provide a strong foundation for students who wish to pursue graduate studies. As an example, graduates of the proposed programs will be well suited for the professional Master's of Environmental Science (MEnvSc) at UTSC.

## 5 Admission/Eligibility Requirements

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- Describe any specific requirements that students must meet to be eligible for this specialist/major and how these will be administered. How do these differ from the requirements of the existing specialist or major?

The proposed Major program will be unlimited enrolment, and there are no associated enrolment requirements. Students will be able to select the program as a Subject POST after completing 4.0 credits, which is the norm at UTSC.

As with all Co-op programs at UTSC, the proposed Major (Co-operative) program will be limited enrolment. Students will be required to complete 4.0 credits, including: CHMA10H3, [CHMA11H3 or CHMA12H3], MATA30H3, MATA36H3, EESA01H3, *and 0.5 credit from:* [EESA06H3, EESA07H3, EESA11H3], and have achieved a cumulative GPA of at least 2.5. Any additional requirements related to Co-op are described in section 6, below.

## 6 Program Requirements

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- Please provide a full calendar entry including all required courses, recommended electives and their prerequisites.

### Proposed Calendar Copy

#### **MAJOR PROGRAM IN ENVIRONMENTAL CHEMISTRY (SCIENCE)**



Supervisor of Studies: Myrna Simpson (416) 287-7234 Email:

[myrna.simpson@utoronto.ca](mailto:myrna.simpson@utoronto.ca)

The Major program in Environmental Chemistry will introduce students to the main areas within chemistry, with emphasis on analytical, environmental, inorganic, and organic chemistry, and also ensure student gain foundational knowledge of the environmental sciences. Students will develop both theoretical knowledge and practical lab skills throughout their course work. This program is intended for students who are interested in developing basic environmental chemistry skills, but who also seek the flexibility of combining this program with other Major and Minor programs. Students interested in developing depth in Environmental Chemistry should consider the Specialist or Specialist (Co-operative) program in Environmental Chemistry.

This program cannot be combined with the Major/Major Co-op programs in Biochemistry, the Major/Major Co-op programs in Chemistry, the Major/Major Co-op programs in Environmental Science, or the Minor in Environmental Science.

#### **Program Requirements**

Students must complete 9.0 credits as follows:

##### **First Year (3.0 credits):**

CHMA10H3 Introductory Chemistry I: Structure and Bonding  
[CHMA11H3 Introductory Chemistry II: Reactions and Mechanisms  
or CHMA12H3 Advanced General Chemistry]

MATA30H3 Calculus I for Physical Sciences

MATA36H3 Calculus II for Physical Sciences

EESA01H3 Introduction to Environmental Science

*and 0.5 credit from:*

EESA06H3 Introduction to Planet Earth

EESA07H3 Water

EESA11H3 Environmental Pollution

##### **Second and Later Years (6.0 credits):**

CHMB16H3 Techniques in Analytical Chemistry

CHMB31H3 Introduction to Inorganic Chemistry

CHMB41H3 Organic Chemistry I

CHMB42H3 Organic Chemistry II

CHMB55H3 Environmental Chemistry

CHMC11H3 Principles of Analytical Instrumentation

*and 0.5 credit from:*

EESB03H3 Principles of Climatology

EESB04H3 Principles of Hydrology

EESB05H3 Principles of Soil Science

*and*

2.5 additional credits in CHM courses, that meet the following criteria:

- at least 2.0 credits must be at the C- or D-level
- at least 0.5 credit must be at the D-level
- at least 0.5 credit at the C- or D-level must be a course with a laboratory component (CHMD16H3 is highly recommended)

### **MAJOR (CO-OPERATIVE) PROGRAM IN ENVIRONMENTAL CHEMISTRY (SCIENCE)**

Co-op Supervisor of Studies: Myrna Simpson (416) 287-7234 Email:

[myrna.simpson@utoronto.ca](mailto:myrna.simpson@utoronto.ca)

The Major (Co-op) Program in Environmental Chemistry is a Work Integrated Learning (WIL) program that combines academic studies with paid work terms in the public, private, and/or non-profit sectors. The program provides students with the opportunity to develop the academic and professional skills required to pursue employment in these areas, or to continue on to graduate training in an academic field related to Environmental Chemistry upon graduation.

In addition to their academic course requirements, students must successfully complete the additive Arts & Science Co-op Work Term Preparation courses and a minimum of three Co-op work terms.

#### **Enrolment Requirements**

The minimum qualifications for entry are 4.0 credits, including: CHMA10H3, [CHMA11H3 or CHMA12H3], MATA30H3, MATA36H3, EESA01H3, *and 0.5 credit from:* [EESA06H3, EESA07H3, EESA11H3], plus a cumulative GPA of at least 2.5.

#### *Current Co-op Students:*

Students admitted to a Co-op Degree POST in their first year of study must request a Co-op Subject POST on ACORN upon completion of 4.0 credits and must meet the minimum qualifications for entry as noted above.

#### *Prospective Co-op Students:*

Students must request the Co-op program on ACORN. Submission deadlines follow the Limited Enrolment Program Application Deadlines set by the Office of the Registrar each year. Failure to submit the program request on ACORN will result in the student's request for admission not being considered.

#### **Program Requirements**

Students must complete the program requirements as described in the Major Program in Environmental Chemistry.

### **Co-op Work Term Requirements**

Students must satisfactorily complete three Co-op work terms, each of four-months duration. To be eligible for their first work term, students must be enrolled in the Major (Co-op) Program in Environmental Chemistry and have completed at least 7.0 credits, including CHMB16H3.

In addition to their academic program requirements, Co-op students complete up to five Co-op specific courses. These courses are designed to prepare students for their job search and work term experience, and to maximize the benefits of their Co-op work terms. They cover a variety of topics intended to assist students in developing the skills and tools required to secure work terms that are appropriate to their program of study, and to perform professionally in the workplace. These courses must be completed in sequence, and are taken in addition to a full course load. They are recorded on transcripts as credit/no credit (CR/NCR) and are considered to be additive credit to the 20.0 required degree credits. No additional course fee is assessed as registration is included in the Co-op Program fee.

#### *Co-op Preparation Course Requirements:*

1. COPB50H3/(COPD01H3) – Foundations for Success in Arts & Science Co-op
  - Students entering Co-op from outside of UTSC (high school or other postsecondary) will complete this course in Fall or Winter of their first year at UTSC. Enrolment in each section is based on admission category: Typically, students in Computer Science, Mathematics and Statistics enroll in the Fall semester while all other Arts & Science Co-op admission categories enroll in the Winter semester however this may vary year to year.
  - Current UTSC students entering Co-op in April/May will complete this course in the Summer semester.
  - Current UTSC students entering Co-op in July/August will complete this course in the Fall semester.
2. COPB51H3/(COPD03H3) – Preparing to Compete for your Co-op Work Term
  - This course will be completed eight months in advance of the first scheduled work term.
3. COPB52H3/(COPD11H3) – Managing your Work Term Search & Transition to Work
  - This course will be completed four months in advance of the first work scheduled work term.
4. COPC98H3/(COPD12H3) – Integrating Your Work Term Experience Part I
  - This course will be completed four months in advance of the second scheduled work term.
5. COPC99H3/(COPD13H3) – Integrating Your Work Term Experience Part II
  - This course will be completed four months in advance of the third scheduled work term (for programs that require the completion of 3 work terms and/or four months in advance of any additional work terms that have been approved by the Arts and Science Co-op Office.

Students must be available for work terms in each of the Fall, Winter and Summer semesters and must complete at least one of their required work terms in either a Fall or Winter semester. This, in turn, requires that students take courses during at least one Summer semester.

For information on fees, status in Co-op programs, and certification of completion of Co-op programs, see Section 6B.5 or the Arts and Science Co-op section in the *UTSC Calendar*.

- Please describe in your own words how the requirements for the major or specialist compare to the requirements of the existing specialist or major.

### Explanation of the Proposed Requirements

#### **Specialist and Specialist (Co-operative) programs in Environmental Chemistry**

The Specialist and Specialist (Co-operative) programs in Environmental Chemistry are limited enrolment programs. The programs are intended for students who want an in-depth study of chemistry, with a specialization in how to apply chemistry to solving environmental problems. This program is suitable for students wishing to pursue graduate programs in Chemistry or who plan to work in government and industry after graduation. The Specialist/Specialist Co-op programs in Environmental Chemistry are accredited by the Canadian Society for Chemistry.

#### *The Specialist program in Environmental Chemistry:*

Students can apply to the Specialist program after completing 4.0 credits from among the following courses: [EESA01H3](#), [EESA06H3](#), [BIOA01H3](#), [BIOA02H3](#), [CHMA10H3](#), [[CHMA11H3](#) or [CHMA12H3](#)], [MATA30H3](#), [MATA36H3](#), and [PHYA10H3](#); in addition, they must have achieved a cumulative grade point average (CGPA) of at least 2.0.

The program requires students to complete a total of 16.0 credits, including:

- 4.5 credits in introductory courses in biology, chemistry, environmental science, calculus and physics as follows: [BIOA01H3](#), [BIOA02H3](#), [CHMA10H3](#), [[CHMA11H3](#) or [CHMA12H3](#)], [EESA01H3](#), [EESA06H3](#), [MATA30H3](#), [MATA36H3](#), and [PHYA10H3](#). These courses provide the foundation for upper level courses for the program and provide depth in the natural and physical sciences.
- 4.5 credits in foundational chemistry courses including analytical chemistry, thermodynamics, and inorganic and organic chemistry, as well as foundational courses in environmental science, as follows: [CHMB16H3](#), [CHMB23H3](#), [CHMB31H3](#), [CHMB41H3](#), [CHMB42H3](#), [CHMB55H3](#), [EESB15H3](#), [[CHMB21H3](#) or [CHMB62H3](#)], and [[EESB03H3](#) or [EESB19H3](#)]. These courses include the

necessary foundation in all chemistry sub-disciplines as well as fundamental courses in environmental sciences.

- 4.0 credits in upper-level chemistry and environmental science courses, including instrumentation, inorganic and organic chemistry, hydrology, and soil science, as follows: CHMC11H3, EESC07H3, EESC20H3, STAB22H3, 1.5 credit in C-level CHM courses selected from a bin, and [EESB04H3 or EESB05H3]. These courses further specialize the student's knowledge in chemistry and environmental sciences which is necessary for developing depth in Environmental Chemistry.
- 3.0 credits in advanced chemistry and environmental science, including environmental impact assessment, remediation; spectroscopy, and modelling, as follows: CHMD16H3, EESC13H3, EESD02H3, EESD15H3, and 1.0 credit in D-level CHM courses selected from a bin. These upper level courses build upon earlier coursework to ensure that students have developed critical knowledge and practice in Environmental Chemistry and its broader applications (impact assessment and remediation of contaminated sites).

*The Specialist (Co-operative) program in Environmental Chemistry:*

Students can apply to the Specialist Co-op program after completing 4.5 credits, including, BIOA01H3, BIOA02H3, CHMA10H3, CHMA11H3, EESA01H3, EESA06H3, MATA30H3, [MATA35H3 or MATA36H3 or MATA37H3] and PHYA10H3; in addition, they must have achieved a cumulative grade point average (CGPA) of at least 2.5.

Students must complete the same course requirements as the Specialist program, and also complete their Co-op Work Term Prep courses, and Work Terms.

Calendar entries for the Specialist and Specialist Co-op programs are given in Appendix A, below.

**The Major and Major (Co-operative) programs in Environmental Chemistry**

The Major in Environmental Chemistry is an unlimited enrolment program, and the Major (Co-operative) in Environmental Chemistry is limited enrolment program. They are intended to provide students with a strong foundation in Environmental Chemistry knowledge. The Major and Major (Co-operative) programs in Environmental Chemistry affords students the option of pairing their chosen program with other Majors and Minors thereby allowing students more flexibility in their learning experience.

*The Major program in Environmental Chemistry:*

Students can apply to the program after completing 4.0 credits, and students must complete a total of 9.0 credits, including:

- 3.0 credits in introductory courses in chemistry, calculus, and environmental science, as follows: CHMA10H3, [CHMA11H3 or CHMA12H3], MATA30H3, MATA36H3, EESA01H3, and 0.5 credit from [EESA06H3, EESA07H3, EESA11H3]. The key differences between the Major and Specialist include:
  - Students in the Major will not be required to complete foundational courses in biology and physics in alignment with other Major programs in Chemistry, and to provide students with flexibility in programming; and
  - Students will also complete fewer introductory courses in environmental science but complete critical environmental science courses that are important for a broader understanding of environmental systems.
- 3.5 credits in foundational courses in chemistry and environmental science, as follows: CHMB16H3, CHMB31H3, CHMB41H3, CHMB42H3, CHMB55H3, CHMC11H3, and 0.5 credit from [EESB03H3, EESB04H3, EESB05H3]. The key differences between the Major and the Specialist include: the level of depth and breadth in Environmental Chemistry and the rigor in background preparedness.
- 2.5 additional credits in chemistry including: 2.0 credits in advanced chemistry, of which at least 0.5 credit must be in a course with a laboratory component. The key differences between the Major and the Specialist include: different levels of skill development based on required courses (broad based learning (Major) versus more focused programming (Specialist)).

*The Major (Co-operative) program in Environmental Chemistry:*

Students can apply to the Major Co-op program after completing 4.0 credits, including, CHMA10H3, [CHMA11H3 or CHMA12H3], MATA30H3, MATA36H3, EESA01H3, and 0.5 credit from: [EESA06H3, EESA07H3, EESA11H3]; in addition, they must have achieved a cumulative grade point average (CGPA) of at least 2.5.

Students must complete the same course requirements as the Major program, and also complete their Co-op Work Term Prep courses, and Work Terms.

## 7 Program Structure, Learning Outcomes and Degree-Level Expectations

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- It is assumed that the learning outcomes will not be new for the specialist or major; that being said, describe here how the learning outcomes for the proposed specialist or major will extend or contract the learning outcomes for the existing major or specialist.

The Specialist and Specialist (Co-operative) programs in Environmental Chemistry provide a rigorous pathway for students who wish to pursue graduate programs in Chemistry. For a complete description of the learning outcomes for these programs, as established in 2019-20, see Appendix B below.

For **Depth and Breadth of Learning** the learning outcomes are:

- Students will be able to demonstrate a thorough understanding of chemistry at an advanced level;
- Students will be able to demonstrate a high-level understanding of environmental chemistry as well as depth in all basic chemistry sub-disciplines (general, analytical, inorganic, organic, and physical chemistry);
- Students will be able to demonstrate key laboratory skills in all chemistry sub-disciplines as well as instrumentation used in environmental chemistry and other chemistry sub-disciplines;
- Students will be able to demonstrate depth of understanding in chemistry and environmental chemistry and its applications in research, government, and industry.

The learning outcomes for the proposed Major and Major (Co-operative) programs in Environmental Chemistry are aligned with the learning outcomes of the Specialist programs but have different levels of depth in knowledge acquisition. The Specialist and the Major programs (non Co-op and Co-op) will have the core foundational elements required for a basic understanding related to the chemistry of the environment. In addition, the Major programs will retain the same basic framework with respect to the key courses in chemistry and environmental sciences as the Specialist programs; this ensures that the core learning outcomes are achieved. However, the learning outcomes of the proposed Major and Major (Co-operative) programs are a contraction of the learning outcomes of the Specialist and Specialist (Co-operative) programs, in the following ways:

- The Specialist and Specialist (Co-operative) programs require students to complete courses in all the sub-disciplines of Chemistry (general chemistry, analytical, environmental, inorganic, organic and physical chemistry) including the C- and D-level. The Major and Major (Co-operative) programs will provide students with basic knowledge in environmental chemistry and some sub-disciplines within chemistry, including general, analytical, inorganic, and organic chemistry but not physical chemistry. Advanced chemistry courses at the C- and D-level are not required for the Major and Major (Co-operative programs) thereby offering flexibility in how the students acquire more advanced knowledge. Students will also complete fundamental courses in the environmental sciences in the Major and Major (Co-operative programs) but not at the same level of depth via C- and D-level courses which are required for Specialist and Specialist (Co-operative) students.

- The Specialist and Specialist (Co-operative) programs require students to complete independent research courses and advanced D-level courses in Environmental Chemistry; the Major and Major (Co-operative) programs do not. Instead, the Major programs are focused on providing a broad foundation in environmental chemistry that will be supplemented with other Major and Minor programs. The learning outcomes for the Specialist and Specialist (Co-operative) programs are also designed to meet the Canadian Society of Chemistry accreditation requirements for lecture and laboratory hours. The Major and Major (Co-operative) programs do not meet the accreditation requirements because of the contracted course requirements.

In the Specialist/Specialist (Co-operative) programs the learning outcomes for Knowledge of Methodologies are:

- Students will have a strong working knowledge in both theoretical and experimental forms of chemistry. The practical components of chemistry courses will provide students with a range of laboratory skills including: basic chemistry methods, analytical instrumentation, organic synthesis, spectroscopy, and investigating the properties of atoms and molecules.
- Environmental Sciences courses will provide students with methodology related to: elemental cycling, basic field methods, climatology, hydrology, hydrogeology, contaminated site remediation, earth sciences and geochemistry.

In the Major/Major (Co-operative) programs the learning outcomes for Knowledge of Methodologies are aligned with Specialist programs, however they have been pared down as follows:

- Students will have basic working knowledge in both theoretical and experimental forms of some chemistry sub-disciplines. The practical components of chemistry courses will provide students with a range of laboratory skills including: basic chemistry methods, some analytical instrumentation, organic synthesis, some spectroscopy, and some strategies to investigate the properties of atoms and molecules.
- Environmental Sciences courses will provide students with knowledge pertaining to fundamental environmental sciences. Students can select to explore topics in: planet earth geology, climatology, hydrology, soil science, water, and environmental pollution based on their course selection.

In the Specialist/Specialist (Co-operative) programs the learning outcomes for Application of Knowledge are:

- Students will be able to question their understanding of the subject matter as well as the established understanding of environmental chemistry.



- In C- and D-level courses, students will be engaged in experiential learning where they must apply their knowledge to solve problems related to their field.

In the Major/Major (Co-operative) programs the learning outcomes for Application of Knowledge are aligned with Specialist programs, however they have been pared down as follows:

- Students will be able to question their understanding of the subject matter as well as the established understanding of environmental chemistry, but not to the same acuity as Specialist/Specialist (Co-operative) program students.

In the Specialist/Specialist (Co-operative) programs the learning outcomes for Awareness of the Limits of Knowledge are:

- Students will be able to question the limits of their own knowledge and appreciate the limits of environmental chemistry. C- and D -level courses provide students with a better understanding as well as the limitations of methods and knowledge.

In the Major/Major (Co-operative) programs the learning outcomes for Awareness of Knowledge are the same as for the Specialist programs.

In the Specialist/Specialist (Co-operative) programs the learning outcomes for Communication Skills are:

- Students will develop their communication skills. They will also be engaged in interpreting and writing about chemical data.

In the Major/Major (Co-operative) programs the learning outcomes for Communication Skills are the same as for the Specialist programs.

In the Specialist/Specialist (Co-operative) programs the learning outcomes for Autonomy and Professional Capacity are:

- Students will be highly versed in environmental chemistry. The rigor and depth of this program will enable students to work as a basic chemist as well as pursue interest in environmental chemistry/environmental sciences. Through their coursework, they will emerge as independent and critical thinkers. They will be able to face problems pertaining to environmental chemistry such as for example: fate and transport of contaminants, sampling and analysis of pollutants in soil, water, sediment and air, quantification of compounds, quality assessments, and methods for remediated contaminated sites.

In the Major/Major (Co-operative) programs the learning outcomes for Autonomy and Professional Capacity are aligned with Specialist programs, however they have been pared down as follows:

- Students will be proficient in environmental chemistry. Students completing this program will be able to work as a basic chemist as well as pursue related interests in environmental chemistry/environmental sciences. Through their coursework, they will emerge as independent and critical thinkers. They will be able to face problems pertaining to environmental, for example: fate and transport of contaminants, sampling and analysis of pollutants in soil, water, sediment and air, and quantification of compounds.

## 8 Consultation

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- Describe any consultation with programs and units that may be affected within and outside the unit and Faculty/division.

The proposal has been reviewed and approved by the Department of Physical and Environmental Sciences Teaching and Curriculum committee on June 16, 2020.

The proposal was circulated to Chemistry faculty via email and reviewed and approved by the Chemistry Faculty on July 16, 2020.

The proposal has been shared with the DPES Council and they have signalled their support.

The proposal has been shared with the Arts and Science Co-op Office, and their feedback has been incorporated into this proposal.

No academic units outside of the DPES will be impacted by the proposal.

## 9 Resources

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- Describe any resource implications of the change(s) including, but not limited to, faculty complement, space, libraries, and enrolment/admissions.
- Please specify where this may impact significant enrolment agreements with the Faculty/Provost's office.
- Indicate if the major modification will affect any existing agreements with other institutions, or will require the creation of a new agreement to facilitate the major modification (e.g., Memorandum of Understanding, Memorandum of Agreement, etc). Please consult with the Provost's office ([vp.academicprograms@utoronto.ca](mailto:vp.academicprograms@utoronto.ca)) regarding any implications to existing or new agreements.

The proposed Major and Major (Co-operative) programs in Environmental Chemistry will not require any new resources.

Faculty and staff who are currently associated with the Specialist and Specialist (Co-operative) programs in Environmental Chemistry will support the Major and Major (Co-operative) programs. There are four tenure-stream faculty with expertise in Environmental Chemistry in the DPES (Profs. Donaldson, A. Simpson, M. Simpson and Wania). In addition, DPES has sixteen faculty members (both teaching- and tenure-stream) that support all Chemistry programs and course offerings in the DPES.

Prof. M. Simpson is currently the Program Supervisor for the Specialist and Specialist (Co-operative) programs in Environmental Chemistry, and will take on Program Supervisor responsibilities for the proposed Major and Major (Co-operative) programs. Workload around program supervision is revisited annually by the DPES Chair and the supervisory role may be reallocated and divided as needed; however, given that there are four faculty members with expertise in Environmental Chemistry, reallocation of the supervisory role will not jeopardize the quality of student guidance.

A complete list of the supporting faculty is given in Table 1, below.

No new courses are needed, and no additional teaching or TA resources are required to handle any increases in course enrolments. In fact, C- and D-level courses in chemistry currently have space for enrolment growth.

The proposed Major and Major (Co-operative) programs will not impact overall enrolments at UTSC; however, there may be some shifting of enrolments at the program level within the DPES, and potentially among programs at UTSC more broadly.

The proposed Major does not currently affect any existing agreements, but should that change in the future the appropriate processes will be followed.

**Table 1: List of Chemistry Faculty**

Faculty Member	Rank	Unit of Primary Appointment	Courses Taught (2020-21)
Shadi Dalili	Associate Professor, Teaching Stream	DPES (100%)	CHMB41H3* CHMD71H3
Jamie Donaldson	Professor	DPES (100%)	Has teaching release due to role as Vice-Dean, Recruitment,

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Faculty Member	Rank	Unit of Primary Appointment	Courses Taught (2020-21)
			Enrolment & Student Success for 2020-21
Alen Hadzovic	Associate Professor, Teaching Stream	DPES (100%)	CHMB31H3 CHMC31Y3 CHMD39H3 CHMD69H3
Artur Izmaylov	Associate Professor	DPES (100%)	CHMC20H3 CHMD71H3 PHYD37H3
Kagan Kerman	Associate Professor	DPES (100%)	CHMD71H3 CHMD79H3
Kris Kim	Assistant Professor, Teaching Stream	DPES (100%)	CHMA11H3* CHMB16H3 PSCB90H3**
Heinz-Bernhard Kraatz	Professor	DPES (100%)	Has teaching release due to role as Vice-Principal Research and Innovation for 2020-21
Lana Mikhaylichenko	Associate Professor, Teaching Stream	DPES (100%)	CHMC42H3 CHMC47H3 PSCB90H3**
Effie Sauer	Associate Professor, Teaching Stream	DPES (76%)	CHMB42H3*
Andre Simpson	Professor	DPES (100%)	CHMC11H3 CHMC16H3
Myrna Simpson	Professor and Program Supervisor	DPES (100%)	EESC20H3 CHMD16H3
Ruby Sullan	Assistant Professor	DPES (100%)	CHMA11H3* CHMB16H3
Oleksandr Voznyy	Assistant Professor	DPES (100%)	CHMA11H3* CHMB21H3
Frank Wania	Professor	DPES (100%)	CHMD59H3 PSCD02H3
Xiao-an Zhang	Associate Professor	DPES (100%)	CHMA10H3* CHMC41H3 CHMC42H3 CHMD90Y3** CHMD91H3**
Marco Zimmer-De Luliis	Assistant Professor, Teaching Stream	DPES (100%)	CHMA10H3* CHMC31Y3

\*Courses are offered in two of three semesters annually.

\*\*Course coordinators: all faculty contribute to these courses annually.

### Faculty Requirements

- Will the establishment of the new major or specialist have any effect on the faculty complement? You may wish to comment on the role of any adjunct faculty; provision of supervision of experiential learning opportunities as appropriate.

There is no effect on the existing faculty complement.

### Space/Infrastructure

- Address any **additional** unique space/infrastructure requirements including information technology, laboratory space and equipment, etc.

There are no new space or infrastructure requirements associated with the proposed Major and Major (Co-operative) programs.

## 10 UTSC Administrative Steps

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Administrative Steps Required	Date
Departmental Curriculum Committee	June 16, 2020
Dean's Office Green Light	August 11, 2020

## 11 UTQAP Process

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Levels of Approval Required	Date
<ul style="list-style-type: none"> <li>• Decanal Sign-Off</li> <li>• Provost Office Sign-Off</li> </ul>	<ul style="list-style-type: none"> <li>• March 1, 2021</li> <li>• February 17, 2021</li> </ul>
UTSC Academic Affairs Committee	March 23, 2021
Submission to Provost's Office	
AP&P – reported annually	
Ontario Quality Council – reported annually	

## Appendix A: Calendar Descriptions, Specialist Programs in Environmental Chemistry

### **SPECIALIST PROGRAM IN ENVIRONMENTAL CHEMISTRY (SCIENCE)**

Supervisor of Studies: Myrna Simpson (416) 287-7234 Email:

myrna.simpson@utoronto.ca

This program is intended for students who want an in-depth study of chemistry, with a specialization in how to apply chemistry to solve environmental problems. The first year of the program emphasizes learning fundamentals across various disciplines, including biology, chemistry, physics, math and environmental science. As students progress into upper years, they develop skills in the fundamental areas of chemistry while also taking specialized courses in environmental chemistry. In their fourth year, students have the opportunity to contribute to the creation of scientific knowledge by participating in a directed research project. Students who graduate from this program will be well qualified for positions in government and industry as well as several graduate programs.

This program is accredited by the Canadian Society for Chemistry (CSC). It meets the national standards of education required by the CSC, ensuring that graduating students possess skills in both the core chemical concepts and practical laboratory skills that are necessary to thrive in today's workforce. Graduates of these programs will receive a certificate stating that they have completed a nationally accredited chemistry program.

### **Enrolment Requirements**

Students may apply to this program after completing at least 4.0 credits from the following: [EESA01H3](#), [EESA06H3](#), [BIOA01H3](#), [BIOA02H3](#), [CHMA10H3](#), [[CHMA11H3](#) or [CHMA12H3](#)], [MATA30H3](#), [MATA36H3](#), and [PHYA10H3](#); in addition, they must have achieved a cumulative grade point average (CGPA) of at least 2.0. Application for admission to the program is made to the Registrar through ACORN. See the UTSC Registrar's website for information on the program (Subject POST) selection, and application window dates on the following [website](#).

### **Program Requirements**

Total requirements: 16.0 credits

#### **First Year (4.5 credits):**

[BIOA01H3](#) Life on Earth: Unifying Principles

[BIOA02H3](#) Life on Earth: Form, Function and Interactions

[CHMA10H3](#) Introductory Chemistry I: Structure and Bonding

[[CHMA11H3](#) Introductory Chemistry II: Reactions and Mechanisms or [CHMA12H3](#) Advanced General Chemistry]

[EESA01H3](#) Introduction to Environmental Science

[EESA06H3](#) Introduction to Planet Earth  
[MATA30H3](#) Calculus I for Physical Sciences  
[MATA36H3](#) Calculus II for Physical Sciences  
[PHYA10H3](#) Physics I for the Physical Sciences

**Second Year (4.5 credits):**

[CHMB16H3](#) Techniques in Analytical Chemistry  
[CHMB23H3](#) Introduction to Chemical Thermodynamics and Kinetics: Theory and Practice  
[CHMB31H3](#) Introduction to Inorganic Chemistry  
[CHMB41H3](#) Organic Chemistry I  
[CHMB42H3](#) Organic Chemistry II  
[CHMB55H3](#) Environmental Chemistry  
[EESB15H3](#) Earth History

*and*

*0.5 credit from the following:*

[CHMB21H3](#) Chemical Structure and Spectroscopy  
[CHMB62H3](#) Introduction to Biochemistry

*and*

*0.5 credit from the following:*

[EESB03H3](#) Principles of Climatology  
[EESB19H3](#) Mineralogy

**Third Year (4.0 credits):**

[CHMC11H3](#) Principles of Analytical Instrumentation  
[EESC07H3](#) Groundwater  
[EESC20H3](#) Geochemistry  
[STAB22H3](#) Statistics I

*and*

*1.5 credit from the following:*

[CHMC16H3](#) Analytical Instrumentation  
[CHMC31Y3](#) Intermediate Inorganic Chemistry  
[CHMC41H3](#) Organic Reaction Mechanisms  
[CHMC42H3](#) Organic Synthesis  
[CHMC47H3](#) Bio-Organic Chemistry

*and*

*0.5 credit from the following:*

[EESB04H3](#) Principles of Hydrology  
[EESB05H3](#) Principles of Soil Science

**Fourth Year (3.0 credits):**

[CHMD16H3](#) Environmental and Analytical Chemistry  
[EESC13H3](#) Environmental Impact Assessment and Auditing  
[EESD02H3](#) Contaminant Hydrogeology  
[EESD15H3](#) Fundamentals of Site Remediation

and

1.0 credit from the following, including one of [CHMD90Y3](#), [CHMD91H3](#) and [CHMD92H3](#):

[CHMD11H3](#) Application of Spectroscopy in Chemical Structure Determination

[CHMD59H3](#) Modelling the Fate of Organic Chemicals in the Environment

[CHMD89H3](#) Introduction to Green Chemistry

[CHMD90Y3](#) Directed Research in Chemistry

[CHMD91H3](#) Directed Research in Chemistry

[CHMD92H3](#) Advanced Chemistry Laboratory Course

### **SPECIALIST (CO-OPERATIVE) PROGRAM IN ENVIRONMENTAL CHEMISTRY (SCIENCE)**

Co-op Contact: [askcoop@utoronto.ca](mailto:askcoop@utoronto.ca)

The Specialist (Co-op) Program in Environmental Chemistry is a Work Integrated Learning (WIL) program that combines academic studies with paid work terms in the public, private, and/or non-profit sectors. The program provides students with the opportunity to develop the academic and professional skills required to pursue employment in these areas, or to continue on to graduate training in an academic field related to Environmental Chemistry upon graduation.

In addition to their academic course requirements, students must successfully complete the additive Arts & Science Co-op Work Term Preparation courses and a minimum of three Co-op work terms.

#### **Enrolment Requirements**

The minimum qualifications for entry are 4.5 credits, including, [BIOA01H3](#), [BIOA02H3](#), [CHMA10H3](#), [CHMA11H3](#), [EESA01H3](#), [EESA06H3](#), [MATA30H3](#), [[MATA35H3](#) or [MATA36H3](#) or [MATA37H3](#)] and [PHYA10H3](#), plus a cumulative GPA of at least 2.5.

#### *Current Co-op Students:*

Students admitted to a Co-op Degree POST in their first year of study must request a Co-op Subject POST on ACORN upon completion of 4.0 credits and must meet the minimum qualifications for entry as noted above.

#### *Prospective Co-op Students:*

In addition to requesting the program on ACORN, prospective Co-op students (i.e., those not yet admitted to a Co-op Degree POST) must also submit a Co-op Supplementary Application Form, which is available from the Arts & Science Co-op Office [website](#). Submission deadlines follow the Limited Enrolment Program Application Deadlines set by the Office of the Registrar each year. Failure to submit both the Supplementary Application Form and the program request on ACORN will result in that student's application not being considered.



### **Program Requirements**

Students must complete the program requirements as described in the Specialist Program in Environmental Chemistry.

#### Co-op Work Term Requirements

Students must satisfactorily complete three Co-op work terms, each of four-months duration. To be eligible for their first work term, students must be enrolled in the Specialist (Co-op) Program in Environmental Chemistry and have completed at least 7.0 credits, including [CHMB16H3](#).

In addition to their academic program requirements, Co-op students complete up to five Co-op specific courses. These courses are designed to prepare students for their job search and work term experience, and to maximize the benefits of their Co-op work terms. They cover a variety of topics intended to assist students in developing the skills and tools required to secure work terms that are appropriate to their program of study, and to perform professionally in the workplace. These courses must be completed in sequence, and are taken in addition to a full course load. They are recorded on transcripts as credit/no credit (CR/NCR) and are considered to be additive credit to the 20.0 required degree credits. No additional course fee is assessed as registration is included in the Co-op Program fee.

#### *Co-op Preparation Course Requirements:*

1. [COPB50H3](#)/(COPD01H3) – Foundations for Success in Arts & Science Co-op  
- Students entering Co-op from outside of UTSC (high school or other postsecondary) will complete this course in Fall or Winter of their first year at UTSC. Enrolment in each section is based on admission category: Typically, students in Computer Science, Mathematics and Statistics enroll in the Fall semester while all other Arts & Science Co-op admission categories enroll in the Winter semester however this may vary year to year.  
- Current UTSC students entering Co-op in April/May will complete this course in the Summer semester.  
- Current UTSC students entering Co-op in July/August will complete this course in the Fall semester.
2. [COPB51H3](#)/(COPD03H3) – Preparing to Compete for your Co-op Work Term  
- This course will be completed eight months in advance of the first scheduled work term.
3. [COPB52H3](#)/(COPD11H3) – Managing your Work Term Search & Transition to Work  
- This course will be completed four months in advance of the first work scheduled work term.
4. [COPC98H3](#)/(COPD12H3) – Integrating Your Work Term Experience Part I  
- This course will be completed four months in advance of the second scheduled work term.
5. [COPC99H3](#)/(COPD13H3) – Integrating Your Work Term Experience Part II  
- This course will be completed four months in advance of the third scheduled work

term (for programs that require the completion of 3 work terms and/or four months in advance of any additional work terms that have been approved by the Arts and Science Co-op Office.

Students must be available for work terms in each of the Fall, Winter and Summer semesters and must complete at least one of their required work terms in either a Fall or Winter semester. This, in turn, requires that students take courses during at least one Summer semester.

For information on fees, status in Co-op programs, and certification of completion of Co-op programs, see Section 6B.5 or the Arts and Science Co-op section in the *UTSC Calendar*.

## Appendix B: Learning Outcomes and Degree Level Expectations – Specialist/Specialist (Co-operative) programs in Environmental Chemistry

Degree Level Expectations	Program Learning Outcomes.	How the program design/structure supports the program learning outcomes.
<p><b>1. Depth and Breadth of Knowledge</b></p> <p>Depth of Knowledge: is attained through a progression of introductory, core and specialized courses. Specialized courses will normally be at the C and D levels.</p> <p>Breadth of Knowledge: students will gain an appreciation of the variety of modes of thinking, methods of inquiry and analysis, and ways of understanding the world that underpin different intellectual fields.</p>	<p>Depth and breadth of knowledge in the Specialist/Specialist Co-op in Environmental Chemistry is reflected in students who are able to:</p> <ul style="list-style-type: none"> <li>- Understand all facets of chemistry taught at the undergraduate level (analytical, environmental, inorganic, organic and physical chemistry);</li> <li>- Develop a strong foundation in fundamental environmental sciences;</li> <li>- Demonstrate excellent chemistry laboratory skills;</li> <li>- Solve problems related to environmental chemistry.</li> </ul>	<p>The program design and requirement elements that ensure these student outcomes for depth and breadth of knowledge are based on:</p> <ul style="list-style-type: none"> <li>- Years 1 and 2 provide a basic foundation in all areas of chemistry. This is necessary to build a strong knowledge base of fundamental chemistry. Also during this period, students are taking several key environmental sciences courses (EESA01H3, EESA06H3, EESB15H3, EESB03H3 or EESB19H3). These environmental sciences courses provide students with a necessary understanding of fundamental environmental sciences.</li> <li>- Year 3 is designed to further strengthen the academic foundation developed in years 1 and 2. Students in Year 3 will take additional chemistry courses relevant to environmental chemistry (such as CHMC11H3) as well as advanced courses in environmental sciences (EESC07H3 and EESC20H3).</li> <li>- Year 4 offers students with more flexibility to select from courses that are specific to their interests as well as the option to conduct basic research (CHMD90H3 or CHMD91Y). CHMD16H3 is a specialized course which was offered in 2017-18 for the first time. This course was designed for the Environmental Chemistry Specialist program and provides students with more experience</li> </ul>

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		with advanced analytical techniques used in environmental chemistry.
<p><b>2. Knowledge of Methodologies</b></p> <p>Students have a working knowledge of different methodologies and approaches relevant to their area of study. They are able to evaluate the efficacy of different methodologies in addressing questions that arise in their area of study.</p>	<p>Students completing the Specialist/Specialist Co-op in Environmental Chemistry will have a strong working knowledge in both theoretical and experimental forms of chemistry. The practical components of chemistry courses will provide students with a range of laboratory skills including: basic chemistry methods, analytical instrumentation, organic synthesis, spectroscopy, and investigating the properties of atoms and molecules.</p> <p>Environmental Sciences courses will provide students with methodology related to: elemental cycling, basic field methods, climatology, hydrology, hydrogeology, contaminated site remediation, earth sciences and geochemistry.</p>	<p>Students will gain a strong working knowledge of chemistry and environmental sciences through B-, C- and D- level courses. CHMB55H3 (Environmental Chemistry) will be taken in year 2 and serve as an introduction to the topic. In year 3, students will take EESC20H3 (Geochemistry) which provides a foundation of chemistry of the earth and draws on prior coursework in both chemistry and environmental sciences. In EESC13H3, students have the opportunity to apply their knowledge by carrying out risk assessments. Students further apply their knowledge in CHMD16H3 where they learn about practical aspects of environmental and analytical chemistry.</p>
<p><b>3. Application of Knowledge</b></p> <p>Students are able to frame relevant questions for further inquiry. They are familiar with, or will be able to seek the tools with which, they can address such questions effectively.</p>	<p>Students completing the Specialist/Specialist Co-op programs in Environmental Chemistry will be able to question their understanding of the subject matter as well as the established understanding of environmental chemistry. In C- and D-level courses, students will be engaged in experiential learning where they must apply their knowledge to solve problems related to their field.</p>	<p>There are several opportunities for students to apply their knowledge in C- and D- level courses. For example, the CHMD16H3 course includes a laboratory practical where the students must identify an unknown compound in a wastewater sample. To solve this, they must apply chemical methods that they have learned earlier in their program. In EESC13H3, students must perform an environmental impact assessment using current regulatory guidelines. This requires students to draw on their basic science foundation as well as environmental science courses.</p>

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		In Year 4, students may also engage in directed research (CHMD90H3 or CHMD91Y) where they must collect data, analyze and interpret and present their findings (as a poster and in a written report).
<p><b>4. Awareness of Limits of Knowledge</b> Students gain an understanding of the limits of their own knowledge and an appreciation of the uncertainty, ambiguity, and limits to our collective knowledge and how these might influence analyses and interpretations.</p>	Students completing the Specialist/Specialist Co-op programs in Environmental Chemistry will be able to question the limits of their own knowledge and appreciate the limits of environmental chemistry. C- and D -level courses provide students with a better understanding as well as the limitations of methods and knowledge.	Students will gain an appreciation for the limits of the science and their own understanding through more advanced C- and D-level chemistry courses. Complexities and limitations of environmental systems will also be obtained through the C- and D-level courses in environmental sciences. For example, EESC20H3 offers students with uncertainty pertaining to pollutant fate in environmental systems. EESD15H3 provides students with insight into site remediation and how there isn't a "one size fits all" approach to cleaning up polluted sites.
<p><b>5. Communication Skills</b> Students are able to communicate information, arguments, and analyses accurately and reliably, both orally and in writing. They learn to read and to listen critically.</p>	Students completing the Specialist/Specialist Co-op programs in Environmental Chemistry will develop their communication skills. They will also be engaged in interpreting and writing about chemical data.	The C and D level courses will support the development of both written and oral communication skills. Students will achieve these skills through writing of laboratory reports, research and technical papers - and oral presentations (for example, in EESC13H3 and CHMD16H3).
<p><b>6. Autonomy and Professional Capacity</b> The education students receive achieves the following broad goals:</p> <ul style="list-style-type: none"> <li>• It gives students the skills and knowledge they need to become informed, independent and creative thinkers</li> <li>• It instills the awareness that knowledge and its applications</li> </ul>	Students completing the Specialist/Specialist Co-op programs in Environmental Chemistry will be highly versed in environmental chemistry. The rigor and depth of this program will enable students to work as a basic chemist as well as pursue interest in environmental chemistry/environmental sciences. Through their coursework, they will emerge	<p>This program supports a basic interest in chemistry and environmental systems. Students will be highly proficient in chemistry but also have a unique understanding of environmental processes. Furthermore, accreditation by the Canadian Society of Chemistry will demonstrate the rigor and high quality of this program.</p> <p>This program also provides students with a strong foundation for graduate work and joint Master's programs (MEnvSci and MT). The BSc in</p>

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<p>are influenced by, and contribute to, society</p> <ul style="list-style-type: none"><li>• It lays the foundation for learning as a life-long endeavour</li></ul>	<p>as independent and critical thinkers. They will be able to face problems pertaining to environmental chemistry such as for example: fate and transport of contaminants, sampling and analysis of pollutants in soil, water, sediment and air, quantification of compounds, quality assessments, and methods for remediated contaminated sites.</p>	<p>Environmental Chemistry will allow students to pursue pure chemistry (MSc or PhD) or graduate work in the environmental sciences (MEnvSci, MSc or PhD). Students will have flexibility in their future career path but emerge from a rigorous and nationally accredited program.</p>
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