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## Science and Technology Programs

# Chemistry (BSc)

**Location Offered:**

Nanaimo

**Credential:**

Bachelor Degree

**Options:**

Major, Minor

**Program Length:**

4 Years

## The Program

B.Sc., Major in Chemistry: The goals of the program are to provide students the opportunity to pursue employment and post-graduate opportunities in Chemistry. The curriculum provides a molecular-level understanding of biological, chemical and physical processes and builds a strong appreciation for the underlying principles that govern structure reactivity, and bonding. The program builds foundational knowledge in the traditional sub-disciplines of chemistry, with a particular emphasis on the theory and practice of analytical and green chemistry. In the upper years, students can choose to specialize their Major in Chemistry by selecting electives in fields of Environmental Chemistry or Biological Chemistry. Students will gain an appreciation for the role of chemistry in many aspects of modern scientific enquiry, and all students will gain hands-on experience with modern chemical instrumentation and techniques.

The program has been designed to be at the forefront of teaching and learning in the chemical sciences by incorporating an emphasis on conceptual learning and the integration of inquiry-based learning experiences, computer assisted learning and undergraduate research opportunities. Chemistry is taught through a combination of lectures and laboratory exercises with close student - instructor interactions and mentorship being a hallmark of the program. Current issues such as the fate and distribution of chemical species in the environment and biological systems, bio-mimetics, environmental ecology, toxicology, molecular design and catalysis as well as development of modern instrumental methods are introduced. Critical thinking, problem solving, and communication skills are emphasized throughout the program and refined in the integrated laboratory experience and independent student projects.

Students graduating from the program have gained highly transferable employment skills and will have a wide range of career opportunities in fields including secondary education, chemical forensics, chemical analysis, environmental monitoring, consulting, science communication, manufacturing, medical lab science, instrument development and sales, food science, material science, pharmaceuticals, quality control, remediation, food security, academic and government research, science policy and government regulation. The program provides a solid foundation for students who wish to further their studies in professional programs such as medical, dental, law, and pharmacy schools and graduate studies at the M.Sc. and Ph.D. level. Graduates with this degree will be qualified to apply for a 'Professional Chemistry' designation.

A Minor in Chemistry may also be obtained and used in combination with another science Minor for a general B.Sc. degree (double Minor) or to augment another science Major. The Minor in Chemistry will be of particular interest to students proceeding towards a career in Primary and Secondary Education, with plans for teaching a science curriculum. For additional information on the program, faculty, and undergraduate research, please visit the VIU Chemistry website.

## **Undergraduate Research**

Undergraduate research allows students to integrate and reinforce their chemistry knowledge, develop their scientific and professional skills and become active participants in their discipline rather than passive observers. Integrating research into the curriculum as early as possible increases the student's interest in the field and their understanding of how scientists think and work on real problems. Students at VIU have the opportunity to work with faculty members on a variety of chemistry related projects and may enroll in an Undergraduate Research Project course (CHEM 491). Projects support deep learning, promote critical thinking, provide experience with instrumental methods, and exposure to the chemical literature. The geographic proximity of VIU to coastal British Columbia provides unique opportunities to incorporate real-world field studies into the curriculum and research experience in both environmental and biological chemistry. The Major in Chemistry is closely integrated with the internationally recognized Applied Environmental Research Laboratories (AERL), which provides authentic experiential learning opportunities with real-world outcomes. This facility provides hands-on experience and student-faculty engagement in the form of part-time work, internships and summer research assistantships for undergraduate students.

## **AERL**

The Applied Environmental Research Laboratories (AERL) conducts pure and applied research in analytical mass spectrometry and environmental chemistry. The group develops new and improved strategies for the measurement of chemical determinants of environmental and human health. The focus of this work is on real-time, in-situ chemical analysis in complex real-world samples with applications to the protection of the environment and improving human health. The AERL team collaborates widely with regional, national and international partners in academia, government agencies and the private sector, enabling solutions to problems that are both regionally relevant and globally significant. The facility supports the training of a wide spectrum of highly qualified personnel spanning the range from undergraduate students to post-doctoral research fellows. In addition to state-of-the art instrumentation for air, water and soil analysis, the AERL specializes in portable, direct analysis mass spectrometry techniques that provide spatially and/or temporally resolved chemical measurements. This work is positioned on the leading edge of bringing high precision chemical measurements to the sample rather than bringing discrete samples back to the lab. The facility is supported by the Canada Foundation for Innovation, the British Columbia Knowledge Development Fund and the Natural Science and Engineering Research Council of Canada.

## **Program Outline**

### **Requirements for a Major**

<b>Year 1</b>	<b>Credits</b>
Select <i>one</i> of the following pairs (CHEM 142 is recommended): CHEM 140 - (Chemistry Fundamentals I) <i>and</i> , CHEM 141 - (Chemistry Fundamentals II) <i>or</i> CHEM 142 - (Chemistry Fundamentals II)	8
Select <i>one</i> of the following pairs (PHYS 121/122 is recommended): PHYS 121 - (Physics for the Physical Sciences I) <i>and</i> , PHYS 122 - (Physics for the Physical Sciences II) <i>or</i> , PHYS 111 - (Physics for the Life Sciences I) <i>and</i> , PHYS 112 - (Physics for the Life Sciences II)	8
Select <i>one</i> of the following pairs (MATH 100/101 is recommended): MATH 121 - (Calculus I) <i>and</i> , MATH 122 - (Calculus II) <i>or</i> , MATH 100 - (Calculus for Engineering and Physical Sciences I) <i>and</i> , MATH 101 - (Calculus for Engineering and Physical Sciences II)	6
General Elective*	6-8
Degree English Requirement	6

*\* Students are encouraged to choose courses that complement the addition of a Minor or meet pre-requisite requirements in another science area (BIOL/CSCI/GEOL/MATH/PSYC). BIOL 123 is recommended for BIOL 201, which is required for the Major in Year 2 or 3.*

*Note: At the end of first year, or after completing a minimum of 24 credits, students need to declare their educational goals in consultation with the B.Sc. Advisor.*

<b>Year 2</b>	<b>Credits</b>
CHEM 212 - (Environmental Chemical Analysis)	3
CHEM 213 - (Practical Spectroscopy)	3
CHEM 222 - (Inorganic Chemistry)	3
CHEM 231 - (Organic Chemistry I)	3
CHEM 232 - (Organic Chemistry II)	3
CHEM 241 - (Physical Chemistry)*	3
BIOL 201- (Principles of Biochemistry I)*	3
Select <i>one</i> of* (MATH 200 or 211 recommended): MATH 200 - (Calculus of Several Variables) MATH 203 - (Biometrics) MATH 211 - (Fundamentals of Statistics I) MATH 141 - (Matrix Algebra for Engineers) MATH 241 - (Linear Algebra) MATH 254 - (Statistics I)	3
Electives (Non-Science, Upper-Level, or General)	6

*\* May be taken in Year 3.*

*Note: Students are strongly encouraged to complete all Year 1 and Year 2 core requirements in the order listed to minimize potential scheduling conflicts later in their degree.*

<b>Years 3 and 4</b>	<b>Credits</b>
CHEM 300 - (Green Chemistry and Toxicology)	3
CHEM 312 - (Principles of Instrumental Analysis)	3
CHEM 341 - (Reaction Kinetics and Mechanisms)	3
CHEM 351 - (Integrated Organic and Inorganic Laboratory)	3
CHEM 352 - (Integrated Physical Laboratory)	3
CHEM 400 - (Emerging Topics and Professional Practice in Chemistry)	3
CHEM 412 - (Advanced Topics in Analytical Chemistry)	3
CHEM 441 - (Bonding, Structure, and Properties)	3
<b>Specialization Options</b>	
Choose <i>three</i> upper-level CHEM Electives numbered 300 and above. A specialization is defined as <i>three</i> courses from the following Biological Chemistry or Environmental Chemistry lists. A specialization is not required; if a specialization is not chosen, select <i>three</i> courses from across both lists.	
<b>Biological Chemistry*</b> Select <i>three</i> courses chosen from: CHEM 323 - (Bio-Inorganic Chemistry) CHEM 334 - (Bio-Organic Chemistry) CHEM 335 - (Synthetic Methods in Organic Chemistry) CHEM 432 - (Macromolecular Chemistry of Biomolecules) CHEM 433 - (Natural Products Chemistry)	9
<b>Environmental Chemistry*</b> Select <i>three</i> courses chosen from: CHEM 301 - (Aqueous Environmental Chemistry) CHEM 302 - (Atmospheric Environmental Chemistry) CHEM 325 - (Coordination Chemistry) CHEM 401 - (Chemical Oceanography) CHEM 431 - (Environmental Organic Chemistry)	
Upper-Level Electives	9
General Electives	18

\* Check individual course prerequisites. Upper-level CHEM electives are not offered every year; see the Chemistry Chair or a B.Sc. Advisor, or the Chemistry Home Page for a yearly schedule.

Additional Experiential Learning Opportunities (credits taken as electives):

CHEM 380 - (Independent Work Experience in Chemistry) (3 credits)

CHEM 390 - (Field Studies in Chemistry) (3 credits)

CHEM 491 - (Undergraduate Research Project) (6 credits)

The Chemistry Department encourages education gained by participating in active research. Students have the option to complete a research project (CHEM 490 or 491) in their final year. For these courses, students carry out their research under the direction of a faculty supervisor from the Chemistry Department (in some cases, faculty may be from another Department). Students interested in taking CHEM 490 or 491 should consult a faculty member as early as possible in their academic career. Additional experiential learning opportunities include, CHEM 380 (Independent Work Experience in Chemistry) (pass/fail) and CHEM 390 (Field Studies in Chemistry (inter-session)). If available, students may complete these courses using General Elective or Upper-level Elective credits. Details of the special registration process required for CHEM 380, 390, 490, and 491 may be obtained from the Chemistry Chair or a B.Sc. Degree Advisor.

## Requirements for a Minor

Students must fulfill all Institutional B.Sc. Degree Requirements, including Degree

English Requirements and courses listed below:

Years 1 and 2	Credits
Select <i>one</i> of the following pairs: CHEM 140 - (Chemistry Fundamentals I) <i>and</i> , CHEM 141 - (Chemistry Fundamentals II) <i>or</i> CHEM 142 - (Chemistry Fundamentals II)	8
Select a minimum of <i>12 credits</i> of 200-level Chemistry courses.* BIOL 201 can be counted towards these credits.	12

*\* Students should check upper-level course prerequisites to guide second year course choices.*

Years 3 and 4	Credits
Select a minimum of 18 credits of Chemistry courses numbered 300 or above.*	18

*\* Check individual course prerequisites.*

### **Notes:**

- *CHEM 490 and CHEM 491 require 9 upper-level CHEM credits that includes at least 3 credits of CHEM 312, 351, or 352.*
- *Not all courses are offered every year; please check the website (VIU Chemistry) to find out which courses are offered each year.*

## **Admission Requirements**

- General admission requirements apply.
- A minimum "B" grade in either Pre-calculus 12 or Principles of Mathematics 12.

### **Notes on Admission**

- Courses in first year have different prerequisites. To satisfy *all* first year course prerequisites, students must complete all of the following B.C. Secondary School course requirements:
  - A minimum grade of "C" in English 12;
  - A minimum grade of "C+" in each of Chemistry 11 and 12 and Physics 12 (Principles of Physics 12)\*; and,
  - A minimum grade of "B" in Mathematics 12 (Pre-calculus 12 or Principles of Mathematics 12).
  - \*Some seats are available for students who have only completed Chemistry 11 and/or Physics 11 (Principles of Physics 11) with a minimum "C+".
- A minimum grade of "C+" in either Biology 11 or 12 is required for students wishing to take first year biology (BIOL 121 or 123). BIOL 123 is recommended for BIOL 201, which is required for the Major in Year 2 or 3.
- Students who do not satisfy all of the first-year course prerequisites will not likely be able to complete the full degree program in four years. Students who are lacking any or all of the first-year course prerequisites should speak with a VIU Advisor about upgrading courses.
- Students with a two-year diploma in a field related to the Chemical Sciences may receive advanced standing, depending upon their program.
- Transcripts from other institutions for courses used towards the B.Sc., Major in Chemistry degree must be received by VIU's Registration office by August 15 for

the Fall semester, and November 30 for the Spring semester.

## Career Opportunities

The field of Chemistry is central to many scientific careers and provides a range of employment opportunities in academic, commercial, and public sectors. Trained chemists have a number of important employment skills identified by the Conference Board of Canada, such as critical thinking, problem solving, observational and communication skills, as well as knowledge of science, technology, and mathematics. The American Chemical Society Employment and Salary outlook/survey indicates continuing trends of low unemployment and competitive salaries for skilled chemists. Analytical chemists, in particular, have been identified as having growing job opportunities. Identified attributes that employers were looking for included; hands-on experience particularly with mass spectrometry and nuclear magnetic resonance spectroscopy, digital information retrieval and ability to apply knowledge to solve problems in novel ways, internship and research experience with instrumentation, experience and coursework outside of immediate discipline, most notably in biology, biochemistry and materials science. In addition to continuing their education the post-graduate level, graduates of the program will possess sufficient knowledge and skills to pursue the following careers;

- Chemical Analyst
- Lab Teaching Assistant
- Research Technician
- Secondary school chemistry and science educator
- Pharmaceutical and biotechnology industry
- Chemical and chemical forensics
- Technical Sales and Service Representative
- Quality control and assurance specialist
- Environmental and Technical consultant
- Clinical Lab Technician
- Water/wastewater treatment technician/analyst
- Abatement and remediation professional
- Chemical Informatics
- Science writer and public policy consultant

Students graduating from the program will have career opportunities in secondary education, chemical forensics, chemical analysis, environmental monitoring, consulting, science communication, manufacturing, medical lab science, instrument development and sales, food science, material science, pharmaceuticals, quality control, remediation, food security, academic and government research, science policy and government regulation. The program provides a strong foundation for students who wish to further their studies in professional programs such as medical, dental, law, and pharmacy schools and graduate studies at the M.Sc. and Ph.D. level in Chemistry or related disciplines. Graduates with this degree will be qualified to apply for a 'Professional Chemist' designation.

## Start Date and Application Deadline

The program starts in September and applications are accepted between the first business day in October and March 31. Applications received after March 31 are considered late and will be processed as space permits.

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