

# FACULTY OF NATURAL AND APPLIED SCIENCES

*Dr. Ka Yin Leung, Dean*

## PURPOSE

The mission of the Faculty of Natural and Applied Sciences is to produce godly Christians with expertise in the theoretical and applied sciences, an understanding of and appreciation for the relationship of scientific knowledge to authoritative biblical truth, as well as an awareness of the present and potential impact of science on society. Responsible scientific advancement requires men and women with sound ethical judgment in addition to scientific expertise. Natural Sciences students at Trinity Western University acquire the fundamental scientific, general, and biblical knowledge that equips them to make a positive scientific contribution in industry, research, teaching, or the health sciences.

## PERSPECTIVE

Natural Sciences students are challenged to live a Christ-centred life while developing a high degree of competence in their specialty. Students learn to apply biblical understanding to scientific issues of today, developing their own answers to many of the ethical issues facing our highly technological society. Students may choose from programs and course work in Biology, Biotechnology, Chemistry, Computing Science, Environmental Studies, Information Systems, Physical Geography, Geology, Mathematics (pure and applied), and Physics, including well-supervised and up-to-date laboratory experience. The Natural Sciences faculty are capable and committed professors who teach their discipline with a deep love for Christ and an awareness of His claim on their lives. They keep abreast of new scientific thought and discovery, and as teachers, are expected to continuously advance in their field of expertise as well as in the application of scriptural truth to their discipline. Natural Sciences students learn an appreciation for scriptural truth and its relevance to scientific issues of today. The faculty emphasizes that knowledge of our created world is possible only because all things are held together through Christ.

## PROGRAM

The Faculty offers a Bachelor of Science degree majoring in Biology, Chemistry, Computing Science, Mathematics, Mathematics with Computing Science, and Biotechnology. An Honours degree is available in Biology, Biotechnology, and Chemistry. Jointly with the Faculty of Humanities and Social Sciences, the Faculty offers a major in Environmental Studies. A major in General Science with a concentration in Biology, Chemistry, Computing Science, Mathematics, Mathematics with Computing Science, or Physics is also available. Minors are offered in each discipline where a major or concentration is offered. A minor is also available in Information Systems. Natural Sciences students may also complete the requirements of many pre-professional programs such as agriculture, architecture, dentistry, engineering,

forestry, medicine, and pharmacy. Emphases of the Natural Sciences program include:

**Scientific Awareness**—Scientific investigation demands well-sharpened analytical, mathematical, observational, and laboratory skills. Faculty members help students develop an appreciation for the essentials of the scientific method and a disciplined approach to scientific investigation. Students are encouraged to approach science as a study of the intricate details of design and order inherent in creation and the resulting functional processes. The comprehensive nature of the program prepares students for entry into more advanced scientific studies at the graduate level;

**The Scope and Limitations of Science**—Careful attention is given to developing sound judgment as to the scope and limits of scientific enterprise. Upper level students are encouraged to expand their capacity to address the ethical issues inherent in scientific discovery;

**Practical Application**—Science teaches clear, logical thought and a rigorous, analytical approach to problems—valuable skills in any profession. Professors urge students to apply basic scientific principles to daily life, enabling them to adapt effectively to an increasingly technological world. Each major offers a fully integrated laboratory program.

An increasing number of field courses are being offered as part of the science programs, including Marine Biology and Botany courses in Hawaii and Salt Spring Island, B.C.

## RECOMMENDED GUIDELINES FOR FIRST YEAR COURSES

The Faculty of Natural and Applied Sciences believes that students taking courses in the Faculty should have as many choices for entry points into the program as is consistent with providing a quality university education. Students should take note of the following 100 level courses and their prerequisites to determine which course is appropriate for them.

## LABS AND TUTORIALS

1. Chemistry, Physics, Biology, Biotechnology, Geology, and Physical Geography courses have required labs that must be included in course registration.
2. Some Biology, Chemistry, and Physics courses have required tutorials that must be included in course registration.
3. Computing Science courses have required labs that must be added after classes have started.

## BIOLOGY

First year Biology students with no previous biology should take BIOL 103, 104, and 105, as well as CHEM 111 and 112 or CHEM 103, 104, or CHEM 103, 112. Those with Grade 12 Biology should take BIOL 113 and 114 as well as CHEM 111 and 112 or CHEM 103, 112. BIOL 241 and 242 are available without prerequisite for non-Biology majors and are not recommended for Biology majors. Biology students who have Grade 12 Mathematics should take MATH 123. Biology students with a limited background in mathematics should take MATH 105 (precalculus).

## CHEMISTRY

To complete a Chemistry major or minor, the following courses are normally taken in first year: CHEM 111, 112 (or CHEM 103, 104; or CHEM 103, 112); MATH 123, 124; PHYS 111, 112. Physics may be delayed to second year if necessary, although there are advantages to taking it in first year.

Students desiring a terminal general Chemistry course: take CHEM 101.

Science majors with Chemistry 11: take CHEM 103, 104. CHEM 103 has four lectures per week.

Science majors with Chemistry 12 or high standing in Chemistry 11: take CHEM 111, 112.

*Note: Students with a B or better in CHEM 103 may take CHEM 112. Students with a B or better in CHEM 104 may take second year Chemistry courses.*

## COMPUTING SCIENCE

Students with no previous computing experience: consider CMPT 140, or ISYS 113.

Science majors:

- with credit for a university level Pascal course: take CMPT 166 (second semester);
- with some computing experience but little programming: take CMPT 140 and 166

No Computing Science course may be used to satisfy lab science requirements for any TWU program.

## ENVIRONMENTAL STUDIES

Students interested in Environmental Studies should take at least two of the three ENV5 core courses in their first year: BIOL 113, 114; CHEM 111, 112; or GEOG 121, 131; or GEOL 109. See the guidelines above for the recommended high school Biology courses that prepare students for university.

## INFORMATION SYSTEMS

Students should begin with ISYS 113 or 123.

## MATHEMATICS

All science majors take a math survey test during registration to determine whether to enrol in MATH 101, 105, or 123. Students demonstrating skills at the Grade 11 level take MATH 101. Students with limited knowledge of Principles of Mathematics 12 take MATH 105. Those demonstrating a B or better in Principles of Mathematics 12 normally take MATH 123.

Students planning to major in Mathematics or Computing Science are advised to take MATH/CMPT 150 in first year, if possible.

Education majors: elementary level pre-service teachers only with weak mathematics background: take MATH 190; secondary level or elementary level with a B or more in Principles of Mathematics 12: take MATH 123.

Business majors (B.B.A. program) with at least a B in Principles of Mathematics 12 or MATH 101: take MATH 120. Otherwise, take MATH 101; with a very good understanding of math: take MATH 123.

Science majors (except certain ENV5 programs): take MATH 123, 124 (subject to math survey results).

Other majors: Math 102 (Statistics) and 150 (Discrete Mathematics) are good choices for students desiring widely-applicable topics in Mathematics.

*Note: No student may take both MATH 101 and 190. Also, MATH 120 and 123 cannot both be taken for credit. MATH 190 cannot be taken for credit towards a degree in Mathematics. Students with sufficiently high grades in MATH 120 may, however, be permitted to take MATH 124.*

## PHYSICS

Students wishing to complete a concentration or minor in Physics should take CHEM 111, 112; PHYS 111, 112; and MATH 123, 124 in their first year.

## ADDITIONAL INFORMATION

All students must register in the tutorials for BIOL 241, 242; CHEM 103, 104; and CHEM 111, 112.

## MORE INFORMATION

Contact Admissions, the Department chair, or the program coordinator.

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## BIOLOGY

*Department of Biology*

*Dr. Dennis Venema, Chair*

The Department of Biology offers two programs in Biology:

1. An Honours program, leading to a B.Sc. (Honours) degree;
2. A major, leading to a B.Sc. degree;
3. An interdisciplinary major in Environmental Studies, leading to a B.Sc. degree.

The Department also contributes to the Biotechnology programs. The Department provides students with a thorough understanding of the role of biology in modern society. Students are prepared for careers in ecology and environmental science, biotechnology, and medical science. Courses of study meet the requirements for professional schools—education, medicine, dentistry, veterinary medicine, chiropractic, physiotherapy—as well as those for graduate school. The Department provides opportunities for further study in the spring and summer at the Au Sable Institute for Environmental Studies in Washington state, the Great Lakes area, Florida, Africa, and India. The Biology Department offers co-op programs that provide work experience in applied biology. The Department encourages students to participate in faculty research programs in ecology, marine biology, biotechnology, and medical science.

## HONOURS PROGRAM IN BIOLOGY, B.Sc. (HONOURS) DEGREE

The Honours program in Biology provides students with sufficient latitude to design an in-depth program of study tailored to a specific emphasis in Biology. The Biology Department currently offers

four emphases in the Honours program: Cell and Developmental Biology, Biochemistry and Molecular Biology, Ecology, and General Biology.

## GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Biology (36 sem. hrs. must be at 300 or 400 level)	54
Chemistry (111, 112; & 221, 222)	12
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123, 124*	6
NATS 487, 490	3
Philosophy	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives	17
Total	134

\*Students taking the Ecology emphasis or general Honours degree may substitute MATH 102 or MATH 108 for MATH 124.

## REQUIREMENTS FOR THE HONOURS PROGRAM:

1. Admission into the Biology Honours program requires a cumulative GPA of 3.0 over the first two years of study, a GPA of 3.0 in Biology courses, and an overall GPA of 2.7 for graduation;
2. A total of 134 sem. hrs. must be completed;
3. A minimum of 54\* sem. hrs. in Biology courses must be completed of which 36 sem. hrs. must be upper level (300 or higher). (\*Except for Biochemistry and Molecular Biology emphasis.) See table.

## SPECIFIC REQUIREMENTS

The following Biology courses are required:

BIOL 113, 114 Principles of Biology\*  
 BIOL 223 Cell Biology

BIOL 308, 345, or 360 Zoology  
 BIOL 312, 314, or 315 Botany (or other Botany course)  
 BIOL 333 or 334 Microbiology  
 BIOL 371, 372 Genetics  
 BIOL 381 Ecology  
 BIOL 384, 386 Biochemistry  
 BIOL 409, 410 Senior Thesis

\*or BIOL 103, 104 and 105 General Biology

*Note: Students must obtain a minimum grade of C in BIOL 113, 114 (or BIOL 103, 104, and 105) to progress to BIOL 223. Students must obtain a minimum grade of C in BIOL 223 to progress to BIOL 372 or BIOL 423.*

## CELL AND DEVELOPMENTAL BIOLOGY EMPHASIS

Students must take 18 additional sem. hrs. from the following:

BIOL 308 or 360 (Zoology—not already taken as a Specific Requirement above)  
 BIOL 312, 314, or 315 (Botany—not already taken as a Specific Requirement above)  
 BIOL 333 or 334 (Microbiology—not already taken as a Specific Requirement above)  
 BIOL 315, 336, 340, 343, 345, 350; 423, 438, 450, 470, 474, 490

## BIOCHEMISTRY AND MOLECULAR BIOLOGY EMPHASIS

Students must take 12 sem. hrs. of Biology courses from:

BIOL 333 or 334 (Microbiology—not already taken as a Specific Requirement); BIOL 315, 340, 343, 345, 346, 350; 423, 438, 470, 474, 490.

The following ancillary courses are also required:  
 CHEM 230, 240; 321, 322, 357, 358.

## ECOLOGY EMPHASIS

Students must take 18 sem. hrs. from the following:

BIOL 308 or 360 (Zoology—not already taken as a Specific Requirement)

BIOL 312 or 314 (Botany—whichever course(s) was/were not already taken as a Specific Requirement)

BIOL 315, 316, 318, 364, 382; 482

Recommended electives are CHEM 370; MATH 102; 310.

Additional electives are also available through Au Sable Institute.

## GENERAL BIOLOGY EMPHASIS

18 sem. hrs. of 300 or 400 level Biology courses to be chosen in consultation with a Biology advisor from two of the following subdisciplines: Botany, Ecology, Genetics and Molecular Biology, Microbiology and

Immunology, Physiology, or Zoology. The 18 sem. hrs. cannot include courses taken already as a specific Biology requirement.

## MAJOR IN BIOLOGY, B.Sc. DEGREE

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Biology (24 sem. hrs. must be 300 or 400 level)	42
Chemistry (CHEM 103, 104; or 103, 112; or 111, 112; 221, 222)	12
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
Mathematics (MATH 123, 124; or MATH 123 plus Computing Sciences or statistics course)	6
NATS 487, 490	3
Philosophy	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives (a Chemistry minor is particularly recommended; Geology, Computing Science and/or Statistics are also recommended)	17
Total	122

### SPECIFIC REQUIREMENTS

BIOL 113, 114	Principles of Biology*
BIOL 212, 214; 312, 314, or 315	(Vascular Plants/Non-vascular Plants or other Botany course)
BIOL 223	Cell Biology
BIOL 308, 345 or 360	Zoology
BIOL 333 or 334	Microbiology
BIOL 371, 372	Genetics

BIOL 381 Ecology  
 BIOL 384, 386 Biochemistry

\*or BIOL 103, 104, and 105 General Biology

*Note: Students must obtain a minimum grade of C in BIOL 113, 114 or 103, 104, and 105 to progress to BIOL 223. Students must obtain a minimum grade of C in BIOL 223 to progress to BIOL 372 or BIOL 423.*

### CONCENTRATION IN BIOLOGY

Biology: 30 sem. hrs., including:

BIOL 113, 114\* Principles of Biology

BIOL 223 Cell Biology

BIOL 371 or 372 Genetics

BIOL 381 Ecology

\*or BIOL 103, 104, and 105 General Biology

plus 15 sem. hrs. of Biology courses, of which 6 sem. hrs. must be 300 or 400 level, and CHEM 111, 112; or CHEM 103, 104. In certain programs (e.g., Kinesiology), BIOL 371, or 372, and 381 requirements may be replaced.

*Note: Students must obtain a minimum grade of C in BIOL 113, 114 or 103, 104, and 105 to progress to BIOL 223. Students must obtain a minimum grade of C in BIOL 223 to progress to BIOL 372 or BIOL 423.*

### MINOR IN BIOLOGY

The following specific requirements apply: 24 sem. hrs. of Biology (of which 9 sem. hrs. must be 300 or 400 level), including BIOL 103, 104, and 105 or BIOL 113, 114; 223; 371 or 372, and 381; and CHEM 111 and 112; or CHEM 103 and 104. In certain programs (e.g., Kinesiology), BIOL 371 or 372, and 381 requirements may be replaced.

*Note: Students must obtain a minimum grade of C in BIOL 113, 114 or 103, 104, and 105 to progress to BIOL 223. Students must obtain a minimum grade of C in BIOL 223 to progress to BIOL 372 or BIOL 423.*

## BIOTECHNOLOGY

*Department of Biology*

*Dr. Dennis Venema, Chair*

*Dr. Julia Mills, Coordinator*

The Biotechnology program offers:

1. Honours program, leading to a B.Sc. (Honours) degree;
2. Major, leading to a B.Sc. degree;
3. Multidisciplinary major in Biotechnology and Chemistry, leading to a B.Sc. degree;
4. Interdisciplinary major in Biotechnology and Business Administration, leading to a B.Sc. degree.

The TWU Biotechnology Program is comprised of a basic life sciences core together with biotechnology courses offered within the Departments of Biology and Chemistry. Business courses offered by the School of Business are also available for students intending a management career in biotechnology. Standard entry requirements for medical school and

other professional schools are met by the basic life sciences core while biotechnology courses provide an understanding of the component technologies together with applications of biotechnology in health care, agriculture, forestry, food processing, marine sciences, and the environment. The program approaches ethical concerns from both a scientific and Christian perspective enabling students to contribute reasoned, ethical interpretations to the discourse of the biotechnology marketplace. The program includes required intern (for credit) and co-op (paid) placements in biotechnology industries in North America to provide hands-on, supervised work experience.

*Note: This program is offered under the written consent of the Minister of Advanced Education effective March 9, 2006, having undergone a quality assessment process and been found to meet the criteria established by the Minister. Nevertheless, prospective students are responsible for satisfying themselves that the program and the degree are appropriate to their needs (for example, acceptable to potential employers, professional licensing bodies, or other educational institutions).*

## HONOURS PROGRAM IN BIOTECHNOLOGY, B.Sc. (HONOURS) DEGREE

### GENERAL GRADUATION REQUIREMENTS

(see also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Biology & Biotechnology	57
Chemistry (111, 112; 221, 222; 357, 358)	18
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123, 124 (or 102 or 108)	6
NATS 487, 490	3
Philosophy (210 recommended)	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12

Society & Culture	3
UNIV 101	1
Required Internships	3
Electives	5
Total	134

### REQUIREMENTS FOR THE HONOURS DEGREE

1. Admission into the Biotechnology Honours program requires a GPA of 3.0 in the first semester of study in a science program (e.g., BIOL 113; CHEM 111; MATH 123 or 105; ENGL 103; UNIV 101), a GPA of 3.0 in Biology and Biotechnology courses, and an overall GPA of 2.7 for graduation;
2. A minimum of 57 sem. hrs. in Biology and Biotechnology courses must be completed of which 36 sem. hrs. must be upper level credit;
3. A total of 134 sem. hrs. plus two co-op placements must be completed.

### SPECIFIC REQUIREMENTS

The following Biology and Biotechnology courses are required:

BIOL 113, 114	Principles of Biology*
BIOL 223	Cell Biology
BIOL 315	Plant Physiology and Biotechnology
BIOL 333, 334	Microbiology
BIOL 336	Immunology
BIOL 345	Vertebrate Physiology
BIOL 371, 372	Genetics
BIOL 384, 386	Biochemistry
BIOL 423	Advanced Cell Biology Laboratory
BIOL 438	Virology
*or BIOL 103, 104, and 105 General Biology	
BIOT 100	Biotechnology Practicum I
BIOT 200	Biotechnology Practicum II
BIOT 290	Introduction to Biotechnology
BIOT 390	Biotechnology and Christian Theology
BIOT 409, 410	Research Thesis
BIOT 470	Genomics, Proteomics, and Bioinformatics
BIOT 490	Advanced Biotechnology

## MAJOR IN BIOTECHNOLOGY, B.Sc. DEGREE

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Biology & Biotechnology	45
Chemistry (111, 112; 221, 222; 357, 358)	18
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123, 124 (or 102 or 108)	6
NATS 487, 490	3
Philosophy (210 recommended)	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Required Internships	3
Electives	5
Total	122

### REQUIREMENTS FOR B.Sc. DEGREE

1. Admission into the Biotechnology B.Sc. program requires a minimum overall GPA of 2.0 in the first semester of study in a science program (e.g., BIOL 113; CHEM 111; MATH 123 or 105; ENGL 103; UNIV 101) with a minimum GPA of 2.5 in all science courses. Graduation requires a minimum of C for all courses and an overall GPA of 2.5 for all science courses;
2. A minimum of 45 sem. hrs. in Biology and Biotechnology courses must be completed, of which 24 sem. hrs. must be upper level credit;
3. A total of 122 sem. hrs. plus two co-op placements must be completed.

### SPECIFIC REQUIREMENTS

The following Biology and Biotechnology courses are required:

BIOL 113, 114	Principles of Biology*
BIOL 223	Cell Biology
BIOL 333, 334	Microbiology
BIOL 336	Immunology
BIOL 371, 372	Genetics

BIOL 384, 386	Biochemistry
BIOL 423	Advanced Cell Biology Laboratory
*or BIOL 103, 104, and 105	General Biology
BIOT 100	Biotechnology Practicum I
BIOT 200	Biotechnology Practicum II
BIOT 290	Introduction to Biotechnology
BIOT 390	Biotechnology and Christian Theology
BIOT 470	Genomics, Proteomics, Bioinformatics
BIOT 490	Advanced Biotechnology

## MULTIDISCIPLINARY MAJOR IN BIOTECHNOLOGY AND CHEMISTRY, B.Sc. DEGREE

### GENERAL GRADUATION REQUIREMENTS

	Sem. hrs.
Biology & Biotechnology	33
Chemistry	33
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123, 124 (or 102)	6
NATS 487, 490	3
Philosophy (210 recommended)	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Required Internships	3
Electives	2
Total	122

(See also Academic Information section, particularly for further details on core requirements.)

## REQUIREMENTS FOR MULTIDISCIPLINARY B.Sc. DEGREE

1. Admission into the Multidisciplinary Biotechnology and Chemistry program requires a minimum overall GPA of 2.0 in the first semester of study in a science program (e.g., BIOL 113; CHEM 111; MATH 123 or 105; ENGL 103; UNIV 101) with a minimum GPA of 2.5 in all science courses. Graduation requires a minimum of C for all courses and an overall GPA of 2.5 for all science courses;
2. A total of 122 sem. hrs. plus two co-op placements must be completed.

### SPECIFIC REQUIREMENTS

The following Biology, Biotechnology, and Chemistry courses are required:

BIOL 113, 114	Principles of Biology*
BIOL 223	Cell Biology
BIOL 333 or 334	Microbiology
BIOL 336	Immunology
BIOL 371, 372	Genetics
*or BIOL 103, 104, and 105	General Biology
BIOT 100	Biotechnology Practicum I
BIOT 200	Biotechnology Practicum II
BIOT 290	Introduction to Biotechnology
BIOT 390	Biotechnology and Christian Theology
BIOT 470	Genomics, Proteomics, Bioinformatics
BIOT 490	Advanced Biotechnology
CHEM 111, 112	Principles of Chemistry
CHEM 221, 222	Organic Chemistry
CHEM 230	Inorganic Chemistry
CHEM 357, 358	Modern Analytical Methods
CHEM 321, 322	Advanced Organic Chemistry
CHEM 384, 386	Biochemistry

## INTERDISCIPLINARY MAJOR IN BIOTECHNOLOGY AND BUSINESS ADMINISTRATION, B.Sc. DEGREE

### GENERAL GRADUATION REQUIREMENTS

	Sem. hrs.
Biology & Biotechnology	33
Business Administration	24
Computing courses or MATH 101	3
CHEM 111, 112	6
ECON 201	3
ENGL 103, 104	6
Fine Arts	3

History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 120 (or MATH 123)	3
NATS 487, 490	3
Philosophy (210 recommended)	3
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Required Internships	3
Electives	8
Total	122

(See also Academic Information section, particularly for further details on core requirements.)

## REQUIREMENTS FOR INTERDISCIPLINARY B.Sc. BIOTECHNOLOGY AND BUSINESS ADMINISTRATION DEGREE

1. Admission requires a minimum overall GPA of 2.0 in the first semester of study in a science program (e.g., BIOL 113; CHEM 111; MATH 101; ENGL 103; UNIV 101; BUSI 111) with a minimum GPA of 2.5 in all science courses. Graduation requires a minimum of C for all courses and an overall GPA of 2.5 for all science courses;
2. Students are expected to be competent in the use of Microsoft Office Suite (i.e., MS Word: Word Processing; Excel: Spreadsheets; MS Access: Database and PowerPoint software) for use in their second year and subsequent Business classes. Those students who need to enhance their ability to work with this software should take the appropriate Computing Science courses including CMPT 112 (Word Processor), CMPT 122 (Data Base), CMPT 125 (Spreadsheet), and CMPT 127 (PowerPoint);
3. Electives must include 6 sem. hrs. of upper level credit;
4. A total of 122 sem. hrs. plus two co-op placements must be completed.

### SPECIFIC REQUIREMENTS

The following Biology, Biotechnology, and Business courses are required:

BIOL 113, 114	Principles of Biology*
BIOL 223	Cell Biology
BIOL 333 or 334	Microbiology
BIOL 336	Immunology
BIOL 371 or 384	Genetics or Biochemistry**

BIOL 372	Molecular Genetics
*or BIOL 103, 104, and 105 General Biology	
**BIOL 384 Biochemistry requires	
CHEM 221, 222 as prerequisites.	
BIOT 100	Biotechnology Practicum I
BIOT 200	Biotechnology Practicum II
BIOT 290	Introduction to Biotechnology
BIOT 390	Biotechnology and Christian Theology
BIOT 470	Genomics, Proteomics, Bioinformatics
BIOT 490	Advanced Biotechnology
BUSI 111	Introduction to Business and Management
BUSI 221, 222	Principles of Accounting
BUSI 275	Quantitative Methods
BUSI 280	Organizational Behaviour
BUSI 331	Basic Marketing
BUSI 342	Business Finance
BUSI 345	Business Law

## CHEMISTRY

*Department of Chemistry*

*Dr. Craig D. Montgomery, Chair*

The Department of Chemistry offers:

1. An Honours program in Chemistry, leading to a B.Sc. (Honours) degree;
2. A major in Chemistry, leading to a B.Sc. degree;
3. A concentration;
4. A minor.

Chemistry plays an integral role in the professional preparation of the science student. Graduates of our Chemistry program have found many career opportunities, including advancement into management levels in technology-based industries.

Chemistry is a basic foundation to careers in research, industry, the health sciences, and the environment. The Honours program and the program for graduate school preparation enable a student to continue to an advanced research degree. For industry, students should supplement their program with Business courses. For health sciences, the Chemistry major (Life Sciences Emphasis program) provides the prerequisite background.

Within the individual Chemistry courses, there is ample opportunity for breadth of preparation in theory and practice. Following the introduction of general principles and laboratory skills, courses are provided in analytical, organic, physical, and inorganic chemistry as well as biochemistry. Fourth year students may do independent projects in chemical problems encountered in testing, research, and development.

The Chemistry Department, located in the Neufeld Science Centre, features new and up-to-date laboratories and equipment. Advanced students are given opportunities to develop their teaching and leadership skills by acting as teaching assistants in first year laboratories under the supervision of a faculty member.

## HONOURS PROGRAM IN CHEMISTRY, B.Sc. (HONOURS) DEGREE

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Chemistry (36 sem. hrs. must be 300 or 400 level)	54
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123, 124, 223 and either 250 or 321	12
NATS 487, 490	3
Philosophy (380 suggested, not required)	3
PHYS 111, 112 and either 220 or 230	9
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives	20
Total	134

### SPECIFIC REQUIREMENTS

CHEM 111, 112	Principles of Chemistry*
CHEM 221, 222	Organic Chemistry
CHEM 230	Inorganic Chemistry
CHEM 240	Physical Chemistry
CHEM 321	Advanced Organic Chemistry
CHEM 341	Advanced Physical Chemistry
CHEM 357, 358	Modern Analytical Methods
CHEM 384	Principles of Biochemistry
CHEM 409, 410	Senior Thesis
CHEM 431	Advanced Inorganic Chemistry
CHEM Upper Level Electives (15 sem. hrs.)	

(CHEM 372 may not be applied towards an Honours program in Chemistry.)

\*or CHEM 103, 104 with a B or higher; or CHEM 103, 112.

The total of 134 sem. hrs. must include a minimum of 54 sem. hrs. of upper level credit. A minimum cumulative GPA of 3.00 in all TWU courses and an overall Chemistry GPA of 3.00 are required for graduation.

## MAJOR IN CHEMISTRY, B.Sc. DEGREE

### 1. PROGRAM FOR GRADUATE SCHOOL PREPARATION

#### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Chemistry (24 sem. hrs. must be 300 or 400 level)	45
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123, 124; 223	9
NATS 487 & 490	3
One of MATH 250; PHYS 220; or MATH 300 or 400 level	3
Philosophy (380 suggested, not required)	3
PHYS 111, 112; and either 230 or 220 (if not taken above)	9
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives	17
Total	122

#### SPECIFIC REQUIREMENTS

CHEM 111, 112	Principles of Chemistry*
CHEM 221, 222	Organic Chemistry
CHEM 230	Inorganic Chemistry
CHEM 240	Physical Chemistry
CHEM 321	Advanced Organic Chemistry

CHEM 341	Advanced Physical Chemistry
CHEM 357, 358	Modern Analytical Methods
CHEM 384	Principles of Biochemistry
CHEM 409, 410	Senior Thesis
CHEM 431	Advanced Inorganic Chemistry
CHEM electives (6 sem. hrs.)	

(CHEM 372 may not be applied towards the program for graduate school preparation.)

\*or CHEM 103, 104 with a B or higher; or CHEM 103, 112.

### 2. GENERAL PROGRAM

#### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Chemistry (24 sem. hrs. must be 300 or 400 level)	42
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123, 124	6
NATS 487, 490	3
One of MATH 223; CMPT 140, or CMPT 141	3-4
Philosophy	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives	25-26
Total	122

#### SPECIFIC REQUIREMENTS

CHEM 111, 112	Principles of Chemistry*
CHEM 221, 222	Organic Chemistry
CHEM 230	Inorganic Chemistry
CHEM 240	Physical Chemistry
CHEM 357	Modern Analytical Methods

CHEM electives (21 sem. hrs.)  
(CHEM 372 may not be applied towards the general program.)

\*or CHEM 103, 104 with a B or higher;  
or CHEM 103, 112.

### 3. LIFE SCIENCES EMPHASIS PROGRAM

#### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Chemistry (24 sem. hrs. must be 300 or 400 level)	42
BIOL 113, 114; 223	9
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123, 124	6
NATS 487, 490	3
Philosophy	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives	20
Total	122

#### SPECIFIC REQUIREMENTS

CHEM 111, 112 Principles of Chemistry\*  
 CHEM 221, 222 Organic Chemistry  
 CHEM 230 Inorganic Chemistry  
 CHEM 240 Physical Chemistry  
 CHEM 384 Principles of Biochemistry  
 CHEM 386 Biosynthesis  
 CHEM electives (18 sem. hrs.)

\*or CHEM 103, 104 with a B or higher;  
or CHEM 103, 112.

### COMBINED CHEMISTRY AND BUSINESS MAJORS

This combination is ideal for those seeking managerial positions in a technological industry. However, it is demanding and may require five years of study. Consult the deans in both areas for details.

### CONCENTRATION IN CHEMISTRY

Chemistry: 30 sem. hrs., including:  
 CHEM 111, 112\* Principles of Chemistry  
 CHEM 221, 222 Organic Chemistry  
 CHEM 230 Inorganic Chemistry  
 CHEM 240 Physical Chemistry  
 CHEM 357 Modern Analytical Methods

plus 9 sem. hrs. of 300 or 400 level Chemistry courses. (CHEM 372 may not be applied towards a concentration in Chemistry.)

\*or CHEM 103, 104 with a B or higher;  
or CHEM 103, 112.

### MINOR IN CHEMISTRY

In addition to the general requirements (see Graduation Requirements section), the following specific requirements apply: 24 sem. hrs. including CHEM 111, 112 (or CHEM 103, 104 with a B or higher; or CHEM 103, 112); 221, 230; plus 12 sem. hrs. of CHEM electives, 9 sem. hrs. of which must be at the 300 or 400 level. (CHEM 372 may not be applied towards a minor in Chemistry.)

### AU SABLE INSTITUTE COURSES

As a service to Biology and Chemistry majors with an interest in environmental studies, several 300 or 400 level courses are available for credit to Trinity Western students through the Au Sable Institute for Environmental Studies in Washington state, the Great Lakes area, Florida, Africa, and India. These are intensive courses taught primarily during the spring and summer and offer a distinct Christian perspective on the environment. See the Office of the Registrar for tuition rates. Some financial assistance for travel and housing is available from the Au Sable Institute. See course listings under Environmental Studies. Full details can be obtained from the co-coordinator of the Environmental Studies program.

### COMPUTING SCIENCE

*Department of Mathematical Sciences*

*Prof. Rick Sutcliffe, Chair*

The Department of Mathematical Sciences offers:

1. A major in Computing Science leading to a B.Sc. degree, with a general emphasis or graduate school preparation emphasis;
2. A concentration;
3. A minor.

# MAJOR IN COMPUTING SCIENCE, B.Sc. DEGREE

## 1. PROGRAM FOR GRADUATE SCHOOL PREPARATION

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Computing Science (24 sem. hrs. must be 300 or 400 level)	48
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
Laboratory Science	3
MATH 123, 124, 250	9
CMPT 480, NATS 490	4
Philosophy (PHIL 350 recommended)	3
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture (COMM 310 required)	3
UNIV 101	1
Electives	22
Total	122

### SPECIFIC REQUIREMENTS

CMPT 140, 150 and 166

CMPT 150; 231, 237, 242; 385

CMPT 409, 410 (Thesis)

CMPT 480 (fulfils NATS 487 requirement; NATS 490 also required)

plus additional courses in Computing Science to total 48 sem. hrs., of which at least 30 sem. hrs. must be in 300 or 400 level courses.

*Note: 30 sem. hrs. at the upper level is necessary for Education students.*

## 2. GENERAL PROGRAM

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Computing Science (24 sem. hrs. must be 300 or 400 level)	42
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
Laboratory Science	3
MATH 123, 150 (250 recommended)	6-9
CMPT 480; NATS 490	4
Philosophy (PHIL 350 recommended)	3
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture (COMM 310 required)	3
UNIV 101	1
Electives	28-31
Total	122

### SPECIFIC REQUIREMENTS

CMPT 140, 150 and CMPT 166

At least 3 of CMPT 150; 231, 237, 242; or 385

CMPT 480 (fulfils NATS 487 requirement)

plus additional courses in Computing Science to total 42 sem. hrs., of which at least 24 sem. hrs. must be in 300 or 400 level courses.

*Note: a) There are a few Mathematics courses in the Mathematics with Computing Science programs (MATH 330, 350; 430) that are cross-listed as Computing Science, but students are advised that these have significant Mathematics prerequisites. PHYS 320 is cross-listed as Computing Science but has significant Physics prerequisites;*

*b) Business courses cross-listed as ISYS (Information Systems) may not be counted as CMPT courses for the purpose of a major, concentration, or minor in Computing Science. CMPT courses cross-listed as ISYS (Information Systems) must be taken as CMPT courses for Computing Science students. No course may be counted towards both a Computing Science degree and an Information Systems major, concentration, or minor;*

*c) MATH 190, MATH courses numbered below 123, and CMPT courses numbered below 130 do not count towards a Mathematics, Mathematics with Computing Science, or Computing Science major, concentration, or*

*minor. Exceptions: (1) A student with a B+ or higher in MATH 120 may, on approval of the Department chair, count this course as fulfilling the departmental requirements of MATH 123. (2) CMPT/ISYS 113 may be counted towards any computing degree.*

## CONCENTRATION IN COMPUTING SCIENCE

30 sem. hrs. of Computing Science courses, including:

	Sem. hrs.
CMPT 140 and 166	6
CMPT 231 and at least one other Computing Science course at the 200 level	6
CMPT 480	3
An additional 15 sem. hrs. of Computing Science courses, at least 9 sem. hrs. at the 300 or 400 level	<u>15</u>
	Total: 30

Other courses: None are required, but MATH 250, COMM 310, and PHIL 103 are recommended.

*Note: Cross-listed courses generally have prerequisites in the cross-listed subject area. They may fulfil requirements in only one department at a time and for only one program at a time.*

## MINOR IN COMPUTING SCIENCE

The following specific requirements apply:  
24 sem. hrs. of Computing Science including CMPT 140 and 166; one 200 level Computing Science course; and 15 sem. hrs. of other Computing Science courses (of which 9 sem. hrs. must be 300 or 400 level).

## FACILITIES

TWU has computers that run MacOS, Windows NT Client, and UNIX. Small labs are set aside for senior students. Modula-2 is used for introductory programming courses, and other languages are employed as appropriate in later courses. The Department's goal is to graduate computer-literate students who can use many tools and systems and who are problem-solving software engineers by profession.

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## ENVIRONMENTAL STUDIES (B.Sc.)

*Faculty of Natural and Applied Sciences & Faculty of Humanities and Social Sciences*

*Dr. David R. Clements and Prof. Karen M. M. Steensma, Coordinators*

TWU offers a multidisciplinary Environmental Studies program by combining strengths from three departments across two faculties: the Geography Department in the Faculty of Humanities and Social Sciences, and the Biology and Chemistry departments in the Faculty of Natural and Applied Sciences.

## PURPOSE

The purpose of the program is to develop godly leaders with solid scientific and technical skills who are also actively growing in their creative problem solving, and thinking abilities developed within the context of a liberal arts education. This background, combined with a biblical Christian perspective on the environment, helps future leaders offer innovative, creative, and effective solutions to the challenging task of creation stewardship.

## PERSPECTIVE

The environmental field requires knowledge of biology, chemistry, geography, and insights from other disciplines within the natural and social sciences. Such knowledge is indispensable when dealing with complex issues such as species habitat, the remediation of a polluted site, renewable and non-renewable resources, ecological conservation and restoration projects, spatial and statistical analysis, air quality, global warming, and environmental toxicology. At the same time, a person working in environmental studies often faces social, political, ethical, and philosophical issues that both affect and go beyond the science. Indeed, significant environmental debates are usually rooted in values and beliefs. Thus, the program strives to prepare the environmental professional by building a solid core of scientific subjects, based on the ethical foundation of Christian thought and practice.

## THE CHRISTIAN AND THE ENVIRONMENT

The foundation of the Environmental Studies program is the fact that God is. He is the creator as revealed in Scripture. There may be pragmatic reasons for caring for the environment, but even if no other reason exists, we believe creation has intrinsic value because God created it. God saw all that He had made and it was very good. We recognize that aspects of the creation are fallen as a result of sin, but also that God continues to care for and sustain the creation. In Psalms we see God in an intimate relationship with creation—He “make[s] the grass grow for the cattle” (104:14) and the lions “seek their food from God” (104:21). In Job we see a similar relationship; He even “counts the months” until the “doe bears her fawn” (39:1-2). God has at times made covenants not only with man, but with all of creation (Gen. 9:8-17). If He is concerned about His creation, we should be also.

Our Christian perspective also affirms the value of humanity. “Are not two sparrows sold for a farthing? And not one of them shall fall to the ground apart from the Father. But the very hairs of your head are all numbered. Therefore do not fear, you are more valuable than many sparrows” (Matthew 10:29-31). This tells us that while a creature as common as the sparrow is valuable to God, people are even more valuable. Isaiah 45:18 reminds us of this fact: “For this is what the LORD says—He who created the heavens, He is God; He who fashioned and made the earth, He founded it; He did not create it to be empty, but formed it to be inhabited.” We don't view humanity as a blight on the planet. Rather we seek the goal of understanding and living responsibly with and in the environment of which we are a part. We are created in the image of God and have, among other things, the

responsibility of tending the creation. Thus, in our perspective, environmental paradigms for behaviour, management, and solutions to problems should consider all the creation and its interrelationships, including human relationships and needs.

Taking care of the environment should not be something out of the ordinary; it is a normal Christian duty. There may be debate as to how that may be best accomplished. That debate is part of the exploration and growth at TWU.

## PROGRAM

There is a core group of courses that all B.Sc. students take in the Environmental Studies program. Beyond the core are three specialized emphases from which to choose. A fourth emphasis leads to a B.A. in Environmental Studies. (For the B.A. degree requirements, please see the listing under Faculty of Humanities and Social Sciences). The three B.Sc. emphases are:

1. Natural Systems and Resources Emphasis in Environmental Studies (B.Sc.);
2. Biochemical Emphasis in Environmental Studies (B.Sc.);
3. Physical and Analytical Emphasis in Environmental Studies (B.Sc.).

## ENVIRONMENTAL STUDIES CORE

### REQUIRED COURSES IN GEOGRAPHY/GEOLOGY

GEOG 121	Earth and Atmospheric Science
GEOG 282	Applied Geographic Information Systems
GEOL 109	Introductory Geology

### REQUIRED COURSES IN BIOLOGY

BIOL 113	General Biology
BIOL 114	General Biology
BIOL 381	General Ecology

### REQUIRED COURSES IN CHEMISTRY

CHEM 111	General Chemistry
CHEM 112	General Chemistry
CHEM 370	Environmental Chemistry

### REQUIRED COURSES IN ENVIRONMENTAL STUDIES

ENVS/GEOG 131	Global Environmental Issues
ENVS/GEOG 442	Environmental Thought
ENVS 409	Thesis Preparation
ENVS 410, 411	Senior Thesis

### REQUIRED FIELD COURSES

Choice of at least two field courses:

BIOL 364	Coral Reef Ecology (Hawaii)
BIOL 382	Marine Ecology (Salt Spring Island)
BIOL 316	Plant Ecology (Salt Spring Island)
BIOL 318	Tropical Botany (Hawaii)

or Au Sable field courses  
or other field courses offered through TWU

*Note: For more information on Au Sable courses, see Au Sable Institute of Environmental Studies in this Calendar's Additional Curricular Information. Course descriptions are listed in Environmental Studies.*

## REQUIRED COURSES IN MATHEMATICS

Choice of:

MATH 102	Statistics
MATH 123	Calculus
GEOG 383	Geographic Data Analysis

*Note: 42 sem. hrs. within the overall degree must be upper level. At least 30 sem. hrs. of upper level credit must be within the Environmental Studies degree requirements or electives listed. Courses may also include Au Sable courses in addition or as a substitution appropriate for the requirements and with permission of an Environmental Studies coordinator. An overall GPA of 2.00 or higher must be maintained.*

## ENVIRONMENTAL STUDIES EMPHASES

Specific details of the B.Sc. emphases in Biochemical, Natural Systems and Resources, and Physical and Analytical Environmental Studies are listed here. For details of the B.A. degree, see listings under the Faculty of Humanities and Social Sciences.

## MAJOR IN ENVIRONMENTAL STUDIES, B.Sc. DEGREE

### NATURAL SYSTEMS AND RESOURCES EMPHASIS

This degree emphasizes a hybrid of Geography and Biology. Beyond requirements for this track, students may continue to take both Biology and Geography or may wish to emphasize one discipline in their choice of electives.

This degree is for those interested in wildlife management, reclamation, parks, ecological restoration, forest systems, marine systems, agriculture, land use planning, environmental consulting, naturalist occupations, conservation, resource sustainability, and planning.

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Biology	21
Chemistry	9
Geography	18
Environmental Studies	9

Field courses	6
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123 or 102	3
NATS 487, 490	3
Philosophy	3
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
UNIV 101	1
Electives	20
Total	122

### SPECIFIC REQUIREMENTS

Courses listed in the Environmental Studies Core (see list under program description), plus:

### REQUIRED COURSES IN GEOGRAPHY/GEOLOGY

- GEOG 341 Resource and Environmental Management  
 GEOG 382 Applied Geographic Information Systems

Choice of at least one of the following:

- GEOG/GEOL 320 Geomorphology  
 GEOG/GEOL 321 Soils Geography  
 GEOG 322 Global Climate Change

### REQUIRED COURSES IN BIOLOGY

1. Choice of at least one of the following:

- BIOL 312 Vascular Plants  
 BIOL 314 Non-Vascular Plants  
 BIOL 315 Plant Physiology

2. Choice of at least one of the following:

- BIOL 308 Vertebrate Zoology (cannot be taken if BIOL 345 is taken)  
 BIOL 345 Vertebrate Physiology (cannot be taken if BIOL 308 is taken)  
 BIOL 360 Invertebrate Zoology

3. BIOL 482 Applied Ecology

4. Choice of at least one of the following:

- BIOL 233 Cell Biology  
 BIOL 334 Basic and Applied Microbiology

Electives may be taken from any area but, to add to a student's knowledge of environmental studies, it is recommended to take above courses not already taken

or some of the following:

- BIOL 344 Environmental Physiology  
 BIOL 371 Genetics  
 GEOG 111 Human Geography and Global Change  
 GEOG/GEOL 220 Geology of the Vancouver Region  
 GEOG 355 Geography of Urban Areas  
 GEOG 356 Urban and Regional Planning  
 GEOG 400 Special Topics

### BIOCHEMICAL EMPHASIS

This degree is for those interested in applying chemical knowledge to biological systems, environmental toxicology, health effects, bioremediation, phytoremediation, biogeochemistry, applied chemistry, managing hazardous waste disposal, toxic modes of action, global elemental cycles, environmental consulting, chemical ecology, agriculture, pesticides, toxic organics, natural products, and worker exposure and safety.

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Biology	18
Chemistry	21
Geography	9
Environmental Studies	9
Field Courses	6
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123	3
NATS 487, 490	3
Philosophy	3
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
UNIV 101	1
Electives	20
Total	122

## SPECIFIC REQUIREMENTS

Courses listed in the Environmental Studies core (see list under program description), plus:

### REQUIRED COURSES IN BIOLOGY

BIOL 223 Cell Biology  
 BIOL 334 Basic and Applied Microbiology

Choice of at least one of the following:

BIOL 315 Plant Physiology  
 BIOL 336 Immunology  
 BIOL 344 Environmental Physiology  
 BIOL 345 Vertebrate Physiology  
 BIOL 372 Molecular Genetics

### REQUIRED COURSES IN CHEMISTRY

CHEM 221, 222 Organic Chemistry  
 CHEM/BIOL 384 Biochemistry  
 CHEM/BIOL 386 Biochemistry/Biosynthesis

### REQUIRED COURSES IN MATH

MATH 123 must be taken in this track, which is counted towards the Environmental Studies core.

Electives may be taken from any area but, to add to a student's knowledge of environmental studies, it is recommended to take above courses not already taken or some of the following:

BIOL 308 Vertebrate Zoology  
 BIOL 360 Invertebrate Zoology  
 BIOL 482 Applied Ecology  
 CHEM 321, 322 Advanced Organic Chemistry  
 GEOG/GEOL 321 Soils Geography  
 GEOG 355 Geography of Urban Areas  
 GEOG 382 Applied Geographic Information Systems

### PHYSICAL AND ANALYTICAL EMPHASIS

This track emphasizes physical and chemical processes, mechanisms, and analysis of environmental parameters.

This emphasis is for students interested in environmental monitoring (industrial, agricultural, natural), environmental cleanup, environmental laboratory analysis, environmental chemistry research, applied chemistry, hazardous waste storage and remediation, biogeochemistry, global elemental cycles, global warming, environmental consulting, or energy issues.

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Biology	9
Chemistry	22
Geography	12

Environmental Studies	9
Field courses	6
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 123	3
NATS 487, 490	3
Philosophy	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
UNIV 101	1
Electives	19
Total	122

### SPECIFIC REQUIREMENTS:

Courses listed in the Environmental Studies core (see list under program description), plus:

### REQUIRED COURSES IN GEOGRAPHY/GEOLOGY

At least one of the following:

GEOG/GEOL 321 Soils Geography  
 GEOG 322 Global Climate Change

### REQUIRED COURSES IN CHEMISTRY

CHEM 221, 222 Organic Chemistry

Choice of at least one of the following:

CHEM 230 Inorganic Chemistry  
 CHEM/PHYS 240 Physical Chemistry

plus

CHEM 357 Modern Analytical Methods I  
 CHEM 358 Modern Analytical Methods II

### REQUIRED COURSES IN PHYSICS

PHYS 111 Fundamentals of Physics I  
 PHYS 112 Fundamentals of Physics II

### REQUIRED COURSES IN MATHEMATICS

MATH 123 must be taken in this track, which is counted towards the Environmental Studies core.

Electives may be taken from any area but, to add to a student's knowledge of environmental studies,

it is recommended to take above courses not already taken or some of the following:

BIOL 482	Applied Ecology
CHEM 321, 322	Advanced Organic Chemistry
CHEM/BIOL 384	Biochemistry
GEOG/GEOL 320	Geomorphology
GEOG 382	Applied Geographic Information Systems

### MINOR IN ENVIRONMENTAL STUDIES, B.Sc. DEGREE

BIOL 113	Principles of Biology
BIOL 381	General Ecology
BIOL 482	Applied Ecology
CHEM 101	Introduction to General Chemistry
ENVS/GEOG 131	Global Environmental Issues
GEOG 282	Geographic Information Systems
Students may choose two of the following field courses:	
BIOL 316	Plant Ecology*
BIOL 318	Tropical Botany*
BIOL 364	Coral Reef Ecology*
BIOL 382	Marine Ecology*
GEOG/GEOL 220	Geology of the Vancouver Region
GEOG/GEOL 320	Geomorphology

\*Denotes Travel Studies courses. AuSable Institute courses may be substituted for these field courses with approval of the Environmental Studies Program Directors.

### GENERAL STUDIES

A student may choose to pursue a B.A. or a B.Sc. in General Studies. These programs incorporate academic study in a combination of disciplines. This is particularly suitable for students whose areas of interest extend beyond the usual disciplinary boundaries.

A B.A. in General Studies is available by combining a minimum of two minors (24 sem. hrs. each), at least one of which is not a natural or applied science. A B.Sc. in General Studies is available by combining a minimum of two minors (24 sem. hrs. each) in the natural sciences. For more depth, students may choose to do a concentration (30 sem. hrs.) for either degree. Minor and concentration requirements are listed under the various disciplines in this Calendar.

## INFORMATION SYSTEMS

*Department of Mathematical Sciences*

*Prof. Rick Sutcliffe, Chair*

### MINOR IN INFORMATION SYSTEMS

The Department of Mathematical Sciences offers a minor in Information Systems. The following specific requirements apply:

	Sem. hrs	
ISYS 113	Intro to Information Systems and Web Technologies	3
ISYS 123	Data Analysis for Information Systems	3
ISYS/CMPT 140	Intro Programming	3
ISYS 211	Web Technologies I	3
ISYS/CMPT 237	Files and Databases	3
ISYS/CMPT 325	Networking	3
ISYS/BUSI 371* or ISYS/CMPT 385**	Systems Analysis/Software Engineering	3
ISYS/BUSI 470* or ISYS/CMPT 386	ISYS/SE Project	3-4

plus additional Information Systems courses as necessary taken from the following to total 24 sem. hrs., of which at least 9 sem. hrs. must be in 300 or 400 level courses and have not already been counted towards a major:

ISYS/BUSI 370*	Business and Information Systems	3
ISYS/BUSI 377	Management Science	3
ISYS/CMPT 480	Ethical and Social Issues	3
ISYS/CMPT 400	Directed Studies	3

\*Business majors

\*\*Option for other majors

Ancillary Course

MATH 150	Discrete Math	3
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*Note: The first group could total 24 sem. hrs. or more, but some students may not require some of the 100 level courses. Business majors may have been required to take BUSI 370.*

## MATHEMATICS

*Department of Mathematical Sciences*

*Prof. Rick Sutcliffe, Chair*

The Department of Mathematical Sciences offers:

1. A major in Mathematics, leading to a B.Sc. degree, with either a general or graduate school preparation emphasis;
2. A concentration;
3. A minor.

## MAJOR IN MATHEMATICS, B.Sc. DEGREE

### 1. PROGRAM FOR GRADUATE SCHOOL PREPARATION

#### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Mathematics (30 sem. hrs. must be 300 or 400 level)	48
CMPT 140 and 166	6
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
MATH 480	3
NATS 490	1
Philosophy	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives	22
Total	122

#### SPECIFIC REQUIREMENTS

MATH 123, 124	Calculus I & II
MATH 150	Discrete Mathematics
MATH 220	Analysis
MATH 223	Calculus III
MATH 250	Linear Algebra
MATH 370	Modern Geometry
MATH 380	Abstract Algebra
MATH 409, 410	Senior Thesis
MATH 480	Foundations of Mathematical Sciences (fulfils NATS 487 and IDIS 400 requirements, provided NATS 490 is also taken.)

plus additional courses in Mathematics to a total of 48 sem. hrs., of which at least 30 sem. hrs. must be at the 300 or 400 level.

## 2. GENERAL PROGRAM GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Mathematics (24 sem. hrs. must be 300 or 400 level)	42
CMPT 140 and 166	6
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
Laboratory science (PHYS 111 recommended)	3
MATH 480	3
NATS 490	1
Philosophy (PHIL 350 recommended)	3
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives	31
Total	122

#### SPECIFIC REQUIREMENTS

MATH 123, 124	Calculus I & II
MATH 150	Discrete Mathematics
MATH 220	Analysis
MATH 223	Calculus III
MATH 250	Linear Algebra
MATH 370	Modern Geometry
MATH 380	Abstract Algebra
MATH 480	Foundations of Mathematical Sciences (fulfils NATS 487 and IDIS 400 requirements, provided NATS 490 is also taken.)

plus additional courses in Mathematics to a total of 42 sem. hrs., of which at least 24 sem. hrs. must be at the 300 or 400 level.

*Note: MATH 190, MATH courses numbered below 123, and CMPT courses numbered below 130 do not count towards a Mathematics, Mathematics with Computing Science, or Computing Science major, concentration, or minor. Exception: A student with a B+ or higher in MATH 120 may,*

*on approval of the Department chair, count this course as fulfilling the departmental requirements of MATH 123.*

## CONCENTRATION IN MATHEMATICS

Mathematics: 30 sem. hrs., including:  
 MATH 123, 124    Calculus I and II  
 MATH 150        Discrete Mathematics  
 MATH 223        Calculus III  
 CMPT 140        Introduction to Programming  
 plus 18 sem. hrs. of Mathematics courses, of which at least 12 sem. hrs. must be 300 or 400 level courses.

## MINOR IN MATHEMATICS

(see General Graduation Requirements section)  
 The following specific requirements apply: 24 sem. hrs. of Mathematics (of which 9 sem. hrs. must be 300 or 400 level), including MATH 123, 124; and 223; and CMPT 140.

## MATHEMATICS WITH COMPUTING SCIENCE

*Department of Mathematical Sciences  
 Prof. Rick Sucliffe, Chair*

- The Department of Mathematical Sciences offers:
1. A major in Mathematics with Computing Science, leading to a B.Sc. degree;
  2. A concentration;
  3. A minor;
  4. A departmental major in Mathematics and Computing that stresses applications to practical problems, making use of computers.

## MAJOR IN MATHEMATICS WITH COMPUTING SCIENCE, B.Sc. DEGREE

### GENERAL GRADUATION REQUIREMENTS

(See also Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Mathematics and Computing Science (24 sem. hrs. must be 300 or 400 level)	42
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4

IDIS 102	1
CMPT 480 or MATH 480	3
NATS 490	1
Philosophy (PHIL 350 recommended)	3
PHYS 111, 112	6
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12
Society & Culture	3
UNIV 101	1
Electives	34
Total	122

## SPECIFIC REQUIREMENTS

MATH 123, 124    Calculus I and II  
 MATH/CMPT 150 Introduction to Discrete Mathematics  
 MATH 480        Ethical and Social Issues  
 or CMPT 480     (CMPT 480 or MATH 480 fulfils NATS 487 requirement.)  
 CMPT 140 and 166

plus at least 3 sem. hrs. in a 200 level CMPT course, 6 sem. hrs. in 300 or 400 level CMPT courses, 6 sem. hrs. in 300 or 400 level CMPT courses, and 12 additional sem. hrs. of Mathematics and/or Computing Science electives at the 300 or 400 level.

Students who do not have a strong background in computer programming must either take CMPT 140 or have the instructor's permission before enrolling in CMPT 166.

*Note: MATH 190, MATH courses numbered below 123, and CMPT courses numbered below 130 do not count towards a Mathematics, Mathematics with Computing Science, or Computing Science major, concentration, or minor. Exception: A student with a B+ or higher in MATH 120 may, on approval of the Department chair, count this course as fulfilling the departmental requirements of MATH 123.*

## CONCENTRATION IN MATHEMATICS WITH COMPUTING SCIENCE

Mathematics and Computing Science: 30 sem. hrs. including:  
 MATH 123, 124    Calculus I and II  
 MATH/CMPT 150   CMPT 140 and 166  
 plus another 15 sem. hrs. of Mathematics and Computing Science courses, at least 6 sem. hrs. of each (a total of 12 sem. hrs.) are at the 300 or 400 level.

## MINOR IN MATHEMATICS WITH COMPUTING SCIENCE

(see General Graduation Requirements section)

The following specific requirements apply: 24 sem. hrs. including MATH 123, 124, and 150; and 9 sem. hrs. of Mathematics electives, of which 6 sem. hrs. are at the 300 or 400 level; CMPT 140 and 166; 3 sem. hrs. of a 200 level Computing Science elective; and 3 sem. hrs. of a 300 or 400 level Computing Science elective.

Society & Culture	3
UNIV 101	1
Electives	23
Total	122

### SPECIFIC REQUIREMENTS

Biology, Chemistry, Computing Science, Mathematics, Mathematics with Computing Science, and Physics concentrations are found in the listings under each department.

## NATURAL AND APPLIED SCIENCES

*Faculty of Natural and Applied Sciences*

*Dr. Craig D. Montgomery, Coordinator*

The Faculty of Natural and Applied Sciences offers a Multidisciplinary Natural and Applied Sciences major with:

1. A concentration in one science area;
2. A minor in a second area;
3. At least 6 sem. hrs. in a third area, chosen from BIOL 113, 114 (or 103, 104); CHEM 111, 112 (or 103, 104); GEOL 109; MATH 123, 124; or PHYS 111, 112.

It is also possible to gain a multidisciplinary major with concentrations in two areas: for example, Biology and Chemistry, Chemistry and Mathematics, etc.

## MAJOR IN NATURAL AND APPLIED SCIENCES, B.Sc. DEGREE

### GENERAL GRADUATION REQUIREMENTS

(See Academic Information section, particularly for further details on core requirements.)

	Sem. hrs.
Natural Science	60
ENGL 103, 104	6
Fine Arts	3
History	3
Human Kinetics (incl. HKIN 190)	4
IDIS 102	1
NATS 487, 490	3
Philosophy	3
Religious Studies (incl. RELS 101, 102; Bible content; Christianity & Inter-Cultural Studies)	12

## PHYSICS

*Department of Mathematical Sciences*

*Prof. Rick Sutcliffe, Chair*

*Dr. Arnold E. Sikkema, Coordinator*

The Department of Mathematical Sciences offers a concentration and a minor in Physics.

### CONCENTRATION IN PHYSICS

The following specific requirements apply: 30 sem hrs. of Physics including:

PHYS 111, 112	Fundamentals of Physics
PHYS 220	Mechanics
PHYS 230	Electricity and Magnetism
PHYS 240	Physical Chemistry

One of the following:

PHYS 210	Conceptual Modern Physics
PHYS 215	Stellar and Galactic Astronomy

plus 12 sem. hrs. of Physics courses at the 300 or 400 level.

### MINOR IN PHYSICS

The following specific requirements apply: 24 sem. hrs. of Physics (of which 9 sem. hrs. must be 300 or 400 level), including PHYS 111, 112. Either PHYS 210 or 215, but not both, may be part of the minor.

## PRE-PROFESSIONAL STUDIES (SCIENCES)

*Faculty of Natural and Applied Sciences*

*Dr. Eve Stringham-Durovic, Coordinator*

In addition to the major programs, students may study in various pre-professional programs including:

### 1. PRE-MEDICINE

Students planning to enter the field of medicine may take their full pre-medicine program at Trinity Western. Due to very restricted enrolments in medical schools, students are encouraged to select a course of studies which will lead to a degree in their area of interest. Each medical school has specific

requirements for entrance; however, requirements may include the following:

BIOL 113, 114 (or BIOL 103, 104, and 105);  
223; 384, 386

CHEM 111, 112 (or 103, 104; or 103, 112); 221, 222

ENGL 103, 104

MATH 123, 124; or 123, 102

PHYS 111, 112

## 2. PRE-DENTISTRY

Normally students are required to complete three academic years towards a baccalaureate degree, including courses in the humanities and social sciences. Specific requirements for many dental schools may include the following:

BIOL 113, 114 (or BIOL 103, 104, and 105); 384, 386

CHEM 111, 112 (or 103, 104; or 103, 112); 221, 222

ENGL 103, 104

MATH 123, 124

PHYS 111, 112

## 3. PRE-VETERINARY MEDICINE

Normally two years of study are required for admission to a school of veterinary studies and students are able to complete their requirements at Trinity Western. Admission to the Western College of Veterinary Medicine (in Saskatoon, Sask.), for example, requires:

BIOL 113, 114 (or BIOL 103, 104, and 105);  
333 or 334, 384, 386, 371

ENGL 103, 104

CHEM 111, 112 (or CHEM 103, 104;  
or CHEM 103, 112); 221, 222

MATH 123, 124; or 123, 102

PHYS 111, 112

Electives: 15 sem. hrs.  
(i.e. sufficient to complete two full years).

## 4. PRE-PHARMACY

Normally one year of study is required for admission to pharmacy. Admission to the Faculty of Pharmaceutical Sciences at the University of British Columbia, for example, requires:

BIOL 113, 114 (or BIOL 103, 104, and 105)

CHEM 111, 112 (or CHEM 103, 104 or 103, 112)

ENGL 103, 104

MATH 123, 124 (both are recommended)

PHYS 111

plus 3 sem. hrs. of appropriate electives.

## 5. PRE-ENGINEERING AND ENGINEERING TRANSFER PROGRAM

*Dr. Arnold Sikkema, Coordinator*

The three universities in British Columbia offering Engineering programs, namely the University of British Columbia (UBC), Simon Fraser University, and the University of Victoria, reserve space in their second year for students who have completed

the equivalent of first year Engineering at another institution. Requirements vary among these universities; a one or two-year program at Trinity Western University can be crafted in consultation with the Engineering Transfer program coordinator and the destination university.

Students who have completed the following courses at Trinity Western University can apply for entry into the first year of the Engineering program at UBC:

CHEM 111, 112

ENGL 103, 104

MATH 123, 124

PHYS 111, 112

Humanities electives (6 sem. hrs.)

Completion of these courses will reduce the course requirements in the four-year engineering program at UBC.

For entry into the second year of Engineering at UBC, one or more of the following additional courses are required, which are usually a part of a two-year program at Trinity Western University:

MATH 250

PHYS 220

CMPT 140

an Engineering Graphics course (available at Kwantlen University College in May/June)

Several additional courses may help reduce the course load in the final three years of the UBC Engineering program:

MATH 223; 310, 321

MATH/PHYS 322

CMPT 480

ECON 201, 202

BIOL/ENVS 353

Additional science courses relevant to the Engineering program of interest

Humanities and Social Sciences electives