

# Faculty of Science

---

**The Professors 522**

---

Members of the Faculty 522

---

**Faculty Regulations 524**

---

Faculty Overview 524

Degrees 524

Admission 524

Definitions 524

Academic Standing 524

Courses 526

Graduation 526

Appeals and Grievances 526

Visiting Student Status 526

Study Abroad 526

Science Internship Program 527

---

**General Information 527**

---

Certificates 527

Geophysics 528

Marine Science 528

Northern Studies 528

Professional Association 528

Professional Registration 528

Science After Degrees 529

---

**Details of Courses 529**

---

Course Listings 529

Prerequisites 529

Course Exceptions 529

Graduate Courses 530

---

**BSc General Program 530**

---

**BSc Honors Programs 536**

---

BSc Honors Requirements 53

---

**BSc Specialization Programs 552**

---

BSc Specialization Requirements 553

---

**BSc (Specialization in Science and Education)/BEd (Secondary) Combined Degrees Program 573**

---

**Certificates 580**

---

Certificate in Engaged Leadership and Citizenship in Arts and Science 580

Research Certificate in Science (Biological Sciences) 580

Research Certificate in Science (Psychology) 580

# The Professors

## Members of the Faculty

### Officers of the Faculty

**Dean**  
J Schaeffer, PhD, FRSC

**Vice Dean**  
JR Beamish, PhD

**Associate Deans**  
MA Armour, PhD  
D Coltman, PhD  
R Elio, PhD  
BK Leskiw, PhD  
G Loppnow PhD

**Assistant Deans**  
M Fuko, BA  
JL McClelland, MPA  
J Naylor, BA, MACT

**Administrative Professional Officers**  
C Duniece  
S Fraser, BCom  
L Hasham  
A Kirkland  
J Pascoe, BA  
K Wanchuk

**Director of Science Animal Support Services**  
T Bayans, DVM

**Distinguished University Professor**  
M Belosevic  
D Bundle  
D Hall  
W Israel  
B Jones  
A Lau  
D Page  
SG Pemberton  
N Ruttler  
J Schaeffer  
J Vederas

### Biological Sciences

**Professor and Chair**  
MW Caldwell, PhD

**Professor and Associate Chairs**  
JC Hall, PhD  
BD Lanoil, PhD  
TL Raivio, PhD

**Distinguished University Professor**  
M Belosevic, PhD, FRSC

**Professors**  
DW Ali, PhD  
Bayne, EM, PhD  
M Belosevic, PhD, FRSC  
SA Boutin, PhD, FRSC  
MS Boyce, PhD  
JC Cahill, PhD

MW Caldwell, PhD  
SD Campbell, PhD  
JP Chang, PhD  
DW Coltman, PhD  
PJ Currie, PhD, FRSC  
JJ Dennis, PhD  
AE Derocher, PhD  
KJ Devito, PhD  
ML Evenden, PhD  
WJ Gallin, PhD  
JA Gamon, PhD  
AG Good, PhD  
GG Goss, PhD

DS Hik, PhD  
MA Lewis, DPhil  
SP Leys, PhD  
J Locke, PhD  
KE Magor, PhD  
HE McDermid, PhD  
EH Merrill, PhD  
FE Nargang, PhD  
GW Owtrim, PhD  
AR Palmer, PhD  
CA Paszkowski, PhD  
DB Pilgrim, PhD  
HC Proctor, PhD  
TL Raivio, PhD  
LJ Reha-Krantz, PhD  
FAH Sperling, PhD  
CC St Clair, PhD  
VL St Louis, PhD  
LY Stein, PhD  
CM Szymanski, PhD  
GJ Taylor, PhD  
RD Vinebrooke, PhD  
AJ Waskiewicz, PhD  
DS Wishart, PhD  
GKS Wong, PhD

**Associate Professors**  
WT Allison, PhD  
D Barreda, PhD  
R Case, PhD  
JE Cooke, PhD  
MF Feldman, PhD  
JC Hall, PhD  
BA Keddie, PhD  
K King-Jones, PhD  
BD Lanoil, PhD  
BK Leskiw, PhD  
BG Magor, PhD  
DI McKenzie, PhD  
AM Murray, PhD  
E Scarpella, PhD  
MA Srayko, PhD  
JL Stafford, PhD  
CS Sullivan, PhD  
KB Tierney, PhD  
J Walter, PhD

**Assistant Professors**  
Y Boucher, PhD  
EB Koppelhus, PhD  
L Luong, PhD  
JS Manson, PhD  
KJ Mathot, PhD  
SE Tank, PhD  
RG Uhrig, PhD

**Faculty Service Officers**  
R Arseneault, PhD  
A Cornish, PhD  
CS Davis, PhD  
N Harris, PhD  
C La Farge-England, PhD  
AW Shostak, PhD

**Administrative Professional Officer**  
DM Payeur, MBA, BComm

### Chemistry

**Professor and Chair**  
RR Tykwinski, PhD

**Professors and Associate Chairs**  
A Brown, PhD  
D Hall, PhD  
MT McDermott, PhD

**Faculty Service Officer and Assistant Chair (Student Services)**  
CA McDermott, PhD

**Distinguished University Professors**  
DR Bundle, PhD, FRSC  
DG Hall, PhD  
JC Vederas, PhD, FRSC, FRS

**Professors**  
SH Bergens, PhD  
A Brown, PhD  
JM Buriak, PhD, FRSC  
RE Campbell, PhD  
DLJ Clive, PhD  
DG Hall, PhD  
DJ Harrison, PhD, FRSC  
W Jaeger, PhD, FRSC  
JS Klassen, PhD  
MA Klubukowski, PhD  
L Li, PhD  
GR Loppnow, PhD  
TL Lowary, PhD  
CA Lucy, PhD  
A Mar, PhD  
RE McCreery, PhD  
J M Stryker, PhD  
JC Vederas, PhD, FRSC  
JGC Veinot, PhD  
RR Tykwinski, PhD  
FG West, PhD  
Y Xu, PhD

**Associate Professors**  
CW Cairo, PhD  
JM Gibbs-Davis, PhD  
J Harynyuk, PhD  
MT McDermott, PhD  
E Rivard, PhD  
M Serpe, PhD

**Assistant Professors**  
R Derda, PhD  
G Hanna, PhD  
R Lundgren, PhD  
V Michaelis, PhD  
SA Styler, PhD  
FJ Williams, PhD

**Faculty Service Officers**  
N Gee, PhD  
CA McDermott, PhD  
R McDonald, PhD  
R McKay, PhD  
H Wan, PhD  
RM Whittall, PhD

**Professor Emeriti**  
DR Bundle, PhD, FRSC  
RG Cavell, PhD  
M Cowie, PhD  
HB Dunford, PhD  
GR Freeman, PhD  
RB Jordan, PhD  
AH Kalantar, PhD  
P Kebarle, PhD  
KR Kopecky, PhD  
G Kotowych, PhD  
BG Kratochvil, PhD  
JW Lown, PhD  
NO Petersen, PhD  
J Takats, PhD  
RE Wasylshen, PhD

**Administrative Professional Officer**  
KL Johnston, BSc

### Computing Science

**Professor and Chair**  
MA Nascimento, PhD

**Professors and Associate Chairs**  
C-PP Lu, PhD  
M Mueller, PhD  
J-H You, PhD

**Distinguished University Professor**  
J Schaeffer, PhD, FRSC

**Professors**  
JN Amaral, PhD  
A Basu, PhD  
P Boulanger, PhD  
M Bowling, PhD  
M Buro, PhD  
R Elio, PhD  
ES Elmallah, PhD  
RG Goebel, PhD  
R Greiner, PhD  
JJ Harms, PhD  
RB Hayward, PhD  
RC Holte, PhD  
M Jagersand, PhD  
G Kondrak, PhD  
GH Lin, PhD  
C-PP Lu, PhD  
MH MacGregor, PhD  
M Mueller, PhD  
MA Nascimento, PhD  
I Nikolaidis, PhD  
J Sander, PhD  
J Schaeffer, PhD, FRSC  
DE Schuurmans, PhD  
LK Stewart, PhD  
E Stroulia, PhD  
RS Sutton, PhD  
DA Szafron, PhD  
C Szepesvari, PhD  
DS Wishart, PhD  
H Yang, PhD  
J-H You, PhD  
L-Y Yuan, PhD  
OR Zaiane, PhD  
H Zhang, PhD

**Associate Professors**  
D Collins, PhD  
JL Kavanaugh, PhD  
**Assistant Professors**  
DS Alessi, PhD  
M Bhatia, PhD  
SJ Birchall, PhD  
L Deacon, PhD  
M Faramarzi, PhD  
L Li, PhD  
A Reyes, PhD  
M Shirgaoakar, PhD  
A Singh, PhD

**Faculty Service Officers**  
A Dey Nuttal, PhD  
SA DuFrane, PhD  
A Locock, PhD  
RJ Summers, PhD  
RA Stern, PhD  
S Woodland, PhD

**Associate Professors**  
D Barbosa, PhD  
V Bultko, PhD  
D Rafiei, PhD  
N Ray, PhD  
MR Salavatipour, PhD  
K Wong, PhD

**Assistant Professors**  
Z Friggstad, PhD  
A Hindle, PhD  
S Nadi, PhD  
O Sheffert, PhD

**Research Assistant Professors**  
K Ali, PhD

### Earth and Atmospheric Sciences

**Professor and Chair**  
ST Johnston, PhD

**Professors and Associate Chairs**  
T Chacko, PhD  
MK Gingras, PhD  
B Rivard, PhD

**Distinguished University Professors**  
B Jones, PhD, FRSC  
SG Pemberton, PhD, FRSC

**Professors**  
SK Agrawal, PhD  
CG Amrhein, PhD  
ABG Bush, PhD

MW Caldwell, PhD  
O Catuneanu, PhD  
RA Creaser, PhD, FRSC  
DG Froese, PhD  
JA Gamon, PhD  
TD Garvin, PhD  
NB Harris, PhD  
LM Heaman, PhD, FRSC  
CDK Herd, PhD  
KO Konhauser, PhD  
LR Leighton, PhD  
RW Luth, PhD  
H-G Machel, PhD  
TK McGee, PhD  
K Muehlenbachs, PhD  
PG Myers, PhD  
DG Pearson, PhD  
DK Potter, PhD  
GW Reuter, PhD  
BJ Rostron, PhD  
GA Sanchez-Azofeifa, PhD  
MJ Sharp, PhD, FRSC  
T Stachel, PhD  
BR Sutherland, PhD  
MJ Unsworth, PhD  
JWF Waldron, PhD  
JD Wilson, PhD  
JP Zonneveld, PhD

**Associate Professors**  
D Collins, PhD  
JL Kavanaugh, PhD

**Assistant Professors**  
DS Alessi, PhD  
M Bhatia, PhD  
SJ Birchall, PhD  
L Deacon, PhD  
M Faramarzi, PhD  
L Li, PhD  
A Reyes, PhD  
M Shirgaoakar, PhD  
A Singh, PhD

**Faculty Service Officers**  
A Dey Nuttal, PhD  
SA DuFrane, PhD  
A Locock, PhD  
RJ Summers, PhD  
RA Stern, PhD  
S Woodland, PhD

**Administrative Professional Officer**  
M-J Turnell, BSc, MSc, MPM

### Mathematical and Statistical Sciences

**Professor and Acting Chair**  
TJ Gannon, PhD

**Professors and Associate Chairs**  
J Kuttler, PhD  
S Lele, PhD  
V Bouchard, PhD

**Distinguished University Professor**  
AT-M Lau, PhD  
Kilian Memorial Chair  
Y Yi, PhD

**Professors**  
A Berger, PhD  
JC Bowman, PhD  
A Cadenillas, PhD  
KC Chough, PhD  
V Chernousov, PhD  
GH Cliff, PhD  
F Dai, PhD  
G de Vries, PhD  
TJ Gannon, PhD  
E Gombay, PhD  
B Han, PhD  
TJ Hillen, PhD  
R-Q Jia, PhD  
RJ Karunamuni, PhD

MA Kouritzin, PhD  
AT-M Lau, PhD  
SR Lele, PhD  
JD Lewis, PhD  
MA Lewis, DPhil Y Li, PhD  
Y Lin, PhD  
A Litvak, PhD  
A Melnikov, DSc  
PD Mineev, PhD  
I Mizera, PhD  
A Pianzola, PhD  
RA Poliquin, PhD  
V Putkaradze, PhD  
V Runde, PhD  
BA Schmuland, PhD  
M Shirvani, PhD  
GE Swaters, PhD  
V Troitsky, PhD  
DP Wiens, PhD  
AR Weiss, PhD, FRSC  
YS Wong, DPhil  
Y Yi, PhD

### Associate Professors

V Bouchard, PhD  
X Chen, PhD  
T Choulli, PhD  
CF Doran, PhD  
C Frei, PhD  
N Guay, PhD  
DV Hrimiuc, PhD  
R Krechetnikov, PhD  
J Kuttler, PhD  
G Peschke, PhD  
HJ Van Roessel, PhD  
H Wang, PhD  
V Yaskin, PhD  
X Yu, PhD

### Assistant Professors

T Creutzig, PhD  
D Favero, PhD  
B Jiang, PhD  
L Kong, PhD  
B Pass, PhD  
M Patnaik, PhD

**Faculty Service Officers**  
H Kolacz, PhD  
D McNeilly, PhD  
E Woolgar, PhD

**Administrative Professional Officer**  
RT Mikalonis, BScAg

### Physics

**Professor and Chair**  
MD Sacchi, PhD

**Professor and Associate Chairs**  
R Marchand, PhD  
RW Moore, PhD

**Associate Professor and Associate Chair**  
CO Heinke, PhD

**Distinguished University Professor of Physics**  
DN Page, PhD, FRSC  
JL Pinfold, PhD, FRSC  
Kilian Memorial Chair and Professor of Physics  
V Frolov, PhD  
Vargo Teaching Chair  
A Meldrum, PhD

**Professors**  
JR Beamish, PhD  
M Boninsegni, PhD  
KH Chow, PhD  
MR Freeman, PhD  
V Frolov, PhD  
DM Gingrich, PhD  
AL Hallin, PhD  
FA Hegmann, PhD  
JA Jung, PhD

VA Kravchinsky, PhD  
 IR Mann, PhD  
 R Marchand, PhD  
 F Marsiglio, PhD  
 A Meldrum, PhD  
 RW Moore, PhD  
 DN Page, PhD, FRSC  
 AA Penin, PhD  
 JL Pinfeld, PhD, FRSC  
 D Pogolian, PhD  
 D Potter, PhD  
 A Prus-Czarnecki, PhD  
 RW Rankin, PhD  
 W Rozmus, PhD  
 MD Sacchi, PhD  
 DR Schmitt, PhD  
 BR Sutherland, PhD  
 RD Sydora, PhD  
 JA Tuszynski, PhD  
 MJ Unsworth, PhD  
 M van der Baan, PhD  
 RA Wolkow, PhD, FRSC  
 MT Woodside, PhD

#### Associate Professors

CA Currie, PhD  
 JP Davis, PhD  
 M Dumberry, PhD  
 DR Grant, PhD  
 YJ Gu, PhD  
 M Heimpel, PhD  
 CO Heinke, PhD  
 N Ivanova, PhD  
 CB Krauss, PhD  
 SM Morsink, PhD  
 EW Rosolowsky, PhD  
 GR Sivakoff, PhD

#### Assistant Professors

RA Fernandez Munoz, PhD  
 C Kopper, PhD  
 LJ LeBlanc, PhD  
 J Maciejko, PhD

#### Faculty Service Officers

IY Isaac, PhD  
 DK Milling, PhD

#### Administrative Professional Officers

MA Henderson, BSc  
 T Mish, BCom

## Psychology

#### Professor and Chair

C Sturdy, PhD

#### Associate Professor and

##### Associate Chair

N Brown, PhD  
 PL Hurd, PhD  
 AB Singhal, PhD

#### Professors

F Colbourne, PhD  
 CT Dickson, PhD  
 RA Dixon, PhD  
 CL Gagné, PhD  
 EM Nicoladis, PhD  
 ML Spetch, PhD  
 CF Westbury, PhD  
 DR Wylie, PhD

#### Associate Professors

JB Caplan, PhD

#### Assistant Professor

KE Mathewson, PhD

#### Faculty Lecturer

KA Loepelmann, PhD

#### Faculty Service Officers

TE Johnson, PhD  
 S Ziolkowski, PhD

#### Professor Emeriti

DS Grant, PhD  
 CD Heth, PhD  
 DR Treit, PhD

#### Administrative Professional

##### Officer

J Boulter

## Additional Members of Faculty Council

#### President and Vice- Chancellor

D Turpin, CM, LLD, FRSC

#### Vice-Provost & University

##### Registrar

LM Collins

#### Full-time Sessional Staff

within the Faculty of Science

One representative from the  
 Faculties of Agricultural, Life  
 and Environmental Sciences,  
 Arts, Business, Education,  
 Engineering, Faculté  
 Saint-Jean, Medicine and  
 Dentistry, Nursing, Pharmacy  
 and Pharmaceutical Sciences,  
 Physical Education and  
 Recreation

One representative from  
 the departments of  
 Biochemistry, Pharmacology  
 and Physiology

One representative from  
 the Division of Computer  
 Engineering

One representative from the  
 Alumni Association

One representative from the  
 Association of Professional  
 Engineering, Geologists and  
 Geophysicists of Alberta

Two Graduate Students from  
 the Faculty of Science

Twelve Undergraduate  
 Students from the Faculty  
 of Science

# Faculty Regulations

## Faculty Overview

The Faculty of Science offers degrees in Applied Mathematics, Atmospheric Sciences, Astrophysics, Biochemistry, Biological Sciences (Animal Biology, Ecology, Evolutionary Biology, Microbiology, Molecular Genetics, Physiology and Developmental Biology, Plant Biology), Chemistry, Cell Biology, Computing Science, Computing Science with Business Minor, Environmental Earth Sciences, Geology, Geophysics, Immunology and Infection, Mathematical Physics, Mathematics, Mathematics (Computational Science) Mathematics and Economics, Mathematics and Finance, Neuroscience, Paleontology, Pharmacology, Physics, Physiology, Psychology, and Statistics.

A Business Minor, an Arts Minor and an Agricultural, Life and Environmental Sciences minor are available in the BSc General program.

A Science Internship Program (SIP) is available to Faculty of Science BSc students to enhance their studies and provide relevant work experience. Students must complete an 8-, 12- or 16- month work experience term at the end of their third year to receive SIP designation on their degree parchment. For more details, please see Science Internship Program..

## Degrees

The Faculty offers three programs leading to the Bachelor of Science (BSc) degree: Honors, Specialization, and General.

The Faculty also offers a Bachelor of Science with Specialization in Science Education which is part of a five year BSc/BEEd combined degrees program.

The four-year Honors programs are primarily for students who seek careers in scientific research. In addition, they prepare students for admission to graduate school, leading to a Master of Science (MSc) or a Doctor of Philosophy (PhD) degree.

The four-year Specialization programs do not concentrate on one subject to the same extent as the Honors programs. This allows students to choose from a broader range of courses and to take a greater number of courses in a secondary area of interest. They can provide the background necessary for admission to graduate schools, in some cases, and permit attainment of professional status in others.

The four-year General program provides a general education with a scientific emphasis for students who seek careers in business, teaching, medicine, dentistry, etc.

In many cases, transfer from one degree program to another can be easily arranged to suit students' changing ambitions, needs, or academic qualifications.

Regulations governing the Honors, Specialization, and General degree programs are found in Programs, followed by descriptions of each degree program under the subject headings.

## Admission

General admission requirements for the University are set out in Admission to Undergraduate Programs and General Admission Requirements. Specific admission information for the Faculty of Science is detailed in Faculty of Science.

## Definitions

The following terms, definitions, and abbreviations are used throughout this section of the Calendar. Also see the Calendar's Glossary.

### 1. Approved Option

In the Faculty of Science section, the term "approved option" appears only within the description of Honors and Specialization programs. For students registered in an Honors or Specialization BSc program, an "approved option" is a course (from Arts, Science, or another Faculty) approved in writing by the department directing the student's program.

General program students interested in taking courses from Faculties other than Arts or Science should see Selection of Courses.

### 2. Arts Option

Those courses offered by the Faculty of Arts for which the student is eligible, Christian Theology courses and Native Studies courses listed in Course

Listings. Note: Students registered in the Faculty of Science may not take SOC 210, SOC 315 for degree credit.

### 3. Courses Attempted

Refers to university or university transfer courses completed with a final grade and excludes courses from which a student has withdrawn with permission.

### 4. Courses Successfully Completed

Refers to university courses with a final grade of D or higher.

### 5. Course Weight

A unit of course weight indicates the instructional credit assigned to a course and is designated by the ★ symbol after the course number and name. Units of course weight form a part of the degree requirements and are also used to calculate a student's Grade Point Average (GPA).

### 6. Fall/Winter

The instructional period of September to April.

### 7. Two-term Course

A two-term course is a single course worth ★6.

### 8. Term

The instructional periods from September to December (Fall) and January to April (Winter). In Spring/Summer, the instructional periods of May/June (Spring) and July/August (Summer).

### 9. Single-term Course

A single-term course is a single course worth ★3.

### 10. Junior Courses

Those courses numbered 199 or lower.

### 11. Normal Course Load

A normal, full academic course load is ★30 during Fall/Winter.

### 12. Option

The term "option" where it appears in programs means a course chosen by the student from offerings by the Faculties of Arts or Science if the necessary prerequisites have been met.

### 13. Science Option

Those courses offered by the Faculty of Science for which the student is eligible. Note: Not all courses offered by the Faculty of Science are available to students registered in the Faculty of Science.

### 14. Spring/Summer

The instructional periods of May/June (Spring Term) and July/August (Summer Term).

### 15. Year of Program

Year of program, as referred to throughout the Science section, is defined below. Students who are applying to, or continuing in, the Faculty of Science are considered to be in

- Year 1 if they have successfully completed up to ★29 of their degree program;
- Year 2 if they have successfully completed between ★30 and ★59 of their degree program;
- Year 3 if they have successfully completed between ★60 and ★89 of their degree program;
- Year 4 if they have successfully completed at least ★90 of their degree program.

## Academic Standing

- Academic standing is used to determine the eligibility of students to continue or graduate from their programs. The academic standing of all students in the Faculty of Science is assessed annually on the basis of the Grade Point Average (GPA) calculated on all coursework attempted in the Fall/Winter. Spring and Summer work is not included. The assessment of students in BSc Specialization and BSc Honors programs also takes into consideration the minimum course load requirements of the particular program, as well as any specific grade or GPA requirements.

For students in the BSc General program, the Faculty may defer the assessment of academic standing for one Fall/Winter for students who attempt less than ★9. In such cases, the academic standing assigned at the last assessment remains in effect until the conclusion of the next Fall/Winter..

### 2. Academic Standing Assessment

- First Class Standing**, also referred to as the Dean's Honor Roll, is assigned to students who successfully complete at least ★24 and achieve a minimum 3.5 GPA. First class standing is also assigned to students who, as a result of participation in Education Abroad or SIP Work Experience, attend only one term of a Fall/Winter and successfully complete at least ★12 with a minimum 3.5 GPA.

- a. **Satisfactory Standing** is assigned to students in the BSc General program who achieve a minimum GPA of 2.0. Satisfactory standing is assigned to students in BSc Specialization and BSc Honors programs who meet the minimum continuation requirements for their program, including Fall/Winter GPA, course load and any course specific grade or GPA requirements. (Refer to the specific sections covering each BSc Specialization and BSc Honors program in BSc Specialization Programs to BSc Honors Programs)  
Students in satisfactory standing may continue in, and when requirements met, graduate from, their programs.
- b. **Marginal Standing** is assigned to students with a GPA between 1.7 and 1.9 on a minimum ★9 attempted. Students meeting these criteria who do not have in their postsecondary education a prior requirement to withdraw, an academic warning, a probation period or their equivalents may be permitted to continue on academic warning in the BSc General program. Students in BSc Honors and BSc Specialization programs who meet the criteria for marginal standing may not continue in their current programs, but must apply to transfer to the BSc General program in order to continue on academic warning.  
To clear academic warning and return to satisfactory standing, students must attend the subsequent Fall/Winter and must obtain a minimum 2.0 GPA. Students who fail academic warning are required to withdraw. Students who have been placed on academic warning and wish to interrupt their studies must obtain the written permission of the Associate Dean, Undergraduate prior to August 15 of the year in which marginal standing was assigned. Students who interrupt their studies without permission will need to requalify in order to be considered for future readmission (see Requalify).  
Academic warning may be offered once only. To remain in satisfactory standing students must maintain a minimum 2.0 GPA in all subsequent Fall/Winters. Students with a GPA below 2.0 and who have in their postsecondary education a prior requirement to withdraw, an academic warning, a probation period or their equivalents are required to withdraw. Academic warning is not offered to Special Students or to students in BSc Specialization and Honors After Degree programs who are upgrading a previous degree with a major in the same discipline. Students in these programs with marginal standing will be required to withdraw.
- c. **Unsatisfactory Standing** is assigned to students whose GPA on a minimum ★9 is below 1.7. It is also assigned to students with a GPA below 2.0 who have in their postsecondary education a prior requirement to withdraw, an academic warning, a probation period or their equivalents. Students with unsatisfactory standing are required to withdraw.  
Students with two or more prior requirements to withdraw or equivalents are not eligible to continue in the Faculty of Science and do not have the option to appeal.
3. **Requirement to Withdraw and Readmission**  
Students who are required to withdraw cannot continue or register in subsequent terms beyond Spring. If they wish to continue studies in the Faculty of Science, they must choose one of the following mutually exclusive options. Admission to the Faculty of Science is competitive. The number of readmissions to the Faculty is limited. Presentation of the minimum admissions requirements does not assure admission.
- a. **Fresh Start Program:** is available by recommendation of the Faculty to students whose GPA is between 1.3 and 1.6 and have taken less than ★60 of postsecondary work. Students who been on probation or have more than one requirement to withdraw or their equivalents, or who have been sanctioned for any academic-related disciplinary offence at this University or elsewhere are not eligible for the Fresh Start program. A minimum of ★18 with a minimum GPA of 2.7 or a minimum of ★24 with a minimum GPA of 2.0 must be successfully completed in the Fresh Start program to be considered for readmission to the Faculty of Science. The Faculty may also specify course requirements to be fulfilled. Students who successfully complete the Fresh Start program may apply for readmission as transfer students (see Postsecondary Transfer Students).
- b. **Discontinue Studies and Apply for Fall Readmission:** Students in the Faculty of Science **who are being required to withdraw for the first time** in their academic record may elect to discontinue studies for a minimum period of one year and then apply for Fall readmission. Should any coursework be attempted at any institution during this period, the grades may be taken into consideration for readmission purposes, but transfer credit will not be granted.  
Students in the Faculty of Science who have failed probation or been twice required to withdraw or equivalent by Faculty of Science standards may discontinue their studies for a period of five years from the date of

last attendance and seek consideration for Fall readmission by writing a letter of petition to the Associate Dean, Undergraduate. Readmission, if offered, will be on probation, subject to conditions specified by the Associate Dean, Undergraduate.

Students who have been required to withdraw three times or equivalent are ineligible for readmission to the Faculty of Science..

- c. **Requalify:** Students **who are being required to withdraw for the first time** in their academic record may elect to requalify by successfully completing at another postsecondary institution:
- ★18 of postsecondary courses transferable to the University of Alberta with a minimum GPA of 2.7, or
  - ★24 of postsecondary courses transferable to the University of Alberta with the minimum competitive GPA.
4. **Probation** Probation is granted to Faculty of Science students who are required to withdraw and successfully appeal or to Faculty of Science students who are readmitted after studies were discontinued for academic reasons. Probation is completed in the BSc General program. When placed on probation, a student must fulfill specific conditions specified by the Associate Dean, Undergraduate at the time of readmission. To clear probation and return to satisfactory standing, students must normally successfully complete a minimum of ★24 during the Fall/Winter, obtain a minimum 2.0 GPA, and successfully fulfill all other conditions of the probation. Students who fail to satisfy any of the conditions fail Probation, and are required to withdraw without the option of appeal. Students who fail a second period on probation are ineligible for readmission to the Faculty of Science.

## Scholarship, First-Class Standing

1. **Scholarship**  
The basis for scholarship consideration is passing grades in all courses on load of at least ★30.
2. **First-Class Standing**  
First-class standing in a given Fall/Winter is awarded to any student who obtains a GPA of not less than 3.5 and successfully completes a minimum of ★24 during that Fall/Winter. Students who attend only one term of Fall/Winter as a result of enrolment in ABROD, EXCH or WKEX are eligible if they successfully complete at least ★12 with a minimum GPA of 3.5. This is also referred to as the Dean's Honor Roll.

## Graduation Year

Students who have completed ★120 or more and who have either not applied to graduate, or who have applied but have not met graduation requirements, are permitted to register only in those courses necessary to complete their current program as quickly as possible. Such students must have the written approval of the Associate Dean of Science for every course beyond ★120 in which they register. Students in Honors or Specialization programs must also have the written approval of their Departmental Advisor.

## Reexamination

Reexaminations are not normally permitted in the Faculty of Science. Students registered in the Faculty of Science wishing to be considered for a reexamination must, in addition to meeting the requirements set out in Reexaminations, also meet the following conditions:

1. Students must provide evidence of a medical condition or similarly compelling circumstance existing at the time of the writing of the final examination; and
2. provide evidence that the student's performance in the final examination was so affected by circumstances as shown in (1) that there was a substantial difference between the final examination results and the term work; and
3. excluding the final exam, must have completed at least one-half of the term work.

**Note:** Registrants in BSc degree programs in the Faculty of Science who fail to meet the graduation requirements may be granted a reexamination in one passed or failed Science course taken in the final Fall/Winter or Spring/Summer (last ★30 or less) provided the maximum number of reexaminations (★12) has not been previously taken. Such courses must qualify for reexamination, according to Reexaminations.

## Courses

### 1. Selection of Courses

Students are responsible for familiarizing themselves with program requirements and limitations as specified in the Calendar, for ensuring their programs are properly planned in accordance with degree specifications, and for the completeness and accuracy of their registration. Please read the Calendar carefully before registering in courses, and if you are in doubt about any regulations pertaining to your program, consult the Faculty of Science Office (1-001 CCIS) for clarification.

Students registered in the Faculty of Science must complete Science courses and Arts courses as specified by their program. Students may also take courses from other Faculties, but must adhere to the program-imposed limits for such Outside options. Note: Anatomy courses are offered by the Faculty of Medicine and are considered Outside options. Written approval from the Faculty of Science is required if more than ★30 are taken in a Fall/Winter, except in those Honors and Specialization programs requiring more than ★30 in a given year.

### 2. Selection of First-Year Courses

Beginning first-year students who have completed no credits toward their programs normally restrict their registration to junior courses. First year students contemplating taking senior level courses should be careful to ensure that they have completed any prerequisites.

### 3. Withdrawal from Courses

Courses from which the student withdraws up to and including the last day for registration in the Fall and Winter Terms will not appear on the student's record. Courses from which the student withdraws after the last day of registration and up to the withdrawal deadline will appear with a grade of "W" (Withdrew with permission) on the transcript.

Deadlines for withdrawing from courses are listed in Academic Schedule.

### 4. Prerequisites

Courses with prerequisites may only be used for degree credit if the prerequisite requirements are met.

A grade of D is the minimum grade acceptable in a course which is to be used as a prerequisite.

Where a prerequisite is stated, it is understood that equivalent courses may be used to satisfy the requirement. In addition, the department offering a course with prerequisite requirements may waive the prerequisite in writing. (Prerequisite waiver forms are available from the Faculty of Science office and the Department offices).

Students who are unsure if they meet the prerequisite requirements in a course, or who wish to obtain permission to have a prerequisite waived, should consult the department offering the course.

### 5. Repeating Courses

No student will be permitted to repeat any University course, whether a failed course or a course having a grade of W, more than once except for reasons deemed sufficient by the Council of the Faculty in which the student is enrolled. For Science students, the Faculty will withhold credit or indicate the course is extra to degree on any course that contravenes this regulation. Normally, a student will not be permitted to repeat a course in which a grade of D or more has been received.

Only two exceptions are permitted, and each requires written approval of the Dean or designee:

- When a higher grade is necessary for a course that is required in one of the degree programs
- When a student in Satisfactory Standing in the last year of a degree program repeats one course to raise the GPA to the level required by the degree program

A student who repeats a course in which a grade of D or more has been received, without written permission of the Faculty of Science, will have the grade attained on the initial passing of the course used for the purpose of meeting degree requirements, and no credit will be assigned to the repeated course.

admission, continuation, residency and graduation criteria for that BSc program..

### 2. Degree Requirements

All BSc Degrees require a minimum of ★120. Courses with weights of ★0 are offered for credit only, and, although they may be required in specific degree programs, cannot be used to meet the minimum units of course weight requirement in any degree program..

### 3. Convocation

All requirements for graduation at Spring Convocation must be met by the end of Fall/Winter. Those completing degree requirements during Spring/Summer will graduate at the Fall Convocation.

### 4. First-Class Honors

First-class Honors Degrees are awarded to any student in an Honors program who obtained:

- A GPA of at least 3.5 on a minimum of ★24 in each of the last two Fall/Winters of the program;  
and
- A GPA of at least 3.5 on the last ★60 of the program. If determination of the last ★60 requires consideration of one or more courses from a given term then all work from that term is included in the calculation for the purposes of qualifying for First-class Honors. Normally, only UofA courses will be used in the calculation of the GPA for the last ★60 of the program..

### 5. With Distinction

The notation "With Distinction" is inscribed on the parchment of a candidate for a General or Specialization degree if the candidate has obtained a GPA of not less than 3.5 over the last ★60 and if the student successfully completed ★24 or more in each of the last two Fall/Winters. If determination of the last ★60 requires consideration of one or more courses from a given term then all work from that term is included in the calculation for the purposes of qualifying for With Distinction. Normally, only UofA courses will be used in the calculation of the GPA for the last ★60 of the program. Further regulations regarding academic standing, promotion, and graduation vary from program to program within the Faculty of Science, and are therefore given in Programs below. Regulations for Honors, Specialization, and General programs are found in Faculty of Science.

## Appeals and Grievances

A copy of Faculty of Science regulations regarding appeals on grades, academic standing and practicum intervention may be obtained from the Faculty of Science Student Services Office (1-001 CCIS) and on the Faculty of Science website. Certain academic standing decisions made by the Faculty Academic Appeals Committee may be appealed to the General Faculties Council Academic Appeals Committee. Appeals of decisions made by the Faculty Practice Review Committee may be appealed to the General Faculties Council Practice Review Board. See Appeals and Grievances.

Note: Deadlines exist for submission of appeals and are described in the appeals policy document.

## Visiting Student Status

Permission to attend another institution as a Visiting Student depends on the student remaining in good academic standing in the Faculty of Science at the University of Alberta.

A student while registered in the Faculty of Science cannot attend two postsecondary institutions at the same time and will not receive permission to register as a Visiting Student at another institution if the equivalent course is given on campus in the same term, except in the case of formal exchange programs. Transfer credits will not be awarded if a student attends another postsecondary institution without first obtaining a current Letter of Permission from the Faculty of Science.

## Study Abroad

The Faculty of Science encourages all full-time students who have completed at least ★15 credits at the University of Alberta, who are in satisfactory standing in their program with a CGPA of at least 2.5 and have a GPA of at least 2.7 in their most recently completed term, to consider a period of study abroad. This program is administered by University of Alberta International and details of this competitive program can be found on their website [www.international.ualberta.ca/studyabroad](http://www.international.ualberta.ca/studyabroad).

Where possible, credit for courses successfully completed in study abroad programs will be granted transfer credit by the Faculty of Science. However, there may be courses required in a program where there is no substitute

## Graduation

### 1. Application for Graduation

Students must be in satisfactory standing in their program (i.e., meet the continuation requirements in their final Fall/Winter) in order to graduate. Students who intend to receive a BSc (General, Specialization, or Honors) Degree must apply for the Degree on Bear Tracks (<https://www.beartracks.ualberta.ca>) by February 1 for Spring Convocation or by September 1 for Fall Convocation. All official transcripts from other postsecondary institutions are due by May 1 for Spring Convocation or by October 1 for Fall Convocation. Students who intend to apply for admission to an alternate degree program in the Faculty of Science for convocation purposes only must meet all of the

available elsewhere. Thus a period of study abroad may extend the time required to complete a BSc degree. Science students should maintain satisfactory standing during study abroad however they will not be held to the course load and GPA expectations of their individual programs. The thesis-based independent research project required in many honors programs must be completed at the University of Alberta.

## Science Internship Program

The Science Internship Program (SIP) offers science undergraduate students work experience opportunities in addition to their academic courses.

To be eligible to register in this program a student must:

1. Have successfully completed a minimum of ★48, and not more than ★105, of a Science General, Honors or Specialization degree program with a declared major.
2. Be in good standing and have a minimum 2.3 GPA in the previous Fall/Winter Terms.

Students accepted into the program will receive access to approved position descriptions from employers wishing to hire SIP students. Employers are responsible for interviewing and selecting students for the positions. The internship may begin in May, September or January and must be of at least 8 months duration, but may extend to up to 16 months.

Students are limited to one 8 (may consist of two separate 4 month placements), 12 (continuous) or 16 (continuous) month internship placement during their undergraduate degree. Work during the internship period is full time, for which the student is paid by the employer at competitive rates. The student, employer and the Faculty must agree to terms of the internship. During the period of the internship, the student registers in a work experience (WKEXP) course each term and is considered a full-time student at the University of Alberta. All students must register in a minimum of two WKEXP courses that have associated fees.

To successfully complete the SIP, students must complete a minimum of eight months of the following WKEXP courses: WKEXP 955, WKEXP 956, WKEXP 957 and WKEXP 958 and complete INT D 400. An eight month placement may be comprised of two four month placements. Students who have completed one four month WKEXP and are not able to secure a second will receive acknowledgment of one WKEXP course on their transcript but will not receive the SIP designation and are not eligible to take INT D 400. The ultimate responsibility for securing work rests with the student and there is no guarantee that all qualified students will be placed.

Work experience courses are assigned no units of course weight and are graded credit/no credit. Grades are determined by the student's job performance as evaluated by the employer, and/or by the successful completion of assignments as assigned by the Faculty or designate.

The Science Internship Program Coordinator maintains contact at approximately four-month intervals with the student and the person designated by the employer to be responsible for the student's progress. During this time if the student's performance is not satisfactory as evaluated by the employer, the internship may be terminated and the student would then return to classes at the next available opportunity. Following completion of the work experience students return to the university to complete their degree program of studies.

Students should be aware that under the Protection for Persons in Care Act, all new employees, volunteers and other people engaged for services by designated agencies (hospitals, nursing homes, lodges, group homes, etc.) must complete a Police Information Check (also known as a Criminal Record Check, Security Clearance Check, or Police Clearance), which must include a Vulnerable Sector Check. In addition, certain other agencies, organizations, and educational facilities may require students to present a Police Information Check prior to entering a practicum, work placement term, internship, or field experience placement. Students who have concerns related to their ability to provide a clear Police Information Check should consult with the Associate Dean, Undergraduate. Students will be informed of the need for a Police Information Check prior to specific practicum (field experience) placement. See Requirement for Police Information Checks for more information on the general requirements concerning Police Information Checks and the fees associated with them.

Detailed information about the Science Internship Program is available at [uab.ca/ScienceInternship](http://uab.ca/ScienceInternship).

# General Information

## Certificates

The Faculty of Science offers certificates to graduating students which formally acknowledge that students have studied particular themes. These themes can be concentrations within a discipline, or subjects that cross interdisciplinary boundaries.

Normally the requirements for the certificates can be completed as part of the requirements for the degree; however, in some cases, a student may need to take more than the minimum required for their degree program in order to qualify for both the degree and the certificate. The following certificates are available:

### Research Certificate in Science (Biological Sciences)

A Research Certificate in Science will provide an opportunity for undergraduate students to engage in authentic research in their discipline and acquire skills beyond what a normal research experience in an Honors or Specialization program may allow.

#### Research Certificate in Science (Biological Sciences)

A Research Certificate in Science (Biological Sciences) will provide an opportunity for undergraduate students to engage in authentic and focused research.

This certificate is open to undergraduate students in the Faculty of Science with preference given to BSc Honors and Specialization students in the Department of Biological Sciences and BSc General students (Biological Sciences major). Consent of the Department of Biological Sciences is required. Normally, a student will be able to fulfill the requirements for this certificate as part of a BSc program; some students may need to complete more than the minimum number of credits required in order to qualify for both the degree and the certificate.

Students wishing to pursue the Research Certificate in Science (Biological Sciences) must apply through the Department of Biological Sciences Student Services Office (BS CW-312) for acceptance into BIOL 298. Application for this course does not guarantee a position in this program or the awarding of a certificate.

Students may pursue the Research Certificate in Science (Biological Sciences) by fulfilling the existing requirements for their program and by completing ★21 as follows:

- BIOL 298 - Understanding Biological Research

#### ★6 from

- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 498 - Research Project
- BIOL 499 - Research Project
- MA SC 400
- MA SC 403 - Directed Studies in Marine Science
- ★3 from a list of 300- and 400-level approved options in data handling courses in Biological Sciences
- ★3 from a list of 300- and 400-level approved options in practical skills and techniques courses in Biological Sciences Presentation at a conference either on or off campus

**Note:** Students wishing to receive the Research Certificate in Science (Biological Sciences) must apply through Undergraduate Student Services in the Faculty of Science by the application deadline for convocation (see Academic Schedule). MA SC Courses are offered at the Bamfield Marine Sciences Centre. Research Certificate in Science (Psychology)

### Research Certificate in Science (Psychology)

A Research Certificate in Science (Psychology) will provide an opportunity for students to engage in authentic and focused research while pursuing their program.

Normally a student will be able to fulfill the requirements for this certificate as part of their degree; some students may need to complete more than the minimum number of credits required in order to qualify for both the degree and the certificate.

**Students may pursue the Research Certificate in Science (Psychology) by fulfilling the existing requirements for their program and by completing ★21 as follows:**

**★3 in 200- or 300-level research class:**

- PSYCO 299 - Research Opportunity Program in Psychology
- PSYCO 300 - Honors Seminar I
- PSYCO 309 - Honors Seminar I
- PSYCO 396
- PSYCO 398 - Individual Study I

**★9 in 300- or 400-level research class:**

- PSYCO 390 - Honors Thesis I: Research Apprenticeship
- PSYCO 396
- PSYCO 398 - Individual Study I
- PSYCO 399 - Honors Thesis I: Research Apprenticeship
- PSYCO 400 - Honors Seminar II
- PSYCO 409 - Honors Seminar II
- PSYCO 490 - Honors Thesis II: Thesis Research
- PSYCO 496 - Individual Research
- PSYCO 498 - Individual Study II
- PSYCO 499 - Honors Thesis II: Thesis Research

**★9 in**

- PSYCO 212 - Introduction to Research Methods in Psychology
- STAT 252 - Introduction to Applied Statistics II

**and a 300 or 400-level PSYCO methods class**

- PSYCO 356 - Research Methods in Cognition
- PSYCO 411 - Cooperative Program Practicum
- PSYCO 413 - Design and Analysis of Experiments in Psychology
- PSYCO 415 - Qualitative Methods in Sociocultural Psychology
- PSYCO 431 - Theory and Practice of Psychometrics
- PSYCO 471 - Neurophysiology: Theory, Methods, and Analysis
- PSYCO 476
- PSYCO 482
- or other advanced research methods course approved by the Honors Advisor

**Presentation**

- Presentation at a conference either on or off campus

**Certificate in Computer Game Development:**

The Certificate in Computer Game Development is a joint certificate offered by the Faculties of Arts and Science and is open to any undergraduate student at the University of Alberta. The certificate complements discipline-specific studies with courses that provide opportunities to work in multidisciplinary teams, build complete small and medium-scale games, and interact with industry.

Details of the courses and other requirements for the certificate can be found in Certificate in Computer Game Development of the University Calendar in the Faculty of Arts Programs.

**Certificate in Engaged Leadership and Citizenship in Arts and Science**

The Certificate in Engaged Leadership and Citizenship in Arts and Science is a joint certificate offered by the Faculties of Arts and Science and is open to any undergraduate student at the University of Alberta.

Students wishing to pursue the Certificate in Engaged Leadership and Citizenship in Arts and Science must apply through Undergraduate Student Services in the Faculty of Arts or through Undergraduate Student Services in the Faculty of Science by the application deadline for convocation (see Academic Schedule).

Details of the courses and other requirements for the certificate can be found in Certificate in Engaged Leadership and Citizenship in Arts and Science of the University Calendar in the Faculty of Arts Programs.

**Geophysics**

The Department of Physics offers two programs dealing with solid earth physics. The Honors in Geophysics program (see Honors in Geophysics) prepares students for graduate work in geophysics. The Specialization in Geophysics program prepares students with the conceptual and laboratory background required for employment at the BSc level in industry, government and technical

schools. Also see Physics Honors Programs and Physics Specialization Programs (Physics).

**Professional Association**

The practice of geophysics in Alberta is regulated by the Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA).

The right to practise geophysics in Alberta and accept professional responsibility for such work as well as the right to use the geophysicist title is limited to those registered with APEGGA.

Members of the Geophysics Student Society are automatically student members of APEGGA. Graduates are encouraged to join APEGGA as Geophysicists-in-training. Acceptable experience following graduation is necessary for registration as a Professional Geophysicist, the APEGGA membership category which confers the right to accept responsibility for geophysical work. Contact the APEGGA office for more information.

**Marine Science**

Excellent opportunities for the study of marine biology and related subjects exist at Bamfield Marine Sciences Centre (BMSC) on Vancouver Island, BC. An academic program operates at the station, with summer and fall programs providing credit toward degrees in Science.

Prerequisite for all the MA SC courses is consent of the Department of Biological Sciences.

Students are expected to take a full course load of ★15 during the Fall Term. Courses run Monday to Saturday.

In addition to tuition paid to the University there are room and board fees payable to BMSC. Information concerning course prerequisites and application procedures for Marine Science may be obtained from BMSC, the Department of Biological Sciences or the Office of the Dean of Science. Permission to register in these courses is available from the University Programs Coordinator of the Bamfield Marine Sciences Centre, to whom application should be made. See BMSC website [www.bamfieldmsc.com](http://www.bamfieldmsc.com).

See Course Listings for descriptions of available Marine Science courses.

See also BMSC website [www.bamfieldmsc.com](http://www.bamfieldmsc.com) for courses offered in the current year.

**Northern Studies**

Students interested in Canada's North and especially those planning a career in northern Canada should include within their curriculum some of the following: ANTHR 246, 340, 355, 445, and 446; BIOL 366; CANST 302 and 408; EAS 453 and 455; ENCS 201; INT D 443; POL S 432. These courses may be taken within the framework of existing General, Specialization, or Honors programs in the Faculty of Science. Students interested in Northern Studies should mention this to their faculty advisor.

**Professional Registration**

Graduates of EAS programs may qualify for registration as professional geologists (P. Geol.). The practice of geology in Alberta is governed by provincial law in the interest of public protection against unskilled practice. The right to practice independently (meaning that you are legally able to accept responsibility for your work and sign for it), and the right to use the title of professional geologist (P. Geol.), are restricted to individuals registered by the Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA). Members of the PS Warren student society are automatically student members of APEGGA and as such are introduced to the professional association.

Individuals who are planning to meet the knowledge requirements for P. Geol. while also completing their degree at the University of Alberta should plan their program course selection carefully. Attention is drawn in particular to the science subject requirements, additional to calculus, physics and chemistry. APEGGA verifies that specific knowledge requirements are met, by reviewing academic credentials course-by-course. Holders of degrees that do not cover the APEGGA syllabus may be assessed examinations in missing subjects by the APEGGA Board of Examiners before being accepted for registration. Current syllabus and registration information is available at the Departmental Office or from APEGGA. Full information is available at [www.apegga.com/](http://www.apegga.com/)

Specific questions about programs of study or individual courses applicable to professional registration can also be directed to the Departmental APEGGA Liaison.



## Science After Degrees

1. An individual holding one or more undergraduate degrees from recognized postsecondary institutions may earn an additional undergraduate degree (After Degree) from the Faculty of Science. The After Degree may be a BSc General Program, a BSc Specialization Programs or a BSc Honors Programs. The BSc Specialization in Science and Education degree is not available as an After Degree. There may be a limit on the number of After Degree students admitted each year because the Faculty of Science is under enrolment management. Admission priority will be given to students applying for their first after degree from the Faculty of Science.
2. Note: For success in your chosen program, ensure you have satisfied the pre/corequisite requirements for all courses. Departments have the right to remove students from courses for failing to present a passing grade (or higher, where stipulated) in the prerequisite course(s) and/or for failing to be enrolled in the corequisite course(s). Please see [www.uofa.ualberta.ca/science/programs/undergraduate/admission-to-science](http://www.uofa.ualberta.ca/science/programs/undergraduate/admission-to-science) for more information.
3. All of the admission, program, academic standing and graduation standards that apply to a regular degree also apply to After Degree programs, except as noted in Graduation Year. Admission to a BSc Specialization or BSc Honors After Degree program requires the approval of the appropriate Department and the Faculty office. Please refer to Faculty of Science for program admission requirements in the Faculty of Science.
4. An After Degree may not duplicate the degree(s) previously completed. The major or minor of a BSc General After Degree may not be the same as the major or minor of the previous degree(s). The only exception is that students who wish to upgrade a previous Science minor to be the major in the After Degree may do so provided their new minor does not overlap with either the major or minor of the previous degree(s). In the case of BSc Specialization and BSc Honors programs, the area of concentration may not be the same as that of the previous degree(s). However, qualified students holding a BSc General degree from this institution or its equivalent from another institution may use the After Degree to upgrade their previous major to a BSc Specialization or BSc Honors program.
5. If applying to a BSc General After Degree program, a major and a minor must be declared upon application.
6. All students in After Degree programs must follow the program to which they have been admitted and must demonstrate progress towards completion of the degree in each Fall/Winter (see Graduation Year).
7. To complete an After Degree, a minimum ★30 will be required if the student holds a BSc degree from the Faculty of Science at the University of Alberta, and a minimum of ★60 will be required if the student holds an undergraduate degree from another Faculty or University. The actual number of credits required to complete an After Degree is dependent on the coursework that was completed prior to the After Degree program and will be determined at the time of admission.
8. In a BSc General After Degree program, students with a previous BSc General degree from the Faculty of Science at the University of Alberta must complete a minimum of ★9 senior units in their major and a minimum of ★6 senior units in their minor while registered in the After Degree program. Students holding a degree from outside the Faculty of Science at the University of Alberta must complete a minimum of ★18 senior units in their major and a minimum of ★12 senior units in their minor while registered in the After Degree program.
9. In a BSc Specialization or BSc Honors After Degree program, students with a previous undergraduate degree from the Faculty of Science at the University of Alberta must complete a minimum of ★15 senior units in the area of concentration of the new degree while registered in the After Degree program. Students holding a degree from outside the Faculty of Science at the University of Alberta must complete a minimum of ★24 in the area of concentration of the new degree while registered in the After Degree program.

## Details of Courses

### Course Listings

Science courses can be found in Course Listings, under the following subject headings:

Astronomy (ASTRO)  
 Biochemistry (taught by the Faculty of Medicine and Dentistry) (BIOCH)  
 Biochimie (BIOCM) (Faculté Saint-Jean)  
 Biological Science - Biology (BIOL)  
 Biological Science - Botany (BOT)  
 Biological Science - Entomology (ENT)  
 Biological Science - Genetics (GENET)  
 Biological Science - Microbiology (MICRB)  
 Biological Science - Zoology (ZOOZ)  
 Biologie (BIOLE) (Faculté Saint-Jean)  
 Cell Biology (taught by the Faculty of Medicine and Dentistry) (CELL)  
 Chemistry (CHEM)  
 Chimie (CHIM) (Faculté Saint-Jean)  
 Computing Science (CMPUT)  
 Earth and Atmospheric Sciences [formerly Geography and Geology (EAS)]  
 Environmental Physical Sciences (ENVPS)  
 Geophysics (GEOPH)  
 Immunology and Infection (IMIN)  
 Interdisciplinary Courses offered by the Faculty of Science (INT D)  
 Laboratory Animal Management (LB AN)  
 Marine Science (MA SC)  
 Mathematical Physics (MA PH)  
 Mathematics (MATH)  
 Mathématiques (MATHQ) (Faculté Saint-Jean)  
 Neuroscience (taught by the Faculty of Medicine and Dentistry) (NEURO)  
 Paleontology (PALEO)  
 Pharmacology (taught by the Faculty of Medicine and Dentistry) (PMCOL)  
 Physiology (taught by the Faculty of Medicine and Dentistry) (PHYSL)  
 Physics (PHYS)  
 Physique (PHYSQ) (Faculté Saint-Jean)  
 Psychology (PSYCO)  
 Science (SCI)  
 Sciences de la Terre et de l'atmosphère (SCTA) (Faculté Saint-Jean)  
 Statistics (STAT)  
 Statistique (STATQ) (Faculté Saint-Jean)

### Prerequisites

Where a prerequisite is stated in a course description, it is understood that equivalent courses may satisfy the requirement. Also, the department offering a course with prerequisite requirements may waive the prerequisite in writing. (Prerequisite waiver forms are available from the Faculty of Science office and the Department offices.)

### Course Exceptions

#### Biochemistry Courses

All BIOCH courses can be used by students in the Faculty of Science as science courses.

#### Cell Biology Courses

All CELL courses can be used by students in the Faculty of Science as science courses.

#### Food Science Courses

NU FS 363 may be used by students in the Faculty of Science as a science course in Microbiology.

#### Human Geography/Planning Courses

HGP 470 may be used by students in the Faculty of Science as a science course.

### Medical Microbiology Courses

All MMI courses, with the exception of MMI 133, may be used by students in the Faculty of Science as science courses.

### Neuroscience Courses

All NEURO courses may be used by students in the Faculty of Science as science courses.

### Pharmacology Courses

All PMCOL courses, with the exception of PMCOL 300, may be used by students in the Faculty of Science as science courses.

### Physiology Courses

All PHYSL courses, with the exception of PHYSL 600, may be used by students in the Faculty of Science as science courses.

## Graduate Courses

Courses numbered 500 and up are restricted to graduate students and normally may not be taken for credit by undergraduate science students without prior written permission by the Associate Dean, Undergraduate or designate.

# BSc General Program

The BSc General program provides students with a diverse education in more than one branch of study. Students must major in a Science subject area of concentration (as defined either by a single course designator or by groupings of course designators – see below). Students may elect to minor in a Science subject area of concentration, in an Arts subject area of concentration (see BA Honors and BA Major/Minor Requirements), in one of a select number of Agricultural, Life and Environmental Sciences subject areas of concentration (see BSc BSc General—Minor in Agricultural, Life and Environmental Sciences), or in Business (see BSc General—Minor in Business). In addition to providing a path to the BSc General Degree, this program of study allows for subsequent transfer to Specialization and Honors programs. Students intending to transfer to Honors or Specialization programs should consult the appropriate admission requirements for the program of interest (see Faculty of Science), select carefully their first-year core courses in accordance with the requirements of the specific Honors or Specialization program, and pay close attention to course load and GPA requirements for transfer. Students in the combined BSc/BEEd program should consult Education Chart 2 (see Secondary Education Route) when choosing courses for their major and minor.

## Admission

See BSc General Admission Requirements for admission requirements for the BSc (General) programs.

For information about admission to the Business minor, see BSc General—Minor in Business.

## Selection of Courses

Note: For success in your chosen program, ensure you have satisfied the pre/corequisite requirements for all courses. Departments have the right to remove students from courses for failing to present a passing grade (or higher, where stipulated) in the prerequisite course(s) and/or for failing to be enrolled in the corequisite course(s). Please see [www.uofa.ualberta.ca/science/programs/undergraduate/admission-to-science](http://www.uofa.ualberta.ca/science/programs/undergraduate/admission-to-science) for more information.

## Course Load Requirements

Students in the General program should normally take ★30 during the Fall/Winter of each year of the program if they wish to complete the program in four years. Although not held to a minimum Fall/Winter course load requirement while registered in the General program, students intending to transfer to an Honors or Specialization program should pay close attention to course load and GPA requirements for transfer to their program of interest.

## Academic Standing and Graduation

The following regulations govern General Programs: To obtain a BSc General degree, a minimum 2.0 GPA must be attained on the last ★60 credited to the degree. Moreover, a minimum 2.3 GPA must be attained in all courses in the

major. Students must be in Satisfactory Standing in the General program in order to graduate (a minimum 2.0 GPA in the final Fall/Winter). BSc General degrees with Distinction are awarded when students achieve a GPA of 3.5 or higher over the last ★60 if the students have satisfactorily completed at least a normal academic load of a minimum of ★24 during the Fall/Winter periods of the last two years at the University of Alberta.

## Residence Requirement

A student transferring to the Faculty of Science with advanced standing must complete at least ★60 applicable to the BSc program while registered at the University of Alberta. Normally, at least ★30 of the last ★60 must be completed while registered in the Faculty of Science.

## Time Limits for Program Completion

The Faculty of Science may permit a student to complete the requirements for a General degree over a period longer than four years or meet the requirements in a shorter time by attending Spring/Summer. Students wishing to extend their programs beyond four years must first obtain approval of the Senior Associate Dean of Science or designate.

## The following regulations govern the General program:

### To obtain a BSc General Degree

To obtain a BSc General Degree, a student must receive credit in ★120. At least ★72 and not more than ★102 must be in courses offered by the Faculty of Science (see details of courses). At least ★18 and not more than ★48 must be in courses offered by the Faculty of Arts.

### The General program includes a core of courses which must include the following:

- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

#### ★6 from among junior courses offered by the Departments of Computing Science, and Mathematical and Statistical Sciences

- CMPUT 101 - Introduction to Computing
- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I

#### ★6 from among junior courses in the Departments of Chemistry and Physics

- ASTRO 120 - Astronomy of the Solar System
- ASTRO 122 - Astronomy of Stars and Galaxies
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- CHEM 164 - Organic Chemistry I
- PHYS 114 - Physics: The Big Picture
- PHYS 124 - Particles and Waves
- PHYS 126 - Fluids, Fields, and Radiation
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves

#### ★6 from among junior Science courses titled Biology, Earth and Atmospheric Sciences, or Science Psychology

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- EAS 100 - Planet Earth
- EAS 105 - The Dynamic Earth Through Time
- PSYCO 104 - Basic Psychological Processes

**Not more than ★42 may be taken at the junior level.****Each student must complete a Science major**

Each student must complete a Science major. See below for specific course requirements in each major subject area of concentration. With the exception of the Physical Science major, which requires ★42, all Science majors require a minimum of ★36 with at least ★12 in 300-level or higher courses taken while registered in the Faculty of Science at the University of Alberta.

**Each student must also either:**

- complete a second Science major. Students who complete a second Science major will not have a minor. The Double Majors will be recorded on the student transcript; or
- complete a minor. With exception of the Physical Sciences minor, which requires ★27, all minors must have at least ★24 with at least ★6 in 300-level or higher courses taken while registered in the Faculty of Science at the University of Alberta. The minor may be in Science (see below), in an Arts subject area of concentration (see BA Honors and BA Major/Minor Requirements), in one of a select number of Agricultural, Life and Environmental Sciences subject areas of concentration (see BSc General—Minor in Agricultural, Life and Environmental Sciences), or in Business (see BSc General—Minor in Business). For non-Science minors, students are responsible for meeting both the Faculty of Science minor requirements and any outside Faculty or department-specified course requirements. For information about admission to the Business minor, see BSc General—Minor in Business.

**A maximum of ★18 may be taken from faculties other than Arts or Science**

A maximum of ★18 may be taken from faculties other than Arts or Science. For applicants to the BSc General who have already taken courses from faculties other than Arts or Science, potential transfer credit for such courses will be assessed at the time of admission to the program. Such subjects are not included as part of the major or minor (with the exception of those courses meeting the requirements for a Business minor or one of the allowable minors from Agricultural, Life and Environmental Sciences), nor toward the minimum requirement of ★18 in Arts, nor toward the minimum requirement of ★72 in Science.

## BSc Major/Minor Requirements

### Majors

- A Science major consists of Science courses (see details of courses) taken from one of the following nine subject areas of concentration

### Biological Sciences

**A major in the Biological Sciences (see Note 1) consists of**

At least ★36 with at least ★12 at the 300-level or higher.

The major must include the following:

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity

**★3 from**

- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology

**At least ★9**

- At least ★9 in courses at the 200-level or higher with a lab component and offered by the Department of Biological Sciences. The ★3 from BIOL 207 or BIOL 208 in requirement above may not be used to fulfill this program requirement.

**At least ★3 from each of the following three areas of study:**

- Ecology, evolution or diversity
- Genetics and molecular (or micro-) biology
- Physiology, cell and developmental biology

Consult departmental website for a list of approved courses for each of the three areas of study. BIOL 107, BIOL 108, BIOL 207 and BIOL 208 may not be used to fulfill the program requirements in a, b or c.

**At least ★12 at the 300-level or higher**

At the 300-level or higher, of which at least ★3 must be at the 400-level. Many of the senior Biological Sciences courses require either BIOL 207 or BIOL 208 as a prerequisite so both courses are highly recommended.

### Chemistry

**A major in Chemistry consists of**

At least ★36 with at least ★12 at the 300-level or higher.

The major must include the following:

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- 
- CHEM 263 - Organic Chemistry II

**At least ★3 from**

- CHEM 211 - Quantitative Analysis I
- CHEM 241 - Introduction to Inorganic Chemistry
- CHEM 282 - Atomic and Molecular Structure

**At least ★12 at the 300-level or higher**

- At least ★12 in CHEM at the 300-level or higher, of which at least ★3 must be at the 400-level.

**Additional Information**

Any additional courses required to meet the minimum ★36 may come from CHEM or BIOCH

Although it does not count toward the major, students completing a Chemistry major are recommended to take MATH 113 (or MATH 114) and MATH 115. Some senior CHEM courses require MATH 115 as a prerequisite, so students must plan accordingly.

### Computing Science

**A major in Computing Science consists of**

At least ★36 with at least ★12 at the 300-level or higher.

The major must include the following:

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II

**At least ★6 from**

- CMPUT 201 - Practical Programming Methodology
- CMPUT 204 - Algorithms I
- CMPUT 229 - Computer Organization and Architecture I
- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 291 - Introduction to File and Database Management

**At least ★12 in CMPUT at the 300-level or higher**

At least ★12 in CMPUT at the 300-level or higher, of which at least ★3 must be at the 400-level.

**Additional Information**

Many of the CMPUT courses have MATH or STAT prerequisites so students must plan accordingly.

### Earth and Atmospheric Sciences

**A major in Earth and Atmospheric Sciences consists of**

At least ★36 with at least ★12 at the 300-level or higher.

The major must include the following:

- EAS 100 - Planet Earth

**At least ★12 at the 300-level or higher**

- At least ★12 at the 300-level or higher, of which at least ★3 must be at the 400-level. Courses may be chosen from Science EAS, GEOPH or PALEO (see Note 3).

## Mathematical Sciences

The major in Mathematical Sciences is no longer available. Students admitted to the BSc General program before Fall 2014 and wishing to complete the Mathematical Sciences major have until April 30, 2018 to do so.

## Mathematics

### A major in Mathematics consists of

At least ★36 with at least ★12 at the 300-level or higher.

The major must include the following:

- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II

### At least ★3 from

- MATH 228 - Algebra: Introduction to Ring Theory
- MATH 334 - Introduction to Differential Equations

### At least ★12 in MATH at the 300-level or higher

- At least ★12 in MATH at the 300-level or higher, of which at least ★3 must be at the 400-level. If taken to meet the above Requirement, MATH 334 may be used toward this Requirement.

## Physical Sciences

### A major in Physical Sciences consists of

At least ★42 with at least ★12 at the 300-level or higher.

The major must include the following:

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- 
- PHYS 124 - Particles and Waves **OR**
- PHYS 144 - Newtonian Mechanics and Relativity
- 
- PHYS 126 - Fluids, Fields, and Radiation **OR**
- PHYS 146 - Fluids and Waves

### ★3 from

- PHYS 208 - Aspects of Modern Physics
- PHYS 271 - Introduction to Modern Physics

### At least ★3 from

- CHEM 211 - Quantitative Analysis I
- CHEM 241 - Introduction to Inorganic Chemistry
- PHYS 294 - General Physics Laboratory

### At least ★12 at

the 300-level or higher

### At least ★12 in

each of Chemistry and Physics courses

### Additional Information

Chemistry courses may be chosen from BIOCH (see Note 4) or CHEM, and Physics courses may be chosen from ASTRO, GEOPH, MA PH (see Note 5), or PHYS. Many of the courses have MATH pre- or corequisites so students must plan accordingly.

See Note 6.

## Physics

### A major in Physics consists of

At least ★36 with at least ★12 at the 300-level or higher.

The major must include the following:

- PHYS 144 - Newtonian Mechanics and Relativity (recommended) **OR**
- PHYS 124 - Particles and Waves
- 
- PHYS 146 - Fluids and Waves (recommended) **OR**
- PHYS 126 - Fluids, Fields, and Radiation
- 
- PHYS 244 - Mechanics
- PHYS 281 - Electricity and Magnetism
- 
- PHYS 294 - General Physics Laboratory **OR**
- PHYS 295 - Experimental and Statistical Methods of Physics
- 
- PHYS 271 - Introduction to Modern Physics **OR**
- PHYS 208 - Aspects of Modern Physics (With a grade of B+ or higher)

### At least ★3 from

- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 362 - Optics and Lasers
- PHYS 372 - Quantum Mechanics A
- PHYS 381 - Electromagnetic Theory I

### plus an additional ★9

- At the 300-level or higher.

### Additional Information

Courses may be chosen from ASTRO, GEOPH, MA PH or PHYS. Many of the courses have MATH pre- or corequisites so students must plan accordingly and might wish to pair the Physics major with a minor in Mathematics.

## Science Psychology

### A major in Psychology consists of

At least ★36 with at least ★12 at the 300-level or higher

The major must include the following:

- PSYCO 104 - Basic Psychological Processes
- PSYCO 105 - Individual and Social Behavior

### At least ★6 chosen from

- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- PSYCO 282 - Behavior Modification

### At least ★6 chosen from

- PSYCO 239 - Abnormal Psychology
- PSYCO 241 - Social Psychology
- PSYCO 333 - Personality Theory

### At least ★6 in

- PSYCO at the 300-level or higher (minimum of ★3 from Science (see details of courses) and ★3 from Arts).

### At least ★6 in

PSYCO at the 400-level or higher (minimum of ★3 from Science (see details of courses) and ★3 from Arts).

### Additional Information

Although it does not count toward the major, students completing a Psychology major must also take STAT 151. Many senior PSYCO courses require STAT 151 as a prerequisite so students must plan accordingly.

## Statistics

### A major in Statistics consists of

At least ★36 with at least ★12 at the 300-level or higher.

The major must include the following:

- STAT 151 - Introduction to Applied Statistics I
- STAT 252 - Introduction to Applied Statistics II
- STAT 265 - Statistics I
- STAT 266 - Statistics II

### At least ★12 in

STAT at the 300-level or higher, including STAT 378, and of which at least ★3 must be at the 400-level

### Additional Information

The required STAT courses have MATH pre- or corequisites so students must plan accordingly and might wish to pair the Statistics major with a minor in Mathematics.

### Notes

1. Biological Sciences courses include BIOIN (see Note 2), BIOL, BOT, CELL, ENT, GENET, IMIN, MA SC, MICRB, PALEO (see Note 3) and ZOOL courses offered by the Department of Biological Sciences; BIOCH (see Note 4), MMI (with the exception of 133), NEURO, PHYSL and PMCOL courses offered by the Faculty of Medicine and Dentistry and NU FS 363 offered by the Faculty of Agriculture, Life and Environmental Sciences. Students should be aware that it is not possible to combine a major or minor in the Biological Sciences with a minor or major in one of the specific subject disciplines in the Biological Sciences. For example, students may not select a major in the Biological Sciences and a minor in Microbiology. For additional Biological Science courses and information see Faculty of Science.
2. BIOIN courses are offered jointly by the departments of Biological Sciences and Computing Science and may be counted as Biological Sciences or Computing Science. Students completing a Bioinformatics minor must count the BIOIN courses toward the minor.
3. PALEO courses are offered jointly by the departments of Biological Sciences and Earth and Atmospheric Sciences and may be counted as Biological Sciences or Earth and Atmospheric Sciences.
4. BIOCH courses may be counted as Biological Sciences or Physical Sciences or Chemistry.
5. MA PH courses may be counted as Physical Sciences or Physics.
6. EAS 323 may be used as a Physical Science or Chemistry course.
7. Courses in the major and minor may not overlap. For example, the Physical Sciences major or minor may not be paired with a Chemistry or Physics major or minor. The only exception is the pairing of the Bioinformatics minor with either the Biological Sciences major or the Computing Science major. In this case, an individual course(s) cannot be used to meet the course requirements for both the major and the minor.
8. Science options may only be taken from the course subjects listed in details of courses, including SCI and Faculty of Science INT D courses, provided students meet the prerequisite and eligibility requirements, if any.

## Minors

A Science minor consists of Science courses (see details of courses) taken from one of the subject areas listed below.

## Bioinformatics

The Bioinformatics minor is available only when paired with a Biological Sciences or a Computing Science major. A minor in Bioinformatics consists of at least ★24 with at least ★6 at the 300-level or higher.

### When paired with a Biological Sciences major (see Note 1), the Bioinformatics minor must include the following:

- BIOL 207 - Molecular Genetics and Heredity (see Note 7) **OR**
- BIOL 221 - Mechanisms of Evolution (see Note 7)
- 
- GENET 270 - Foundations of Molecular Genetics (see Note 7)
- 
- CMPUT 174 - Introduction to the Foundations of Computation I **AND**

- CMPUT 175 - Introduction to the Foundations of Computation II
- **OR**
- CMPUT 274 - Introduction to Tangible Computing I **AND**
- CMPUT 275 - Introduction to Tangible Computing II
- 
- CMPUT 201 - Practical Programming Methodology **AND**
- CMPUT 291 - Introduction to File and Database Management
- 
- BIOIN 301 - Bioinformatics I **AND**
- BIOIN 401 - Bioinformatics II

### When paired with a Computing Science major, the Bioinformatics minor must include the following:

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- BIOL 207 - Molecular Genetics and Heredity
- GENET 270 - Foundations of Molecular Genetics
- BIOIN 301 - Bioinformatics I
- BIOIN 401 - Bioinformatics II

### At least ★6 from

- (see Note 7)
- CMPUT 201 - Practical Programming Methodology
- CMPUT 204 - Algorithms I
- CMPUT 229 - Computer Organization and Architecture I
- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 291 - Introduction to File and Database Management
- CMPUT 301 - Introduction to Software Engineering
- CMPUT 366 - Intelligent Systems
- CMPUT 391 - Database Management Systems
- CMPUT 410 - Web-Based Information Systems
- CMPUT 466 - Machine Learning

## Biological Sciences

### A minor in the Biological Sciences (see Note 1) consists of

- At least ★24 with at least ★6 at the 300-level or higher.
- 
- The minor must include the following:
- 
- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity

### and one of

- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology

### At least ★6

- at the 300-level or higher

### At least ★3 from each of the following three areas of study:

- a. Ecology, evolution or diversity
- b. Genetics and molecular (or micro-) biology
- c. Physiology, cell and developmental biology

Consult departmental website for a list of approved courses for each of the three areas of study. BIOL 107, BIOL 108, BIOL 207 and BIOL 208 may not be used to fulfill the program requirements in a, b or c.

### Additional Information

Many of the senior Biological Sciences courses require either BIOL 207 or BIOL 208 as a prerequisite so both courses are highly recommended.

## Chemistry

### A minor in Chemistry consists of

At least ★24 with at least ★6 at the 300-level or higher.

The minor must include the following:

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- 
- CHEM 263 - Organic Chemistry II

**At least ★3 from**

- CHEM 211 - Quantitative Analysis I
- CHEM 241 - Introduction to Inorganic Chemistry
- CHEM 282 - Atomic and Molecular Structure

**At least ★6**

- in CHEM at the 300-level or higher.

**Any additional courses required to meet the minimum ★24**

Any additional courses required to meet the minimum ★24 may come from CHEM or BIOCH.

**Computing Science****A minor in Computing Science consists of**

At least ★24 with at least ★6 at the 300-level or higher.

The minor must include the following:

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II

**At least ★6 from**

- CMPUT 201 - Practical Programming Methodology
- CMPUT 204 - Algorithms I
- CMPUT 229 - Computer Organization and Architecture I
- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 291 - Introduction to File and Database Management

**At least ★6 in**

- CMPUT at the 300-level or higher

**Additional Information**

Many of the CMPUT courses have MATH or STAT prerequisites so students must plan accordingly.

**Earth and Atmospheric Sciences****A minor in Earth and Atmospheric Sciences consists of**

At least ★24 with at least ★6 at the 300-level or higher.

- The minor must include the following:
- EAS 100 - Planet Earth

**At least ★6 at**

- the 300-level or higher

**Additional Information**

- Courses may be chosen from Science EAS, GEOPH or PALEO (see Note 3).

**Mathematical Sciences**

The minor in Mathematical Sciences is no longer available. Students admitted to the BSc General program before Fall 2014 and wishing to complete the Mathematical Sciences minor have until April 30, 2018 to do so.

**Mathematics****A minor in Mathematics consists of**

At least ★24 with at least ★6 at the 300-level or higher.

The minor must include the following:

- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I

**• AND**

- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- 
- MATH 228 - Algebra: Introduction to Ring Theory
- **OR BOTH**
- MATH 215 - Intermediate Calculus II **OR** MATH 317 **AND**
- MATH 334 - Introduction to Differential Equations

**At least ★6 in**

MATH at the 300-level or higher.

Any 300-level courses taken to meet the above requirement may be used toward this requirement.

**Physical Sciences****A minor in Physical Sciences consists of**

At least ★27 with at least ★6 at the 300-level or higher.

The minor must include the following:

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- 
- PHYS 124 - Particles and Waves **OR**
- PHYS 144 - Newtonian Mechanics and Relativity
- 
- PHYS 126 - Fluids, Fields, and Radiation **OR**
- PHYS 146 - Fluids and Waves

**At least ★9 in**

each of Chemistry and Physics courses

**At least ★6**

at 300-level or higher

**Additional Information**

Courses may be chosen from ASTRO, BIOCH (see Note 4), CHEM, GEOPH, MA PH (see Note 5), or PHYS.

**See Note 6.**

**Physics****A minor in Physics consists of**

At least ★24 with at least ★6 at the 300-level or higher.

The minor must include the following:

- PHYS 144 - Newtonian Mechanics and Relativity (recommended) **OR**
- PHYS 124 - Particles and Waves
- 
- PHYS 146 - Fluids and Waves (recommended) **OR**
- PHYS 126 - Fluids, Fields, and Radiation
- 
- PHYS 244 - Mechanics
- PHYS 281 - Electricity and Magnetism
- 
- PHYS 294 - General Physics Laboratory **OR**
- PHYS 295 - Experimental and Statistical Methods of Physics
- 
- PHYS 271 - Introduction to Modern Physics **OR**
- PHYS 208 - Aspects of Modern Physics (with a grade of B+ or higher)

**At least ★3 from**

- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 362 - Optics and Lasers
- PHYS 372 - Quantum Mechanics A
- PHYS 381 - Electromagnetic Theory I

**Plus an additional ★3**

- at the 300-level or higher

### Additional Information

Courses may be chosen from ASTRO, GEOPH, MA PH or PHYS. Many of the courses have MATH pre- or corequisites so students must plan accordingly and might wish to pair the Physics minor with a major in Mathematics.

## Psychology

### A minor in Psychology consists of

At least ★24 with at least ★6 at the 300-level or higher.

The minor must include the following:

- PSYCO 104 - Basic Psychological Processes
- PSYCO 105 - Individual and Social Behavior

### At least ★3 chosen from

- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- PSYCO 282 - Behavior Modification

### At least ★3 chosen from

- PSYCO 239 - Abnormal Psychology
- PSYCO 241 - Social Psychology
- PSYCO 333 - Personality Theory

### At least ★6 in

PSYCO at the 300-level or higher (minimum of ★3 from Science and ★3 from Arts)

### Additional Information

Although it does not count toward the minor, students completing a Psychology minor must also take STAT 151. Many senior PSYCO courses require STAT 151 as a prerequisite so students must plan accordingly.

## Statistics

### A minor in Statistics consists of

At least ★24 with at least ★6 at the 300-level or higher.

The minor must include the following:

- STAT 151 - Introduction to Applied Statistics I
- STAT 252 - Introduction to Applied Statistics II
- STAT 265 - Statistics I
- STAT 266 - Statistics II
- STAT 378 - Applied Regression Analysis

### Additional Information

The required STAT courses have MATH pre- or corequisites so students must plan accordingly and might wish to pair the Statistics minor with a major in Mathematics

### Non-Science Minors

Science students may also complete a minor outside of the Faculty of Science. For information about the BSc General – minor in Arts, see BA Honors and BA Major/Minor Requirements (all Arts minors are available to Science students with the exception of Arts and Cultural Management). For information about the BSc General – minor in Agricultural, Life and Environmental Sciences, see BSc General—Minor in Agricultural, Life and Environmental Sciences. For information about the BSc General – minor in Business, see BSc General—Minor in Business. In all cases, the faculty and/or department-specified requirements for the minor must be met.

### Notes

1. Biological Sciences courses include BIOIN (see Note 2), BIOL, BOT, CELL, ENT, GENET, IMIN, MA SC, MICRB, PALEO (see Note 3) and ZOOL courses offered by the Department of Biological Sciences; BIOCH (see Note 4), MMI (with the exception of 133), NEURO, PHYSL and PMCOL courses offered by the Faculty of Medicine and Dentistry; and NU FS 363 offered by the Faculty of Agriculture, Life and Environmental Sciences. Students should be aware that it is not possible to combine a major or minor in the Biological Sciences with a minor or major in one of the specific subject disciplines in the Biological Sciences. For example, students may not select a major in the Biological Sciences and a minor in Microbiology. For additional Biological Science courses and information see Specialization in Biological Sciences [Science].

2. BIOIN courses are offered jointly by the departments of Biological Sciences and Computing Science and may be counted as Biological Sciences or Computing Science.
3. PALEO courses are offered jointly by the departments of Biological Sciences and Earth and Atmospheric Sciences and may be counted as Biological Sciences or Earth and Atmospheric Sciences.
4. BIOCH courses may be counted as Biological Sciences or Physical Sciences or Chemistry.
5. MA PH courses may be counted as Physical Sciences or Physics.
6. EAS 323 may be used as a Physical Science or Chemistry course.
7. Courses in the major and minor may not overlap. For example, the Physical Sciences major or minor may not be paired with a Chemistry or Physics major or minor.
8. Science options may only be taken from the course subjects listed in details of courses, including SCI and Faculty of Science INT D courses, provided students meet the prerequisite and eligibility requirements, if any.

## BSc General—Minor in Agricultural, Life and Environmental Sciences

Students may choose a minor in Agriculture, Human Ecology or Nutrition. All other restrictions and requirements of the BSc General program, as outlined in BSc General Program apply.

### Minor in Agriculture

#### The minor in Agriculture consists of

At least ★24 and no more than ★30 in Agriculture courses as follows:

- AN SC 200 - Principles of Animal Agriculture
- AREC 200 - Current Economic Issues for Agriculture and Food (Prerequisite of ECON 101 or consent of Department)
- PL SC 221 - Introduction to Plant Science
- REN R 210 - Introduction to Soil Science and Soil Resources (Prerequisite: Must have completed a university-level course in life or natural sciences. A university-level chemistry course is strongly recommended.)

#### ★12 to ★18 in additional courses at the 300-level or higher to be chosen from

- Can also be chosen as options.
- ANSC
- AREC
- ENCS
- PL SC
- REN R 307 - Environmental Assessment Principles and Methods
- REN R 360 - Soil and Water Conservation
- REN R 364 - Principles of Managing Natural Diversity
- REN R 376 - Fisheries and Wildlife Management
- REN R 441 - Soil Formation and Landscape Processes
- REN R 442 - Soil Biogeochemistry
- REN R 443 - Soil Physics
- REN R 444 - Environmental Soil Chemistry
- REN R 445 - Soil Fertility
- REN R 446 - Climates and Ecosystems
- REN R 462 - Parks, Ecology, and Society
- REN R 464 - Conservation and Management of Endangered Species
- REN R 465 - Environmental and Conservation Field Studies
- REN R 467 - Environmental Interpretation and Science Communication
- REN R 474 - Utilization of Wildlife Resources
- REN R 476 - Advanced Fisheries and Wildlife Management
- REN R 482 - Soil Remediation
- REN R 483

### Minor in Human Ecology

#### The minor in Human Ecology consists of

- At least ★24 and no more than ★30 in Human Ecology as follows:
- HECOL 100 - Introduction to Principles and Practice in Human Ecology
- ★21 to ★27 in HECOL courses, with at least ★9 at the 300-level or higher.

## Minor in Nutrition

### The minor in Nutrition consists of

- At least ★24 and no more than ★30 in Nutrition as follows:
- NUTR 100 - Nutrition and Wellbeing
- NU FS 305 - Introduction to the Principles of Nutrition
- NU FS 356 - Nutrition Across the Lifespan
- NU FS 373 - Food Chemistry

### ★12 to ★18 from the following:

- NUTR 380 - Sports Nutrition
- NU FS 200 - Introduction to Functional Foods and Nutraceuticals
- NU FS 223 - The Cultural Ecology of Food and Health
- NU FS 363 - Food Microbiology
- NU FS 374 - Food Fundamentals and Quality
- NU FS 377 - Introduction to Nutrition in the Community
- NU FS 427 - Food Safety
- NU FS 428 - Advances in Human Nutrition and the Intestinal Microbiome

**Note:** CHEM 261 and CHEM 263 are prerequisites for NU FS 373..

## BSc General—Minor in Business

**Note:** Note: For requirements, see BSc General Program. Students admitted to the program lacking one or more prerequisites will be required to make up the deficiency during the first Fall/Winter in the Business minor program.

### The BSc General—Minor in Business program consists of the following:

- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics

### ★18 to ★30 in courses offered by the Faculty of Business including

- ACCTG 311 - Introduction to Accounting for Financial Performance
- SMO 301 - Behavior in Organizations

### Two of

- FIN 301 - Introduction to Finance
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- SMO 321 - Introduction to Strategic Management and Organization Design

### Additional Information

1. Several of the above courses have one or more Arts or Science courses as prerequisites. These prerequisites must be met.
2. Students completing a minor in Business must still choose a major in Science and at least ★72 of the ★120 credited to the degree must be in Science courses (see details of courses).
3. Students minoring in Business must still complete at least ★18 in Arts. ECON 101 and ECON 102 constitute six of those required Arts units.

Once admitted to the minor in Business, students in the BSc General program will be allowed to continue in the Business minor as long as they remain in good standing in the BSc General program. BSc General program students who have been admitted to the minor in Business and who subsequently apply to transfer to a Specialization or Honors program which has a Business component controlled by quota will have to apply and compete for admission to that quota.

## BSc Honors Programs

A minimum of ★120 normally taken in no more than five consecutive academic years is required to complete the Honors program for the degree of BSc with Honors. Some departments require that an Honors program be completed in four years, others permit five. See individual departments for details. These programs provide specialization in the chosen subject or subjects as well as the higher standard implied by the term "Honors."

Honors programs are available in the Departments of Biochemistry, Biological Sciences, Cell Biology, Chemistry, Computing Science, Earth and Atmospheric Sciences, Mathematical and Statistical Sciences, Neuroscience, Pharmacology, Physics, Physiology, and Psychology. Honors is the preferred program for students who plan graduate study.

## Admission

See BSc (Honors) for admission requirements.

## Selection of Courses

Note: For success in your chosen program, ensure you have satisfied the pre/corequisite requirements for all courses. Departments have the right to remove students from courses for failing to present a passing grade (or higher, where stipulated) in the prerequisite course(s) and/or for failing to be enrolled in the corequisite course(s). Please see [www.science.ualberta.ca/en/ProspectiveStudents/ScienceDegrees.aspx](http://www.science.ualberta.ca/en/ProspectiveStudents/ScienceDegrees.aspx) for more information.

The following regulations govern Honors programs:

1. In each year, an Honors student's program must be approved by an Honors Advisor in the student's Department and by the Faculty Office.
2. A minimum of ★72 in Science is required in most Honors programs. Certain Departments may require more than ★72 in Science courses.
3. A student normally must take at least ★18 in Arts courses as part of the requirements for the Honors degree.
4. Normally, no more than ★42 in junior (100-level) courses are permitted in Honors programs.
5. Certain non-Arts and non-Science courses appropriate to the program may be permitted in Honors programs with the written approval of the Department directing the student's program.

Applicants to the BSc Honors program who have taken non-Arts and non-Science courses before application will have the potential to transfer credit for such courses assessed at the time of admission to the program.

## Course Load Requirements

Students in Honors programs must complete ★24 or more during the Fall/Winter of each year of the program. In some Departments, Honors students are required to complete ★30 each Fall/Winter. See individual Departments for details. Exceptions to course load requirements must be approved in advance each year by the Department and the Faculty Office.

## Academic Standings and Graduation

The following regulations govern Honors programs:

1. Continuation in an Honors program is by recommendation of the department concerned and requires a GPA of at least 3.0 on a course load of ★24 or more in the preceding Fall/Winter periods. See description of Honors programs of individual departments for additional requirements relating to continuation in the Honors program. Students must be in good standing (i.e., meet the continuation requirements) in the Honors program in order to graduate.
1. A student who fails to attain the standard necessary for continuance in Honors must withdraw from the Honors program. In so doing, the student may transfer to a Specialization program with the appropriate department's approval or to the General program in the Faculty of Science. Students applying to transfer from an Honors program to Specialization or General must meet the continuation standards for the program concerned.
2. A student who fails to complete the requirements for a degree with Honors in the fourth year may be granted the Specialization degree or the General degree on application if the courses taken and the standing attained are satisfactory. Such students must apply to transfer to a Specialization or General program.
3. Degrees with First Class Honors are awarded as per First-Class Honors, a. and First-Class Honors, b.

## Residence Requirement

A student transferring to the Faculty of Science with advanced standing must complete at least ★60 applicable to the BSc program while registered at the University of Alberta. Normally, at least ★30 of the last ★60 must be completed while registered in the Faculty of Science.

## Time Limits for Program Completion

All BSc Honors programs are designed to be four-year programs. However, in some cases the minimum course load requirements have been reduced to allow students the flexibility to complete the degree over a longer time period. Students wishing to extend their programs beyond the time frame dictated by the minimum course load requirement for their program must first obtain the written



approval of the Department and the Associate Dean, Undergraduate or designate.

## BSc Honors Requirements

### Honors in Biochemistry

Continuation in the Honors in Biochemistry program requires successful completion of at least ★24 with a minimum GPA of 3.0 in the previous Fall/Winter. In addition, graduation from the program requires a minimum GPA of 3.0 on the last ★60 credited towards the degree.

#### Year 1

- BIOL 107 - Introduction to Cell Biology
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- PHYS 124 - Particles and Waves
- PHYS 126 - Fluids, Fields, and Radiation (or equivalent)
- ★3 junior-level MATH or STAT option
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

#### Year 2

- BIOCH 200 - Introductory Biochemistry (Fall)
- BIOCH 320 - Structure and Catalysis (Winter)
- BIOCH 330 - Nucleic Acids and Molecular Biology (Winter)
- 
- BIOL 201 - Eukaryotic Cellular Biology **OR**
- CELL 201 - Introduction to Molecular Cell Biology
- 
- CHEM 211 - Quantitative Analysis I
- CHEM 213 - Quantitative Analysis II
- CHEM 263 - Organic Chemistry II (Fall)
- ★9 in Options (See Note 3)

#### Year 3

- BIOCH 310 - Bioenergetics and Metabolism (Fall)
- BIOCH 401 - Biochemistry Laboratory
- ★6 in senior-level BIOCH courses (See Note 1)
- ★6 in Group A options (See Note 4)
- ★9 in Options (See Note 3)

#### Year 4

- BIOCH 499 - Directed Research Project
- ★9 in senior-level BIOCH courses (See Note 1)
- ★6 in Group A or Group B options (See Note 4)
- ★9 in Options (See Note 3)

#### Notes

1. Students must receive a grade of not less than B- in each of ★39 in BIOCH courses credited towards the degree, as follows: BIOCH 200; BIOCH 310, BIOCH 320 and BIOCH 330; five of BIOCH 410, BIOCH 420, BIOCH 425, BIOCH 430, BIOCH 441, BIOCH 450, BIOCH 455, BIOCH 465, BIOCH 481, and BIOCH 482; BIOCH 401; and BIOCH 499.
2. Students should consult the Department of Biochemistry for advice about course selection throughout the program. Several alternative course schedules are possible.
3. The Honors program in Biochemistry includes a total of ★27 in Options. ★3 must be SCIENCE options, ★12 must be ARTS options, and the remainder (★12) may be selected from the Faculty of Arts, the Faculty of Science, or any other Faculty of interest to the student.
4. Group A options are selected from BIOCH 398, BIOCH 4XX, CHEM, PHYS, MATH, STAT, COMPUT. Group B options are selected from Group A or BIOIN,

CELL, GENET, IMIN, MICRB, PHYSL, PMCOL. Group A and B options may not be junior courses.

5. Credit in SCI 100 will be considered equivalent to BIOL 107, CHEM 101, CHEM 102, CHEM 164, MATH 114, PHYS 124, PHYS 126, ★3 junior-level MATH or STAT option and ★3 Science option (see details of courses).
6. Credit in SCI 151 will be considered equivalent to ★3 junior level MATH or STAT option and ★3 Science option..

### Honors in Biological Sciences

All students in Honors and Specialization programs in Biological Science take a common core of four BIOL courses in the first and second years. Thereafter, they follow the course sequence of one of the areas of concentration in either Honors or Specialization in Biological Sciences identified in Science Chart 2 Course Sequence in Biological Sciences. At the time of application, students indicate their chosen area of concentration on the application; if admitted, they follow the appropriate course sequence. The title of the area of concentration will appear on their degree. Additional course requirements for Honors students include BIOL 499 and program specific courses. BIOL 499, a directed research project, must be conducted on a topic appropriate to the student's area of concentration. BIOL 499 is a recommended option for Specialization students.

Streams have been developed within several programs in Biological Sciences. These are lists of courses that provide guidance to students wishing to focus further on specific areas of Biology. Students in a program are not required to declare or follow a stream, and stream designations do not appear on transcripts. On the Course Sequence chart, available streams are noted under Years 3 and 4. Streams are described in full on the Department of Biological Sciences website. Students should consult with advisors in choosing and following streams within their programs.

### Honors in Biological Sciences

Admission to the BSc Honors in Biological Sciences program see Admissions Chart 7, Faculty of Science

Continuation in the Honors in Biological Sciences program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★60 credited to the degree.

Effective September 2016, there will be no further admissions to BSc Honors or BSc Specialization in Bioinformatics. Students who entered one of these programs prior to September 2016 must complete all program requirements by April 30, 2020. Refer to the Calendar in effect at the time you were admitted or readmitted for the regulations governing the degree program requirements. The last BSc Honors or BSc Specialization in Bioinformatics will be granted at Spring Convocation 2020..

#### First-Year Core for BSc Honors in Biological Sciences

The following courses are common to all programs:

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 in Arts options (junior level ENGL or WRS recommended)
- ★6 in program-specific courses (see individual programs for requirements and recommendations)

**Note:** SSCI 100 may be used in lieu of BIOL 107, BIOL 108, CHEM 101, CHEM 164 and MATH 114. SCI 151 may be used in lieu of STAT 151.

### Course Sequence in Biological Sciences

- See Science Chart 2
- Animal Biology

- Bioinformatics
- Ecology
- Evolutionary Biology
- Microbiology
- Molecular Genetics
- Physiology and Developmental Biology
- Plant Biology

## Honors in Cell Biology

Continuation in the Honors in Cell Biology program requires successful completion of at least ★24 with a minimum 3.0 GPA in each preceding Fall/Winter.

### Year 1

- BIOL 107 - Introduction to Cell Biology
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry II
- MATH 114 - Elementary Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I
- PHYS 124 - Particles and Waves
- PHYS 126 - Fluids, Fields, and Radiation
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★3 in approved options

### Year 2

- BIOCH 200 - Introductory Biochemistry
- BIOL 207 - Molecular Genetics and Heredity
- CELL 201 - Introduction to Molecular Cell Biology **OR**
- BIOL 201 - Eukaryotic Cellular Biology
- CHEM 263 - Organic Chemistry II
- GENET 270 - Foundations of Molecular Genetics
- MICRB 265 - General Microbiology
- STAT 151 - Introduction to Applied Statistics I
- ★3 in an Arts option
- ★6 in approved options

### Year 3

- BIOCH 320 - Structure and Catalysis **OR**
- CHEM 371 - Energetics of Chemical Reactions
- CELL 300 - Advanced Cell Biology I
- CELL 301 - Advanced Cell Biology II
- ★6 from Group A Cell Biology options (BIOCH 401 recommended)
- ★9 in approved options
- ★6 in Arts options

### Notes

1. Cell Biology students should take BIOCH 320 in Winter Term of Year 2 if selecting BIOCH 401 option; BIOCH 330 is not required for Cell Biology students.
2. CHEM 371 requires MATH 115 to be taken as an approved option in Year 2

### Year 4

- CELL 499 - Research Project
- ★3 from a 400-level CELL course
- ★6 from Group A Cell Biology options
- ★12 in approved options
- ★3 in an Arts option

### Notes

1. Students are required to consult the Department of Cell Biology for selection and approval of all options.
2. Students are encouraged to select approved options from the Cell Biology Group A or recommended options list, but may also follow a course of study tailored to their interests (must be approved by a Cell Biology advisor).

3. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, CHEM 102, CHEM 164, MATH 114, MATH 115, PHYS 124, PHYS 126.
4. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

### Cell Biology Group A Options

- BIOCH 401 - Biochemistry Laboratory
- BIOCH 410 - Signal Transduction
- BIOCH 420 - Proteins: Structure, Function, and Regulation
- BIOCH 425 - Proteomics
- BIOCH 441 - Structure and Function of Biological Membranes
- BIOCH 450 - The Molecular Biology of Mammalian Viruses
- BIOCH 481 - Design and Construction of Synthetic Biological Systems I
- BIOCH 482 - Design and Construction of Synthetic Biological Systems II
- BIOCH 430 - Biochemistry of Eukaryotic Gene Expression **OR**
- GENET 304 - Gene Expression and its Regulation
- BIOL 421 - Molecular Evolution and Systematics
- CELL 310 - Evolution and Diversity of the Cell
- CELL 398 - Research Project
- CELL 402 - The Birth and Death of a Cell
- CELL 405 - Cell Biology of Disease
- CELL 425 - Systems Biology
- CELL 445 - Current Topics in Cell Biology
- CELL 498 - Research Project
- CHEM 282 - Atomic and Molecular Structure
- CHEM 371 - Energetics of Chemical Reactions
- CHEM 373 - Physical Properties and Dynamics of Chemical Systems
- CHEM 464 - Biocjugate Chemistry
- GENET 305 - Genetic Analysis
- GENET 375 - Introduction to Molecular Genetics Techniques
- GENET 420 - Research Techniques in Molecular Genetics
- IMIN 200 - Infection and Immunity
- IMIN 324 - Basic Virology
- IMIN 372 - Research Techniques in Immunology
- IMIN 405 - Innate Immunity
- IMIN 452 - Advanced Immunology
- MICRB 316 - Molecular Microbiology
- MMI 391 - Current Methods in Molecular Biology
- MMI 436 - Inflammation
- MMI 490 - Advanced Techniques in Microbiology and Immunology
- ONCOL 320 - Introduction to Oncology
- ONCOL 425 - Advanced Topics in Cancer Research
- PMCOL 371 - Cellular Neuroscience **OR**
- ZOOL 342 - Neurobiology
- ZOOL 303 - Animal Developmental Biology **OR**
- BOT 303 - Plant Development

### Cell Biology Recommended Options

- ANAT 200 - Human Morphology
- ANAT 400 - Human Embryonic Development
- ANAT 401 - Human Neuroanatomy
- ANAT 402 - Human Histology
- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- BIOCH 455 - Biochemistry of Lipids and Lipoproteins
- BIOCH 465 - Methods in Molecular Biophysics
- BIOL 108 - Introduction to Biological Diversity
- BIOL 208 - Principles of Ecology
- BIOL 221 - Mechanisms of Evolution
- BIOL 315 - Biology: An Historical Perspective
- BIOL 322 - Diversity and Evolution of Microbial Life
- BIOL 335 - Principles of Systematics
- BIOL 380 - Genetic Analysis of Populations
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- BIOL 430 - Experimental Biology
- BOT 382 - Plant Biotechnology
- CHEM 361 - Organic Chemistry
- CHEM 363 - Organic Chemistry
- GENET 301 - Organization of Simple Genomes
- GENET 302 - Organization of Complex Genomes
- GENET 364 - Plant Genetics

- GENET 390 - Gene Manipulation
- GENET 408 - Replication, Repair, and Recombination
- GENET 412 - Genetic Control of Animal Development
- IMIN 371 - Introduction to Immunology
- IMIN 401 - Comparative Immunology
- IMIN 410 - Bioinformatics for Molecular Biologists
- MATH 115 - Elementary Calculus II
- MATH 125 - Linear Algebra I
- MICRB 311 - Microbial Physiology
- MICRB 315 - Applied Microbiology and Biotechnology
- MICRB 343 - Analysis of Microbial Macromolecules
- MICRB 410 - Bacterial Structure and Virulence Factors
- MMI 351 - Bacterial Pathogenesis
- MMI 352 - Microbial Pathogenesis
- MMI 405 - Advanced Microbial Pathogenicity
- MMI 415 - Advanced Viral Pathogenesis
- MMI 426 - Medical Parasitology
- MMI 445 - Clinical Microbiology and Human Health
- PHYSL 210 - Human Physiology I
- PHYSL 212 - Human Physiology I
- PHYSL 214 - Human Physiology II
- PHYSL 372 - Systems Neuroscience
- PHYSL 403 - Neuroendimmunomodulation
- PHYSL 404 - Cardiovascular Physiology
- PHYSL 405 - Sensory Physiology
- PMCOL 201 - Introductory Pharmacology
- PMCOL 202
- PMCOL 343 - Scientific Basis of Pharmacology: Part I
- PMCOL 344 - Scientific Basis of Pharmacology: Part II
- PMCOL 412 - Drugs and the Nervous System
- PMCOL 415 - Cardiovascular Pharmacology
- PMCOL 425 - Problem Solving in Pharmacology and Therapeutics
- PMCOL 450 - Diabetes and Its Pharmacotherapy
- PMCOL 475 - Signal Transduction Systems as Pharmacological Targets
- STAT 337 - Biostatistics
- ZOOL 241 - Animal Physiology I: Homeostasis
- ZOOL 242 - Animal Physiology II: Intercellular Communication
- ZOOL 343 - Comparative Endocrinology
- ZOOL 442 - Current Topics in Intercellular Communication

## Honors in Chemistry

Honors students in Chemistry must take a core of Chemistry and auxiliary courses. The core consists of ★45 in Chemistry courses, ★12 in Mathematics courses, ★6 in Physics courses, ★3 in BIOCH 200, ★3 in CHEM 401, ★6 in a junior ENGL or ★3 in ENGL and ★3 in Arts option, and ★12 in Arts options. In addition to the core courses, honors students must complete at least ★18 in senior courses in Chemistry from the courses listed below, with ★6 of these taken at the 400-level. If a student participates in the Science Internship Program, this student may choose to complete ★18 in senior courses in Chemistry as given in the previous statement, or to complete senior courses from Chemistry as follows: ★15 in senior courses in Chemistry from the courses listed below, with ★6 of these taken at the 400-level and INT D 400. Finally, the honors student must include ★15 in options in the third and fourth years of the program. These are normally chosen from offerings within the Faculty of Science (see details of courses). All options must be selected in consultation with the Department of Chemistry.

Continuation in the Honors in Chemistry program requires successful completion of at least ★24 with a minimum 3.0 GPA and a minimum 3.0 GPA on all CHEM courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★90 credited to the degree.

The Honors Chemistry degree is accredited by the Canadian Society for Chemistry.

### Year 1

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- MATH 114 - Elementary Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I

- MATH 115 - Elementary Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- PHYS 144 - Newtonian Mechanics and Relativity **AND**
- PHYS 146 - Fluids and Waves (recommended)
- **OR**
- PHYS 124 - Particles and Waves **AND**
- PHYS 126 - Fluids, Fields, and Radiation
- ★6 in junior ENGL or ★3 in junior ENGL and ★3 in an Arts option
- ★3 in Science option (see details of courses)

### Year 2

- CHEM 211 - Quantitative Analysis I
- CHEM 241 - Introduction to Inorganic Chemistry
- CHEM 243 - Advanced Inorganic Chemistry
- CHEM 263 - Organic Chemistry II
- CHEM 282 - Atomic and Molecular Structure
- CHEM 298 - Introductory Spectroscopy
- MATH 214 - Intermediate Calculus I
- MATH 125 - Linear Algebra I **OR**
- MATH 215 - Intermediate Calculus II **OR**
- STAT 151 - Introduction to Applied Statistics I
- ★6 in Arts options

### Years 3 and 4

- CHEM 313 - Instrumentation in Chemical Analysis
- CHEM 361 - Organic Chemistry
- CHEM 363 - Organic Chemistry
- CHEM 371 - Energetics of Chemical Reactions
- CHEM 373 - Physical Properties and Dynamics of Chemical Systems
- CHEM 398 - Molecular Spectroscopy
- CHEM 401 - Introduction to Chemical Research
- BIOCH 200 - Introductory Biochemistry
- ★18 in senior chemistry courses (with at least ★6 taken at the 400-level). See Note 3.
- ★12 in Science options (see details of courses)
- ★6 in Arts options

### Senior Courses in Chemistry

- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- CHEM 303 - Environmental Chemistry I
- CHEM 305 - Environmental Chemistry II
- CHEM 333 - Inorganic Materials Chemistry
- CHEM 403 - Chemical Research
- CHEM 405 - Special Topics in Chemistry
- CHEM 419 - Bioanalytical Chemistry
- CHEM 424 - Optical Spectroscopy and Electrochemistry
- CHEM 425 - Separations and Mass Spectrometry
- CHEM 434 - X-ray Crystallography
- CHEM 436 - Synthesis and Applications of Inorganic and Nano-materials
- CHEM 437 - Transition Metal Chemistry
- CHEM 438 - Solid State Chemistry
- CHEM 443 - Asymmetric Catalysis
- CHEM 444 - Characterization Methods in Nanoscience
- CHEM 461 - Qualitative Organic Analysis
- CHEM 462 - Physical Organic Chemistry
- CHEM 463 - Organic Synthesis
- CHEM 464 - Bioconjugate Chemistry
- CHEM 477 - Molecular Symmetry and Spectroscopy
- CHEM 479 - Molecular Kinetics
- CHEM 483
- CHEM 489
- CHEM 493 - Computational Chemistry
- CHEM 495 - Molecular Dynamics and its Applications

### Notes

1. Credit in SCI 100 will be considered equivalent to CHEM 101, CHEM 102, CHEM 164, MATH 114, MATH 115, PHYS 144, PHYS 146, BIOL 107 and ★3 Science option (see details of courses).
2. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

- Students in the Science Internship Program may take ★15 in senior chemistry courses (with at least ★6 taken at the 400-level) and INT D 400. .

## Honors in Computing Science

For admission requirements, see Faculty of Science.

There are many routes to the study of Computing Science. Students should visit our website at [www.cs.ualberta.ca](http://www.cs.ualberta.ca). Each student is expected to develop their program of study in consultation with an advisor. All Honors and Specialization programs require annual approval by the department.

### Honors in Computing Science

The Honors program is directed to highly-motivated students with exceptional ability. It provides the opportunity for students to design their program for in-depth study of topics of interest. The Honors program has few specified requirements. Honors students must complete a minimum number of upper level courses (300-level or greater). This implies that they must take the required prerequisites in CMPUT, MATH, and other subjects. There is no set of required 200-level courses, and prerequisites in CMPUT courses can be waived for demonstrated competence in the subject. Programs that cross discipline and faculty boundaries are possible and encouraged.

Because the Honors program is very flexible, all students must obtain departmental guidance in developing their program. All course selections and changes require annual approval by a departmental advisor.

Honors students should keep in mind the degree requirements for Specialization in case they can no longer continue in Honors.

Continuation in the Honors in Computing Science program requires successful completion of at least ★24 with a minimum 3.0 GPA and a minimum 3.0 GPA on all CMPUT courses completed in the previous Fall/Winter.

Graduation requires a minimum GPA of 3.0 GPA on the last ★60 credited to the degree, and 3.0 on all CMPUT courses credited to the degree.

Honors students must complete a minimum of ★24 in CMPUT courses at the 300- or 400-level or greater offered at the University of Alberta.

#### Year 1

- CMPUT 274 - Introduction to Tangible Computing I
- CMPUT 275 - Introduction to Tangible Computing II
- ★6 in junior ENGL or ★3 in junior ENGL and ★3 junior WRS
- ★9 in Science options (see details of courses), (see Notes 4, 5)
- ★9 in approved options

#### Year 2

- ★9 in Science options (see details of courses) (see Notes 4, 5)
- ★6 in Arts options
- ★15 in approved options

#### Year 3

- ★15 in CMPUT at the 300-level or 400-level (see Note 3)
- ★9 in Science options (see details of courses), (see Notes 4, 5)
- ★3 in Arts options
- ★3 in approved options

#### Year 4

- ★15 in CMPUT at the 300-level or 400-level (see Note 3)
- ★9 in Science options (see details of courses), (see Notes 4, 5)
- ★3 in Arts options
- ★3 in approved options

#### Notes

- Students can take a maximum of ★42 in 100-level courses.
- Each Fall and Winter term throughout their program, all Honors students must register in the Honors seminar CMPUT 495 (★0, 1hr/week). This seminar provides honors students with the opportunity to interact with faculty members and honors students from all years of the program to explore topics of interest.
- At least ★12 in CMPUT must be at the 400-level.
- Credit in SCI 100 will be considered equivalent to CMPUT 174 and ★24 Science options (see details of courses). Credit in SCI 151 will be considered equivalent to ★6 Science options.

- MATH 114, MATH 115, MATH 125 or the Honors versions 117, 118, 127; STAT 141, STAT 151 or STAT 265, STAT 252 or STAT 266 are recommended as Science options because they are prerequisites for some advanced CMPUT courses. .

## Computing Science Honors Stream in Bioinformatics

Effective September 2016, there will be no further admissions to BSc Honors or BSc Specialization in Bioinformatics. Students who entered one of these programs prior to September 2016 must complete all program requirements by April 30, 2020. Refer to the Calendar in effect at the time you were admitted or readmitted for the regulations governing the degree program requirements. The last BSc Honors or BSc Specialization in Bioinformatics will be granted at Spring Convocation 2020..

## BSc Honors in Computing Science After an Undergraduate Degree (other than a BSc from the Faculty of Science at the University of Alberta)

For admission requirements, see Faculty of Science.

There are many routes to the study of Computing Science. Students should visit our website at [www.cs.ualberta.ca](http://www.cs.ualberta.ca). Each student is expected to develop their program of study in consultation with an advisor. All Honors and Specialization programs require annual approval by the department.

## BSc Honors in Computing Science After an Undergraduate Degree (other than a BSc from the Faculty of Science at the University of Alberta)

In addition to the requirements set out in After Degrees, a student pursuing this designation must also complete a minimum of ★24 in CMPUT courses at the 300- or 400-level offered at the University of Alberta as part of their ★60.

## Honors in Atmospheric Sciences

Earth and Atmospheric Sciences encompass the study of the atmosphere, surface and interior of the earth. The Department administers 12 academic programs: Honors and Specialization in Atmospheric Sciences, Honors and Specialization in Environmental Earth Sciences, Honors and Specialization in Geology, Honors and Specialization in Paleontology, BSc Specialization in Planning, BA Major and Minor in Human Geography, and BA Major in Planning. For details on the Major and Minor in Human Geography and on the BA Major in Planning, see Faculty of Arts listing.

### Honors in Atmospheric Sciences

Atmospheric science is the study of atmospheric composition, state and motion, from the small scale (e.g., the environment of a single leaf) through medium scales (e.g., a cumulus cloud) to the global scale (global pollution and warming). Most atmospheric scientists in Canada work for Environment Canada, providing weather forecasts or environmental information. Opportunities also arise with provincial governments and in the private sector.

Continuation in the Honors in Atmospheric Sciences program requires successful completion of at least ★24 with a minimum of 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★60 credited to the degree.

A student enrolling in the Honors program should consult the Atmospheric Sciences advisor before registration each year.

#### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- EAS 100 - Planet Earth
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**

- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves
- STAT 151 - Introduction to Applied Statistics I
- 
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

### Year 2

- EAS 212 - The Oceans
- EAS 221 - Introduction to Geographical Information Systems and Remote Sensing
- EAS 270 - The Atmosphere
- HGP 250 - Natural Resources and Environmental Management
- 
- MATH 214 - Intermediate Calculus I
- MATH 215 - Intermediate Calculus II
- PHYS 244 - Mechanics
- PHYS 281 - Electricity and Magnetism
- ★3 Science option (see details of courses)
- ★3 Arts option

### Year 3

- EAS 327 - Environmental Instrumentation
- EAS 370 - Applied Atmospheric Physics
- EAS 371 - Dynamics of the Atmosphere and Ocean I
- EAS 372 - Weather Analysis and Forecasting
- EAS 373 - The Climate System
- PHYS 234 - Introductory Computational Physics
- ★6 in Arts options
- ★3 in Science options (see Note 1 below) (see details of courses)
- ★3 in Open option (see Note 2 below)

### Year 4

- EAS 426 - Undergraduate Thesis
- EAS 470 - Clouds and Storms
- EAS 471 - Atmospheric Modelling
- EAS 475 - Dynamics of the Atmosphere and Ocean II
- ★12 in Science options (see Note 1 below)
- ★3 in Open option (see Note 2 below)

### Notes

1. Students are recommended to consult Advisor for approved Science options.
2. Open option - Chosen from any credit course offered by the University of Alberta.
3. Recommended Arts options include any HGP courses.
4. For students entering Atmospheric Science Honors, credit in SCI 100 will be considered equivalent to CMPUT 174, EAS 100, MATH 114, MATH 115, PHYS 144, PHYS 146 and ★9 Science (see details of courses) options equivalent to CHEM 101, CHEM 102 and EAS 105. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option..

## Honors in Environmental Earth Sciences

Earth and Atmospheric Sciences encompass the study of the atmosphere, surface and interior of the earth. The Department administers 12 academic programs: Honors and Specialization in Atmospheric Sciences, Honors and Specialization in Environmental Earth Sciences, Honors and Specialization in Geology, Honors and Specialization in Paleontology, BSc Specialization in Planning, BA Major and Minor in Human Geography, and BA Major in Planning. **For details on the Major and Minor in Human Geography and on the BA Major in Planning, see Faculty of Arts listing.**

### Honors in Environmental Earth Sciences

Environmental Earth Science is the study of interactions between humans and Earth's natural environment. It encompasses the influence of human activities on the local and global environment, as well as how our actions are shaped and

controlled by the geologic and geomorphic processes occurring around us. Environmental Earth Scientists are typically employed by consulting companies, large resource and industrial firms, and government organizations.

Continuation in the Honors in Environmental Earth Sciences program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★60 credited to the degree.

A student enrolling in the Honors program should confer with the Environmental Earth Sciences Program student advisor before registration each year.

### Year 1

- CHEM 101 - Introductory University Chemistry I **AND**
- CHEM 102 - Introductory University Chemistry II
- 
- EAS 100 - Planet Earth **AND**
- EAS 105 - The Dynamic Earth Through Time
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- PHYS 124 - Particles and Waves **AND**
- PHYS 126 - Fluids, Fields, and Radiation
- **OR**
- PHYS 144 - Newtonian Mechanics and Relativity **AND**
- PHYS 146 - Fluids and Waves
- 
- ★6 junior ENGL **OR** ★3 junior ENGL **AND** ★3 junior WRS

### Year 2

- BIOL 108 - Introduction to Biological Diversity
- EAS 221 - Introduction to Geographical Information Systems and Remote Sensing
- EAS 222 - Stratigraphy and Sedimentation
- EAS 224 - Mineralogy I
- EAS 225 - Earth Surface Processes and Landforms
- EAS 233 - Geologic Structures
- EAS 234 - Geology Field School
- 
- EAS 212 - The Oceans **OR**
- EAS 270 - The Atmosphere
- 
- EAS 294 **OR**
- HGP 250 - Natural Resources and Environmental Management
- 
- STAT 151 - Introduction to Applied Statistics I

### Year 3

- BIOL 208 - Principles of Ecology
- EAS 250 - Biogeography
- EAS 320 - Geochemistry I
- EAS 323 - Introduction to Hydrogeology
- EAS 324 - Quaternary Geoscience and Terrain Analysis
- EAS 354 - Environmental Earth Science Field School
- GEOPH 223 - Environmental Geophysics

### ★6 of

- EAS 327 - Environmental Instrumentation
- EAS 351 - Environmental Applications of Geographical Information Systems
- EAS 451 - Digital Remote Sensing

### Options

- ★3 Arts option

### Year 4

- EAS 425 - Contaminant Hydrogeology **OR**
- EAS 468 - Geochemical Processes
- 
- EAS 426 - Undergraduate Thesis

**★6 of**

- EAS 457 - Global Change
- EAS 458 - Cold Regions Geoscience

**Options**

- ★6 Arts options
- ★9 Science (see details of courses) and related options

**Notes**

1. EAS 458 may be taken more than once for credit. Science and related options require the approval of the Environmental Earth Sciences advisor.
2. For students entering Environmental Earth Science Honors, credit in SCI 100 will be considered equivalent to BIOL 108, CHEM 101, CHEM 102, EAS 100, EAS 105, MATH 114, MATH 115, PHYS 144 and PHYS 146. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option..

## Honors in Geology

Earth and Atmospheric Sciences encompass the study of the atmosphere, surface and interior of the earth. The Department administers 12 academic programs: Honors and Specialization in Atmospheric Sciences, Honors and Specialization in Environmental Earth Sciences, Honors and Specialization in Geology, Honors and Specialization in Paleontology, BSc Specialization in Planning, BA Major and Minor in Human Geography, and BA Major in Planning.

**For details on the Major and Minor in Human Geography and on the BA Major in Planning, see Faculty of Arts listing.**

### Honors in Geology

eology is the study of the planet Earth—the materials it is made of, the processes which affect these materials, and the origin and evolution of life. Geologists are employed by companies engaged in exploration for and production of minerals and fuels, by government agencies, by companies engaged in engineering and environmental projects, and by universities.

Continuation in the Honors in Geology program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★60 credited to the degree.

A student enrolling in the Honors program should consult the Geology program student advisor before registration each year..

**Year 1**

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- EAS 100 - Planet Earth
- EAS 105 - The Dynamic Earth Through Time
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- PHYS 124 - Particles and Waves **AND**
- PHYS 126 - Fluids, Fields, and Radiation
- **OR**
- PHYS 144 - Newtonian Mechanics and Relativity **AND**
- PHYS 146 - Fluids and Waves
- 
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

**Year 2**

- EAS 221 - Introduction to Geographical Information Systems and Remote Sensing
- EAS 222 - Stratigraphy and Sedimentation
- EAS 224 - Mineralogy I
- EAS 225 - Earth Surface Processes and Landforms
- EAS 230 - Introduction to Invertebrate Paleontology
- EAS 232 - Mineralogy II
- EAS 233 - Geologic Structures
- EAS 234 - Geology Field School
- ★3 Arts option
- ★3 Option

**Year 3**

- EAS 320 - Geochemistry I
- EAS 323 - Introduction to Hydrogeology
- EAS 331 - Igneous Petrology
- EAS 332 - Metamorphic Petrology
- EAS 333 - Advanced Geology Field School
- EAS 336 - Sedimentary Systems
- 
- EAS 364 - Petroleum Geology and Subsurface Methods **OR**
- EAS 368 - Ore Deposits Geology
- 
- GEOPH 210 - Physics of the Earth **OR**
- GEOPH 223 - Environmental Geophysics **OR**
- GEOPH 224 - Geophysical Exploration Techniques
- 
- ★3 Arts option
- ★3 Science option (see details of courses)

**Year 4**

- EAS 426 - Undergraduate Thesis
- 
- GEOPH 210 - Physics of the Earth **OR**
- GEOPH 223 - Environmental Geophysics **OR**
- GEOPH 224 - Geophysical Exploration Techniques
- 
- ★6 Arts option
- ★12 EAS Science courses numbered 300 or higher
- ★3 Science option (see details of courses)

**Notes**

1. Recommended Arts options include any HGP courses.
2. For students entering Geology Honors, credit in SCI 100 will be considered equivalent to BIOL 108, CHEM 101, CHEM 102, EAS 100, EAS 105, MATH 114, MATH 115, PHYS 144 and PHYS 146. Credit in SCI 151 will be considered equivalent to ★6 Science options.1.

## Honors in Immunology and Infection

Continuation in the Honors in Immunology and Infection program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★60 credited to the degree.

**Year 1**

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 125 - Linear Algebra I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- STAT 151 - Introduction to Applied Statistics I
- 
- ★3 Approved Option
- ★6 Arts options (junior level ENGL or junior WRS recommended)

**Year 2**

- BIOCH 200 - Introductory Biochemistry
- BIOL 201 - Eukaryotic Cellular Biology
- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- CHEM 263 - Organic Chemistry II
- IMIN 200 - Infection and Immunity
- MICRB 265 - General Microbiology
- 
- GENET 270 - Foundations of Molecular Genetics **OR**
- BIOCH 330 - Nucleic Acids and Molecular Biology (see Note 1)
-

**★6 Arts options**

- Years 3 and 4
- IMIN 324 - Basic Virology
- IMIN 371 - Introduction to Immunology
- IMIN 452 - Advanced Immunology
- MMI 351 - Bacterial Pathogenesis
- 
- ZOOL 241 - Animal Physiology I: Homeostasis **AND**
- ZOOL 242 - Animal Physiology II: Intercellular Communication
- **OR**
- PHYSL 210 - Human Physiology
- **OR**
- PHYSL 212 - Human Physiology I **AND**
- PHYSL 214 - Human Physiology II
- 
- ZOOL 352 - Principles of Parasitism
- 
- BIOL 499 - Research Project **OR**
- MMI 499 - Independent Research in Infection and Immunity
- 
- BIOCH 430 - Biochemistry of Eukaryotic Gene Expression **OR**
- GENET 304 - Gene Expression and its Regulation **OR**
- MICRB 316 - Molecular Microbiology
- 
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics **OR**
- MMI 391 - Current Methods in Molecular Biology
- 
- ★6 Arts options
- ★9 from the List below (see Note 2)
- ★12 in approved options from the List below or approved by the Departmental Advisor

**List**

- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- BIOCH 430 - Biochemistry of Eukaryotic Gene Expression
- BIOCH 450 - The Molecular Biology of Mammalian Viruses
- BIOL 409 - Zoonoses
- CELL 300 - Advanced Cell Biology I
- ENT 378 - Insect Pathology
- GENET 304 - Gene Expression and its Regulation
- IMIN 372 - Research Techniques in Immunology
- IMIN 401 - Comparative Immunology
- IMIN 405 - Innate Immunity
- IMIN 410 - Bioinformatics for Molecular Biologists
- MICRB 316 - Molecular Microbiology
- MICRB 410 - Bacterial Structure and Virulence Factors
- MMI 352 - Microbial Pathogenesis
- MMI 405 - Advanced Microbial Pathogenicity
- MMI 415 - Advanced Viral Pathogenesis
- MMI 426 - Medical Parasitology
- MMI 436 - Inflammation
- MMI 445 - Clinical Microbiology and Human Health
- ZOOL 354 - Wildlife Disease
- ZOOL 452 - Topics in Parasitology

**Notes**

1. GENET 270 is the prerequisite for GENET 304 and MICRB 316, while BIOCH 320 and BIOCH 330 are prerequisites for BIOCH 430.
2. At least ★3 must be in a course with a laboratory component.
3. Normally only ★12 are allowed outside the Faculties of Science and Arts in the entire program. See details of courses for courses outside the Faculty of Science that will be considered as Science options
4. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, CHEM 102, CHEM 164, MATH 114 and ★9 approved options.
5. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

**Honors in Mathematics**

Continuation in the Honors in Mathematics program requires successful completion of at least ★24 with a minimum 3.0 GPA and a minimum 3.0 GPA on all MATH courses completed in the previous Fall/Winter. In addition, graduation

requires a minimum 3.0 GPA on all courses credited towards the degree and a minimum 3.0 GPA on all MATH courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated..

**Year 1**

- MATH 117 - Honors Calculus I (See Note 2)
- MATH 118 - Honors Calculus II (See Note 2)
- MATH 127 - Honors Linear Algebra I (See Note 2)
- MATH 227 - Honors Linear Algebra II (See Note 2)
- ★6 in an approved Science option (see details of courses)
- ★6 in approved Arts options
- ★6 in approved options

**Year 2**

- MATH 217 - Honors Advanced Calculus I
- MATH 317 - Honors Advanced Calculus II
- MATH 328 - Algebra: Introduction to Group Theory
- 
- MATH 326 - Rings and Modules **OR**
- MATH 334 - Introduction to Differential Equations
- 
- ★6 in approved Science options (see details of courses)
- ★6 in approved Arts options
- ★6 in approved options

**Years 3 and 4**

- MATH 326 - Rings and Modules
- MATH 334 - Introduction to Differential Equations
- MATH 411 - Honors Complex Variables
- MATH 417 - Honors Real Variables I
- MATH 418 - Honors Real Variables II
- MATH 424 - Algebra: Groups and Fields
- MATH 447 - Elementary Topology
- MATH 448 - Introduction to Differential Geometry
- MATH 499 - Research Project
- ★12 in approved Science options (see details of courses) including ★3 in CMPUT or STAT
- ★6 in approved Arts options
- ★18 in approved options

**Notes**

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences.
2. With consent of the Department, students may substitute MATH 100, MATH 113, MATH 114, MATH 134, or MATH 144 for MATH 117; MATH 101, MATH 115, or MATH 146 for MATH 118; MATH 102 or MATH 125 for MATH 127; MATH 225 for MATH 227.
3. Several of the required courses, including MATH 411, MATH 424, MATH 447, and MATH 448, may only be offered in alternate years.
4. ECON 299, ECON 386 or ECON 387 may not be used for credit in any Honors degree offered by the Department of Mathematical and Statistical Sciences.
5. SCI 100 will be considered equivalent to MATH 114, MATH 115, CMPUT 174 and ★18 Science options (see details of courses).
6. Credit in SCI 151 will be considered equivalent to ★6 Science options.

The Department also offers a BA in Honors in Mathematics (see Honors in Mathematics, Faculty of Arts).

**Honors in Mathematics, Minor in Computing Science****Requirements**

In addition to the program requirements described in Honors in Mathematics, the student's program must include

- CMPUT 174 - Introduction to the Foundations of Computation I **OR**
- CMPUT 274 - Introduction to Tangible Computing I
- 
- CMPUT 175 - Introduction to the Foundations of Computation II **OR**
- CMPUT 275 - Introduction to Tangible Computing II
- 
- CMPUT 204 - Algorithms I
- CMPUT 272 - Formal Systems and Logic in Computing Science

- CMPUT 304 - Algorithms II
- ★9 in CMPUT at the 300-level or higher

## Honors in Mathematics, Minor in Statistics

### Requirements

In addition to the program requirements described in Honors in Mathematics, the student's program must include

- STAT 265 - Statistics I
- STAT 266 - Statistics II
- at least ★18 in STAT options at the 300-level or higher with at least 6 at the 400-level

## Honors in Applied Mathematics

Continuation in the Honors in Applied Mathematics program requires successful completion of at least ★24 with a minimum 3.0 GPA and a minimum 3.0 GPA on all MATH courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on all courses credited towards the degree and a minimum 3.0 GPA on all MATH courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated.

### Year 1

- MATH 117 - Honors Calculus I (see Note 2)
- MATH 118 - Honors Calculus II (see Note 2)
- MATH 127 - Honors Linear Algebra I (see Note 2)
- MATH 227 - Honors Linear Algebra II (see Note 2)
- ★6 in approved Science options (see details of courses)
- ★6 in approved Arts options
- ★6 in approved options

### Year 2

- MATH 217 - Honors Advanced Calculus I
- MATH 317 - Honors Advanced Calculus II
- 
- MATH 326 - Rings and Modules **OR**
- MATH 328 - Algebra: Introduction to Group Theory
- 
- MATH 334 - Introduction to Differential Equations
- ★6 in approved Science options (see details of courses)
- ★6 in approved Arts options
- ★6 in approved options

### Years 3 and 4

#### ★21 in Mathematics including:

- MATH 337 - Introduction to Partial Differential Equations
- MATH 381 - Numerical Methods I
- MATH 411 - Honors Complex Variables
- MATH 417 - Honors Real Variables I
- MATH 436 - Intermediate Partial Differential Equations I
- MATH 499 - Research Project

#### Options

- ★6 in approved options at the 300-level or higher in the field of application
- ★3 in an approved 300- or 400-level MATH or MA PH
- ★3 in CMPUT or STAT option
- ★9 in approved Science options (see details of courses)
- ★6 in approved Arts options
- ★12 in approved options

#### Notes

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences.
2. With consent of the Department, students may substitute MATH 100, MATH 113, MATH 114, MATH 134, or MATH 144 for MATH 117; MATH 101, MATH 115, or MATH 146 for MATH 118; MATH 102 or MATH 125 for MATH 127; MATH 225 for MATH 227.
3. Several of the required courses, including MATH 411, may only be offered in alternate years.

4. ECON 299, ECON 386 or ECON 387 may not be used for credit in any Honors degree offered by the Department of Mathematical and Statistical Sciences.
5. SCI 100 will be considered equivalent to MATH 114, MATH 115, CMPUT 174 and ★18 Science options (see details of courses).
6. Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Honors in Applied Mathematics, Minor in Computing Science

### Requirements

In addition to the program requirements described in Honors in Applied Mathematics, the student's program must include

- CMPUT 174 - Introduction to the Foundations of Computation I **OR**
- CMPUT 274 - Introduction to Tangible Computing I
- 
- CMPUT 175 - Introduction to the Foundations of Computation II **OR**
- CMPUT 275 - Introduction to Tangible Computing II
- 
- CMPUT 204 - Algorithms I
- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 304 - Algorithms II
- ★9 in CMPUT at the 300-level or higher.

## Honors in Applied Mathematics, Minor in Statistics

### Requirements

In addition to the program requirements described in Honors in Applied Mathematics, the student's program must include

- STAT 265 - Statistics I
- STAT 266 - Statistics II
- at least ★18 in STAT options at the 300-level or higher with at least ★6 at the 400-level

## Honors in Mathematics and Economics

Continuation in the Honors in Mathematics and Economics program requires successful completion of at least ★24 with a minimum 3.0 GPA and a minimum 3.0 GPA on all ECON, MATH and STAT courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on all courses credited towards the degree and a minimum 3.0 GPA on all ECON, MATH and STAT courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated.

### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- 
- MATH 117 - Honors Calculus I (see Note 2)
- MATH 118 - Honors Calculus II (see Note 2)
- MATH 127 - Honors Linear Algebra I (see Note 2)
- MATH 227 - Honors Linear Algebra II See Note (2)
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

### Year 2

- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- MATH 217 - Honors Advanced Calculus I
- MATH 317 - Honors Advanced Calculus II
- STAT 265 - Statistics I
- STAT 266 - Statistics II
- ★6 in approved Science options (see details of courses)
- ★6 in approved options

### Years 3 and 4

- ECON 384 - Intermediate Microeconomic Theory II



- ECON 385 - Intermediate Macroeconomic Theory II
- ECON 481 - Advanced Microeconomic Theory
- ECON 482 - Advanced Macroeconomic Theory
- ECON 497 - Econometric Methods
- STAT 378 - Applied Regression Analysis

---

#### ★12 from

- MATH 334 - Introduction to Differential Equations
- MATH 373 - Mathematical Programming and Optimization I
- MATH 381 - Numerical Methods I
- MATH 417 - Honors Real Variables I
- STAT 372 - Mathematical Statistics
- STAT 479 - Time Series Analysis

---

#### Options

- ★9 in Economics options
- ★12 in MATH or STAT courses (see Note 6)
- ★3 in approved Science options (see details of courses)
- ★6 in approved options

#### Notes

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences.
2. With consent of the Department, students may substitute MATH 100, MATH 113, MATH 114, MATH 134, or MATH 144 for MATH 117; MATH 101, MATH 115, or MATH 146 for MATH 118; MATH 102 or MATH 125 for MATH 127; MATH 225 for MATH 227.
3. Credit is not granted for ECON 299, ECON 386 or ECON 387.
4. Credit in SCI 100 will be considered equivalent to MATH 114, MATH 115, ★15 Science options (see details of courses) and ★6 approved options.
5. Credit in SCI 151 will be considered equivalent to ★6 Science options.
6. Suggested MATH and STAT courses include MATH 411, MATH 418, MATH 432, MATH 447, STAT 471.

## Honors in Mathematics and Finance

Continuation in the Honors in Mathematics and Finance program requires successful completion of at least ★24 with a minimum 3.0 GPA and a minimum 3.0 GPA on all ACCTG, ECON, FIN, MATH, MGTSC, OM and STAT courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on all courses credited towards the degree and a minimum 3.0 GPA on all ACCTG, ECON, FIN, MATH, MGTSC, OM and STAT courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated.

---

#### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- 
- MATH 117 - Honors Calculus I **OR**
- MATH 114 - Elementary Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 118 - Honors Calculus II **OR**
- MATH 115 - Elementary Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 127 - Honors Linear Algebra I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

---

#### Year 2

- ACCTG 311 - Introduction to Accounting for Financial Performance
- ECON 281 - Intermediate Microeconomic Theory I
- 
- MATH 217 - Honors Advanced Calculus I **OR**
- MATH 214 - Intermediate Calculus I
- 
- MATH 317 - Honors Advanced Calculus II **OR**

- MATH 215 - Intermediate Calculus II
- 
- MATH 227 - Honors Linear Algebra II **OR**
- MATH 225 - Linear Algebra II
- 
- MATH 253 - Theory of Interest
- OM 352 - Operations Management
- STAT 265 - Statistics I
- STAT 266 - Statistics II
- ★3 in approved options

---

#### Year 3

- FIN 301 - Introduction to Finance
- FIN 412 - Investment Principles
- MATH 334 - Introduction to Differential Equations
- MATH 337 - Introduction to Partial Differential Equations
- MATH 356 - Introduction to Mathematical Finance I
- MATH 357 - Introduction to Mathematical Finance II
- STAT 371 - Probability and Stochastic Processes
- ★6 in approved MATH options (see note 4)
- ★3 in approved options

---

#### Year 4

- ECON 399 - Introductory Econometrics **OR**
- STAT 378 - Applied Regression Analysis
- 
- FIN 413 - Risk Management
- MATH 373 - Mathematical Programming and Optimization I
- MATH 417 - Honors Real Variables I
- 
- MATH 408 - Computational Finance **OR**
- MATH 415 - Mathematical Finance I
- 
- STAT 471 - Probability I
- ★3 in approved FIN options
- ★9 in approved options

#### Notes

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences and must include:
  - a. ★18 in Arts courses
  - b. ★33 in ACCTG, ECON, FIN, MGTSC or OM, including ★9 in 400-level FIN
2. Approved ACCTG, ECON, FIN and MGTSC options include ACCTG 322, ACCTG 412, ACCTG 432; ECON 282, ECON 384, ECON 385, ECON 399, ECON 481, ECON 482, ECON 497; FIN 414, FIN 416, FIN 422, FIN 434, FIN 442; MGTSC 405. Credit will not be given for ECON 299, ECON 386 or ECON 387.
3. Recommended Science options include: MATH 381, MATH 418, MATH 432, MATH 436, MATH 481, MATH 499; STAT 353, STAT 472, STAT 479; CMPUT 201.
4. A student not presenting the Honors Calculus sequence MATH 117/MATH 118/MATH 217/MATH 317 must take MATH 314 and MATH 414.
5. Credit in SCI 100 will be considered equivalent to CMPUT 174, MATH 114, MATH 115 and ★18 options.
6. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Honors in Statistics

Continuation in the Honors Statistics program requires successful completion of at least ★24 with a minimum 3.0 GPA and a minimum 3.0 GPA on all MATH and STAT courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on all courses credited towards the degree and a minimum 3.0 GPA on all MATH and STAT courses credited towards the degree.

The program must contain the following courses, which should be taken in the years indicated:

---

#### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- 
- MATH 117 - Honors Calculus I **OR**
- MATH 114 - Elementary Calculus I **OR**

- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 118 - Honors Calculus II **OR**
- MATH 115 - Elementary Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 127 - Honors Linear Algebra I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★6 in approved options

### Year 2

- MATH 217 - Honors Advanced Calculus I **OR**
- MATH 214 - Intermediate Calculus I
- 
- MATH 317 - Honors Advanced Calculus II **OR**
- MATH 215 - Intermediate Calculus II
- 
- MATH 227 - Honors Linear Algebra II **OR**
- MATH 225 - Linear Algebra II
- 
- STAT 252 - Introduction to Applied Statistics II
- STAT 265 - Statistics I
- STAT 266 - Statistics II
- ★6 in approved Arts options
- ★3 in approved Science options (see details of courses)
- ★3 in an approved option

### Years 3 and 4

- MATH 314 - Analysis I **OR**
- MATH 417 - Honors Real Variables I
- 
- MATH 414 - Analysis II **OR**
- MATH 418 - Honors Real Variables II
- 
- STAT 361 - Sampling Techniques
- STAT 368 - Introduction to Design and Analysis of Experiments
- STAT 371 - Probability and Stochastic Processes
- STAT 372 - Mathematical Statistics
- STAT 378 - Applied Regression Analysis
- STAT 471 - Probability I
- STAT 499 - Research Project
- ★12 in STAT options at the 400-level
- ★6 in approved Arts options
- ★15 in approved Science options (see details of courses)

### Notes

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences.
2. Credit will not be granted for ECON 299, ECON 386 or ECON 387.
3. Credit in SCI 100 will be considered equivalent to CMPUT 174, MATH 114, MATH 115 and ★18 approved Science options (see details of courses).
4. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

### Science Internship Program

A Science Internship Program, similar to a co-op program, is offered to students in the General, Specialization or Honors programs in Mathematical and Statistical Sciences (see Science Internship Program for guidelines to the program). The Science Internship designation will appear on the degree parchments of students who have participated in the program and who have also successfully completed MATH 400 or STAT 400

## Honors in Neuroscience

The Honors program in Neuroscience is an interdisciplinary program coordinated by the Neuroscience and Mental Health Institute. This program is for students planning a career in Neuroscience.

For admission to the Honors in Neuroscience program see Admissions Chart 7, Faculty of Science.

Neuroscience is a broadly based discipline covering all aspects of brain function. Some major areas are brain development, nerve cells and synapses, sensation and perception, learning and memory, control of movement, animal behavior, cognitive psychology, and disorders of the nervous system.

The Honors program introduces the major areas of Neuroscience and allows students to explore topics of interest in their final year.

Continuation in the Honors program requires a minimum GPA of 3.3 in each preceding Fall/Winter. Graduation requires a minimum GPA of 3.3 on ★60 in Years 3 and 4 of the program. Each program of study must be approved by the program coordinator in the Neuroscience and Mental Health Institute.

A full course load of ★30 per academic year must be maintained throughout each year of the Honors program. Courses cannot be deferred to the Spring/Summer Terms without prior permission of the program coordinator..

### Year 1

- BIOL 107 - Introduction to Cell Biology
- CHEM 101 - Introductory University Chemistry I
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- STAT 141 - Introduction to Statistics **OR**
- STAT 151 - Introduction to Applied Statistics I
- 
- PHYS 124 - Particles and Waves
- PHYS 126 - Fluids, Fields, and Radiation
- PSYCO 104 - Basic Psychological Processes
- ★6 junior ENGL or WRS

### Year 2

- BIOCH 200 - Introductory Biochemistry
- BIOL 207 - Molecular Genetics and Heredity
- CHEM 263 - Organic Chemistry II
- NEURO 210 - Introduction to Clinical Neuroscience
- 
- PHYSL 212 - Human Physiology I **AND**
- PHYSL 214 - Human Physiology II (Students must be manually enrolled in both courses by the Department of Physiology. Registration via Bear Tracks is not possible.)
- 
- PSYCO 275 - Brain and Behavior
- ★6 in Science options (see details of courses)
- ★3 in Arts options

### Year 3

- NEURO 375 - Functional Neuroanatomy
- 
- PMCOL 371 - Cellular Neuroscience **OR**
- ZOOL 342 - Neurobiology but not both
- 
- PHYSL 372 - Systems Neuroscience

#### ★3 from

- PSYCO 371 - The Neurobiology of Learning and Memory
- PSYCO 375 - Introduction to Cognitive Neuroscience
- PSYCO 377 - Human Neuropsychology
- GENET 270 - Foundations of Molecular Genetics
- GENET 390 - Gene Manipulation
- ZOOL 344 - Laboratory Exercises in Animal Physiology

#### Options

- ★12 in approved options
- ★6 in Arts options

### Year 4

Honors neuroscience students may choose from two research streams during their fourth year of study. Research Stream A (Independent Study and Laboratory Research) allows for ★6 or ★9 of independent study and research in one or more labs in the Neuroscience and Mental Health Institute. This stream provides flexibility and allows for exposure to multiple research areas. Research Stream B (Undergraduate Honors Thesis in Neuroscience) involves ★12 in independent study and research to be performed in the lab of a single faculty member in the Neuroscience and Mental Health Institute, with the development of an

undergraduate honors research thesis. This option is therefore a more intensive research experience allowing for more time and independent study in a neuroscience lab, and will culminate with a written research thesis and oral thesis defense.

#### Research Stream A (Independent Study and Laboratory Research):

- NEURO 450 - Readings on Selected Topics in Neuroscience
- 
- NEURO 451 - Honors Research Project in Neuroscience **AND/OR**
- NEURO 452 - Honors Research Project in Neuroscience
- 
- ★6 (if NEURO 450, NEURO 451 and NEURO 452 are taken) or ★9 (if NEURO 450 and one of NEURO 451 or NEURO 452 are taken) of Science options (see details of courses) approved by the program coordinator.
- ★3 in Arts options

#### ★6 chosen from the following courses covering topics in Cellular and Molecular Neuroscience:

- NEURO 410 - Neurobiology of Aging and Neurodegenerative Disorders
- PHYSL 444 - Current Topics in Neuroscience
- PMCOL 412 - Drugs and the Nervous System
- PMCOL 512 - Pharmacology of the Synapse
- PSYCO 478 - Behavior and Brain Chemistry

#### ★6 chosen from the following courses covering topics in Systems and Cognitive Neuroscience:

- NEURO 443 - Neuroendocrine Concepts
- NEURO 472 - Autonomic Nervous System
- NEURO 496 - Computational Neuroscience
- PHYSL 403 - Neuroendimmunomodulation
- PHYSL 405 - Sensory Physiology
- PSYCI 511 - Biological Aspects of Psychiatry
- PSYCO 471 - Neurophysiology: Theory, Methods, and Analysis
- PSYCO 475 - Biological Bases of Behavior

### OR

#### Research Stream B (Undergraduate Honors Thesis in Neuroscience):

- NEURO 498 - Honors Research Project in Neuroscience I
- NEURO 499 - Honors Research Project in Neuroscience II
- ★3 of Science options (see details of courses) approved by the program coordinator
- ★3 in Arts options

#### ★6 chosen from the following courses covering topics in Cellular and Molecular Neuroscience:

- NEURO 410 - Neurobiology of Aging and Neurodegenerative Disorders
- PHYSL 444 - Current Topics in Neuroscience
- PMCOL 412 - Drugs and the Nervous System
- PMCOL 512 - Pharmacology of the Synapse
- PSYCO 478 - Behavior and Brain Chemistry

#### ★6 chosen from the following courses covering topics in Systems and Cognitive Neuroscience:

- PSYCO 471 - Neurophysiology: Theory, Methods, and Analysis
- PHYSL 403 - Neuroendimmunomodulation
- PHYSL 405 - Sensory Physiology
- NEURO 443 - Neuroendocrine Concepts
- NEURO 472 - Autonomic Nervous System
- NEURO 496 - Computational Neuroscience
- PSYCI 511 - Biological Aspects of Psychiatry

### Notes

1. Each student's program must include:
  - a. a minimum of ★18 in Arts courses;
  - b. a minimum of ★90 in Science courses (see details of courses);
  - c. no more than ★12 in Outside (non-Science, non-Arts) courses;
  - d. no more than ★42 at the junior level.
2. Each student's program must have the approval of the Neuroscience and Mental Health Institute.
3. Approved Science options in Years 1-3 may be chosen from Science departments including BIOCH, BIOL, CELL, CHEM, CMPUT, EAS, ENT, GENET, IMIN, MATH, MICRB, PMCOL, PHYS, PHYSL, PSYCO, STAT. 300- and 400-level options are preferable in Years 3 and 4. Science options must be approved by the program coordinator for the Neuroscience and Mental Health Institute Undergraduate Honors Program.

4. Courses in Faculties outside of the Faculty of Science and Arts that may be used as approved Outside (non-Science, non-Arts) options include: ANAT 200, ANAT 400; LABMP 400; PHER 567, and BME 520. All other Outside options require prior approval by the Neuroscience and Mental Health Institute.
5. In the fourth year, all students must successfully complete an individual study program with members of the Neuroscience and Mental Health Institute. This program can be chosen from either Research Stream A (Independent Study and Laboratory Research) or Research Stream B (Undergraduate Honors Thesis in Neuroscience).
6. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, CHEM 164, MATH 114, MATH 115, PHYS 144, PHYS 146 and PSYCO 104.
7. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option..

## Honors in Paleontology

Paleontology is a basic science concerned with the evolutionary history of life. Students are required to have a broad knowledge base of biological and geological knowledge. Areas of detailed knowledge will include vertebrate and invertebrate paleobiology, paleobotany, evolutionary biology, systematics, functional morphology, sedimentology, stratigraphy, and plate tectonics. Paleontologists usually hold advanced research degrees and work as research scientists and teachers in universities, museums, and industrial laboratories.

### Honors in Paleontology

The Honors program is administered by the Departments of Earth and Atmospheric Sciences and Biological Sciences. The curriculum is drawn from both departments enabling students to develop a broad knowledge base that will prepare them for later entry into more specialized postgraduate studies in their selected paleontological discipline. Interested students should consult with an Honors program advisor to prepare their programs.

Continuation in the Honors in Paleontology program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★60 credited to the degree.

#### Year 1

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- 
- CHEM 101 - Introductory University Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- 
- EAS 100 - Planet Earth
- EAS 105 - The Dynamic Earth Through Time
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- 
- ★3 Science option (see details of courses)
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

#### Years 2, 3, and 4

- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- BIOL 221 - Mechanisms of Evolution
- BIOL 335 - Principles of Systematics
- 
- BIOL 499 - Research Project **OR**
- EAS 426 - Undergraduate Thesis
- 
- EAS 222 - Stratigraphy and Sedimentation
- EAS 230 - Introduction to Invertebrate Paleontology
- EAS 233 - Geologic Structures
- EAS 234 - Geology Field School
- 
- EAS 336 - Sedimentary Systems **OR**

- ZOOL 325 - Comparative Anatomy of the Vertebrates
- 
- ZOOL 224 - Vertebrate Diversity **OR**
- ZOOL 250 - Survey of the Invertebrates
- 
- ★6 PALEO 4XX and/or EAS 4XX
- ★21 in Science from approved courses below (see note)
- ★12 in approved Arts options
- ★15 Open options [including Science courses (see details of courses) below]

#### Recommended option courses for Vertebrate Paleontology:

- BIOL 315 - Biology: An Historical Perspective
- BIOL 361 - Marine Science
- BIOL 364 - Freshwater Ecology
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 421 - Molecular Evolution and Systematics
- BIOL 498 - Research Project
- MA SC 412 - Biology of Fishes
- PALEO 400 - Paleontology Field School
- PALEO 412 - Selected Topics in Paleontology
- PALEO 414 - Paleontology
- PALEO 418 - Paleobiology of the Lower Vertebrates
- PALEO 419 - Paleobiology of the Higher Vertebrates
- ZOOL 224 - Vertebrate Diversity
- ZOOL 325 - Comparative Anatomy of the Vertebrates
- ZOOL 405 - Biology of Fishes
- ZOOL 406 - Biology of Amphibians and Reptiles
- ZOOL 407 - Biology of Birds
- ZOOL 408 - Biology of Mammals

#### Recommended option courses for Invertebrate Paleontology:

- BIOL 315 - Biology: An Historical Perspective
- BIOL 361 - Marine Science
- BIOL 364 - Freshwater Ecology
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 421 - Molecular Evolution and Systematics
- BIOL 498 - Research Project
- BOT 205 - Fundamentals of Plant Biology
- BOT 308 - Plant Anatomy
- BOT 321 - Flowering Plants
- EAS 110 - Earth Science Field School
- EAS 208 - Introduction to Global Change
- EAS 225 - Earth Surface Processes and Landforms
- EAS 270 - The Atmosphere
- EAS 320 - Geochemistry I
- EAS 336 - Sedimentary Systems
- EAS 364 - Petroleum Geology and Subsurface Methods
- EAS 373 - The Climate System
- EAS 421 - Structural Geology and Tectonics
- EAS 457 - Global Change
- EAS 460 - Geobiology
- EAS 462 - Stratigraphy and Sedimentary Basins
- EAS 465 - Sedimentology
- ENT 220 - Insect Biology
- ENT 327 - Terrestrial Arthropod Diversity
- MA SC 410 - Marine Invertebrate Zoology
- PALEO 412 - Selected Topics in Paleontology
- PALEO 414 - Paleontology
- ZOOL 250 - Survey of the Invertebrates

#### Notes

1. Some courses are offered in alternate years only, so plan your schedule appropriately.
2. Approved Arts options: ANTHR 209, ANTHR 390, ANTHR 391, CHRTC 350, PHIL 265, PHIL 317.
3. Approved options: BIOL 299, BIOL 315, BIOL 361, BIOL 364, BIOL 398, BIOL 399, BIOL 421, BIOL 498, BIOL 499; BOT 205, BOT 308, BOT 314, BOT 321; EAS 110, EAS 207, EAS 208, EAS 221, EAS 224, EAS 225, EAS 250, EAS 270, EAS 320, EAS 336, EAS 364, EAS 373, EAS 421, EAS 426, EAS 427, EAS 428, EAS 457, EAS 460, EAS 462, EAS 465; ENT 220, ENT 327; GEOPH 223, GEOPH 224; MA SC 410, MA SC 412, MA SC 430; PALEO 400, PALEO 412, PALEO 414, PALEO 418, PALEO 419; ZOOL 224, ZOOL 250, ZOOL 325, ZOOL 405, ZOOL 406, ZOOL 407, ZOOL 408. For information regarding additional approved options, please consult your program advisor.

4. For students entering Paleontology Honors, credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, EAS 100, EAS 105, MATH 114, MATH 115, PHYS 144 and PHYS 146. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.
5. Please refer to the Association of Professional Engineers and Geoscientists of Alberta (APEGA) course requirements when choosing courses if you wish to apply to APEGA for Professional Geoscientist status following the completion of your degree.

## Honors in Pharmacology

The program leading to an Honors degree in Pharmacology prepares students for advanced study leading to academic or research careers.

Continuation and graduation in the Honors in Pharmacology program requires successful completion of ★24 with a minimum 3.0 GPA, a minimum 3.0 GPA on all Science courses taken and a minimum 3.0 GPA in PMCOL courses taken in each previous Fall/Winter with at least a grade of B- in each course.

#### Year 1

- BIOL 107 - Introduction to Cell Biology
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- STAT 151 - Introduction to Applied Statistics I
- 
- ★6 in Arts options ENGL recommended
- ★9 in Science options from BIOCH, BIOL, CHEM, GENET, MATH, MICRB, PHYS, PHYSL, PMCOL, STAT or ZOOL

#### Year 2

- BIOCH 200 - Introductory Biochemistry
- CHEM 263 - Organic Chemistry II
- 
- PHYSL 210 - Human Physiology **OR**
- PHYSL 212 - Human Physiology I
- **AND**
- PHYSL 214 - Human Physiology II
- 
- PMCOL 201 - Introductory Pharmacology
- ★9 in Science options as indicated in Year 1
- ★6 in Arts options

#### Year 3

- PMCOL 303 - Introduction to Toxicology
- PMCOL 305 - An Introduction to the Pharmacology of Drug Abuse
- PMCOL 337 - Experimental Procedures in Pharmacology
- PMCOL 343 - Scientific Basis of Pharmacology: Part I
- PMCOL 344 - Scientific Basis of Pharmacology: Part II
- BIOCH 320 - Structure and Catalysis
- ★6 in Science options as indicated in Year 1
- ★3 in Arts options
- ★3 in approved options

#### Year 4

- PMCOL 498 - Pharmacology Research Program

#### ★12 from the following:

- PMCOL 412 - Drugs and the Nervous System
- PMCOL 415 - Cardiovascular Pharmacology
- PMCOL 416 - Current Topics in Endocrine Pharmacology
- PMCOL 425 - Problem Solving in Pharmacology and Therapeutics
- PMCOL 450 - Diabetes and Its Pharmacotherapy
- PMCOL 475 - Signal Transduction Systems as Pharmacological Targets

#### Options

- ★3 in Arts options
- ★6 in Science option as indicated in Year 1
- ★3 in approved options

#### Notes

1. Students must consult the Chair of the Department or designee for approval of the selection of options. Students will not be permitted to take 400-level pharmacology courses unless all prerequisites have been met.

- Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, CHEM 102, CHEM 164, MATH 114, MATH 115 and ★6 Science options (see details of courses).
- Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.
- Students who take PMCOL 498 may not take PMCOL 401 or PMCOL 402.
- Recommended Science options: BIOCH 310, BIOCH 330, BIOCH 401, BIOCH 410, BIOCH 420, BIOCH 430, BIOCH 441, BIOCH 450, CHEM 211, CHEM 213, CHEM 313, CHEM 419, GENET 270, GENET 301, GENET 304, GENET 390, GENET 408, MATH 114, MATH 115, PHYSL 372, PHYSL 401, PHYSL 402, PHYSL 403, PHYSL 404, PMCOL 371, STAT 252.

## Honors in Physics

The Honors Programs offered by the Department of Physics provide a comprehensive education for students planning advanced degrees and a research or academic career.

Students interested in the Engineering-Physics program should consult Engineering Physics of the Faculty of Engineering section.

Honors Physics students must consult an advisor in the Department of Physics regarding their programs. Not all 200-, 300- and 400-level Physics and Geophysics courses are offered every year so students should plan accordingly.

Continuation in the Honors in Physics program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★90 credited to the degree.

### Year 1

- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 117 - Honors Calculus I
- .
- MATH 146 - Calculus for the Physical Sciences II **OR**
- MATH 118 - Honors Calculus II
- .
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- .
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- .
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves
- ★6 in Science options (see details of courses) (CMPUT 174 recommended if a student has no computing background)
- ★6 in an Arts options (see Note 1)

### Year 2

- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- .
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- .
- PHYS 234 - Introductory Computational Physics
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 281 - Electricity and Magnetism
- PHYS 295 - Experimental and Statistical Methods of Physics
- PHYS 297 - Classic Experiments in Physics
- ★6 in an Arts option (see Note 1)

### Year 3

- MATH 311 - Theory of Functions of a Complex Variable **OR**
- MATH 411 - Honors Complex Variables
- .
- MATH 334 - Introduction to Differential Equations
- MATH 337 - Introduction to Partial Differential Equations
- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 311 - Statistical Physics
- PHYS 362 - Optics and Lasers
- PHYS 372 - Quantum Mechanics A
- PHYS 381 - Electromagnetic Theory I
- PHYS 397 - Projects in Experimental Physics
- ★3 in an Arts option (see Note 1)

### Year 4

- MA PH 343 - Classical Mechanics I
- PHYS 472 - Quantum Mechanics B
- PHYS 481 - Electromagnetic Theory II
- PHYS 499 - Special Projects
- ★3 in PH Pool A options (see Note 2)
- ★3 in PH Pool B options (see Note 3)
- ★9 in PH Pool options (see Note 4)
- ★3 in an Arts option (see Note 1)

### Notes

- By the end of their programs, students must have taken ★18 of Arts options.
- PH Pool A options: All 400-level ASTRO; PHYS 415, PHYS 485, PHYS 495.
- PH Pool B options: MA PH 451; all 400-level MATH; PHYS 458, PHYS 467.
- PH Pool options: ASTRO 320, ASTRO 322; EAS 370, EAS 371, EAS 373; all 300- and 400-level GEOPH; all 400-level PHYS; all courses in Pool A and Pool B. Other courses may be taken by prior consent of the Department of Physics.
- Credit in SCI 100 will be considered equivalent to MATH 114, MATH 115, PHYS 144, PHYS 146 and ★6 Science options (see details of courses).
- Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Honors in Astrophysics

Continuation in the Honors in Astrophysics program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★90 credited to the degree.

### Year 1

- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 117 - Honors Calculus I
- .
- MATH 146 - Calculus for the Physical Sciences II **OR**
- MATH 118 - Honors Calculus II
- .
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- .
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- .
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves
- ★6 in Science options (see details of courses) (recommended options are ASTRO 120, ASTRO 122, or CMPUT 174 if a student has no computing background)
- ★6 in Arts options

### Year 2

- ASTRO 320 - Stellar Astrophysics I
- .
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- .
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- .
- PHYS 234 - Introductory Computational Physics
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 281 - Electricity and Magnetism
- PHYS 295 - Experimental and Statistical Methods of Physics
- PHYS 297 - Classic Experiments in Physics
- ★3 in Arts options

### Year 3

- ASTRO 322 - Galactic and Extragalactic Astrophysics
- MATH 311 - Theory of Functions of a Complex Variable
- MATH 334 - Introduction to Differential Equations
- MATH 337 - Introduction to Partial Differential Equations
- PHYS 310 - Thermodynamics and Kinetic Theory

- PHYS 311 - Statistical Physics
- PHYS 362 - Optics and Lasers
- PHYS 372 - Quantum Mechanics A
- PHYS 381 - Electromagnetic Theory I
- ★ 3 Arts option

#### Year 4

- MA PH 343 - Classical Mechanics I
- PHYS 458 - Special and General Relativity
- PHYS 472 - Quantum Mechanics B
- PHYS 481 - Electromagnetic Theory II
- PHYS 499 - Special Projects

#### ★6 from

- ASTRO 429 - Upper Atmosphere and Space Physics
- ASTRO 430 - Physical Cosmology
- ASTRO 465 - Stellar Astrophysics II

#### Options

- ★3 in AH Pool option (see Note 2)
- ★6 in Arts options

#### Notes

1. Students must take a total of ★18 in Arts options.
2. AH Pool: EAS 370, EAS 371, EAS 373; all 300-level GEOPH courses; PHYS 397; MA PH 451; all 400-level ASTRO, GEOPH, PHYS, and MATH courses. Other courses may be taken with prior consent of Department.
3. Credit in SCI 100 will be considered equivalent to MATH 114, MATH 115, PHYS 144 and PHYS 146 and ★6 Science options (see details of courses).
4. Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Honors in Geophysics

Continuation in the Honors in Geophysics program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★90 credited to the degree.

#### Year 1

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- GEOPH 110 - Introduction to Geophysics
- 
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 117 - Honors Calculus I
- 
- MATH 146 - Calculus for the Physical Sciences II **OR**
- MATH 118 - Honors Calculus II
- 
- MATH 125 - Linear Algebra I
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves
- ★6 in Arts options (junior ENGL or junior WRS recommended)

#### Year 2

- EAS 105 - The Dynamic Earth Through Time
- EAS 233 - Geologic Structures
- 
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- PHYS 234 - Introductory Computational Physics
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 281 - Electricity and Magnetism
- PHYS 295 - Experimental and Statistical Methods of Physics
- ★3 in an Arts or approved Science option (see Note 1). CMPUT 174 in Fall Term is recommended if a student has no computing background.

#### Year 3

- EAS 222 - Stratigraphy and Sedimentation
- GEOPH 325 - Gravity, Magnetic, and Electrical Geophysics
- GEOPH 326 - Seismic Imaging

- 
- MATH 311 - Theory of Functions of a Complex Variable **OR**
- MATH 411 - Honors Complex Variables
- 
- MATH 334 - Introduction to Differential Equations
- MATH 337 - Introduction to Partial Differential Equations
- PHYS 381 - Electromagnetic Theory I
- ★9 in approved Science or Arts options (see Note 2)

#### Year 4

- GEOPH 421 - Seismology and the Physical Structure of the Earth
- GEOPH 424 - Electromagnetic Methods in Geophysics
- GEOPH 426 - Signal Processing in Geophysics
- GEOPH 436 - Geophysics Field School
- GEOPH 438 - Seismic Data Processing
- PHYS 467 - Fundamentals of Continuum Mechanics
- PHYS 481 - Electromagnetic Theory II
- ★6 in approved Science options (see Note 2)
- ★3 in an Arts option (See Note 1)

#### Notes

1. In addition to the specific courses listed in the program, students must take ★15 in approved Science options (see details of courses) and ★12 in Arts options.
2. Suggested approved Science options: ASTRO 429 ; CMPUT 174 (recommended); EAS 221, EAS 224, EAS 320, EAS 323, EAS 324, EAS 425; GEOPH 332, GEOPH 431, GEOPH 440; MIN E 323; PET E 365, PET E 477; PHYS 308, PHYS 310 (recommended), PHYS 499; STAT 151. Students in Geophysics will not have the formal prerequisites for many of the EAS, MIN E, and PET E courses, and must request permission to register in those courses from the department offering the particular course.
3. Not all 300-level and 400-level courses are offered every year. Students must consult the Department of Physics for approval of programs.
4. Students entering this program after first year may take GEOPH 210 in lieu of GEOPH 110. However, students will not receive credit for both GEOPH 110 and GEOPH 210.
5. Credit in SCI 100 will be considered equivalent to CHEM 101, CHEM 102, EAS 105, MATH 114, MATH 115, PHYS 144 and PHYS 146.
6. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Honors in Mathematical Physics

Continuation in the Honors in Mathematical Physics program requires successful completion of at least ★24 with a minimum 3.0 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 3.0 GPA on the last ★90 credited to the degree.

#### Year 1

- MATH 117 - Honors Calculus I
- MATH 118 - Honors Calculus II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- 
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves
- ★6 in Science options (see details of courses) (CMPUT 174 recommended if a student has no computing background)
- ★6 in Arts options

#### Year 2

- MATH 217 - Honors Advanced Calculus I
- MATH 317 - Honors Advanced Calculus II
- MATH 334 - Introduction to Differential Equations
- PHYS 234 - Introductory Computational Physics
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 281 - Electricity and Magnetism
- PHYS 295 - Experimental and Statistical Methods of Physics
- ★6 in Arts option

### Year 3

- MATH 311 - Theory of Functions of a Complex Variable **OR**
- MATH 411 - Honors Complex Variables
- 
- MATH 337 - Introduction to Partial Differential Equations
- MA PH 343 - Classical Mechanics I
- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 311 - Statistical Physics
- PHYS 372 - Quantum Mechanics A
- PHYS 381 - Electromagnetic Theory I
- ★3 in MPH Senior Science options (see Note 1)
- ★6 in Arts option

### Year 4

- MATH 417 - Honors Real Variables I
- MA PH 451 - Mathematical Methods of Physics I
- PHYS 458 - Special and General Relativity
- PHYS 472 - Quantum Mechanics B
- PHYS 481 - Electromagnetic Theory II
- PHYS 499 - Special Projects
- ★12 in MPH Pool courses (see Note 2)

### Notes

1. MPH Senior Science options: any 300- or 400-level course offered by the Faculty of Science (see details of courses).
2. MPH Pool courses: PHYS 362, PHYS 397; all 300- and 400-level ASTRO and GEOPH courses; all 400-level MA PH, MATH and PHYS courses. Other courses may be taken with prior consent of Department.
3. Credit in SCI 100 will be considered equivalent to MATH 114, MATH 115, PHYS 144, PHYS 146 and ★6 Science options (see details of courses).
4. Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Honors in Physiology

Honors in Physiology is offered by the Department of Physiology in the Faculty of Medicine and Dentistry through the Faculty of Science.

The Honors program is designed to prepare students for advanced study leading to careers in academia, industrial research, or for entry into health-related professions. A choice of courses is available for students with interests in particular branches of the life sciences (e.g., cell and molecular biology, endocrinology, cardiovascular physiology, and neurobiology).

Continuation and graduation in the Honors Physiology program requires successful completion of ★24 with a minimum 3.0 GPA, in the previous Fall/Winter. In addition, second-year students must present a minimum grade of B in PHYSYL 212 and PHYSYL 214 in order to continue, whereas students who are eligible to enter the program in their third year and have credit in PHYSYL 210 must present a minimum grade of A- in order to be admitted. Students must consult the Departmental Advisor prior to registration in each year of the program.

### Year 1

- BIOL 107 - Introduction to Cell Biology
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- CHEM 263 - Organic Chemistry II
- STAT 151 - Introduction to Applied Statistics I
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★6 in approved options

### Year 2

- BIOCH 200 - Introductory Biochemistry
- BIOL 201 - Eukaryotic Cellular Biology
- BIOL 207 - Molecular Genetics and Heredity
- 
- PHYS 124 - Particles and Waves **OR**
- PHYS 126 - Fluids, Fields, and Radiation
- 
- PHYSYL 212 - Human Physiology I
- PHYSYL 214 - Human Physiology II

- PMCOL 201 - Introductory Pharmacology

### Year 3

- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- PHYSL 310 - Experimental Techniques in Physiology
- PHYSYL 372 - Systems Neuroscience
- PHYSYL 403 - Neuroendimmunomodulation
- PMCOL 371 - Cellular Neuroscience
- ★9 in approved options

### Year 4

#### Requirements

- PHYSYL 467 - Undergraduate Research Project

#### ★9 from

- BIOL 545 - Advanced Topics in Animal and Cell Physiology
- NEURO 410 - Neurobiology of Aging and Neurodegenerative Disorders
- or other 400- or 500-level Science (see details of courses) or Non-Science or Non-Arts courses, with consent of the Department.

#### ★9 from

- PHYSYL 400 - Reproductive Physiology
- PHYSYL 404 - Cardiovascular Physiology
- PHYSYL 405 - Sensory Physiology
- PHYSYL 444 - Current Topics in Neuroscience
- PHYSYL 501 - Topics in Cardiovascular Physiology
- PHYSYL 513 - Fetal Physiology
- 
- PHYSYL 545 - Physiology of Transport Systems **OR**
- NEURO 443 - Neuroendocrine Concepts

#### Options

- ★6 in other approved options

### OR

#### Requirements

- PHYSYL 468 - Undergraduate Research Thesis I
- PHYSYL 469 - Undergraduate Research Thesis II

#### ★12 from

- PHYSYL 400 - Reproductive Physiology
- PHYSYL 404 - Cardiovascular Physiology
- PHYSYL 405 - Sensory Physiology
- PHYSYL 444 - Current Topics in Neuroscience
- PHYSYL 501 - Topics in Cardiovascular Physiology
- PHYSYL 513 - Fetal Physiology
- 
- PHYSYL 545 - Physiology of Transport Systems **OR**
- BIOL 545 - Advanced Topics in Animal and Cell Physiology
- 
- NEURO 410 - Neurobiology of Aging and Neurodegenerative Disorders
- or other 400- or 500-level Science (see details of courses) or non-Arts/non-Science courses, with consent of the Department

#### Options

- ★6 in another approved options

### Notes

1. The program must consist of a minimum of ★90 in Science (see details of courses), a minimum of ★18 in Arts, and no more than ★18 in non-Arts/non-Science options and no more than ★42 in junior (100-level) courses.
2. Honors students in the first year of the program who are unable to take CHEM 263 may take 263 in second year.
3. All options must be approved by Departmental Advisor.
4. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, CHEM 102, CHEM 164, PHYS 144, PHYS 146 and ★6 approved Science options (see details of courses). Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Honors in Psychology

The Department offers courses leading to the degrees of BSc and BA with Honors in Psychology. Students wishing to emphasize the physical, biological, and mathematical sciences should enrol in the BSc program; those wishing to

emphasize the humanities and social sciences should enrol in the BA program. Either program is appropriate for students considering postgraduate training in psychology or in other fields that require these research skills.

Admission into the Honors program is permitted after completion of a minimum of ★48. Final acceptance into the Honors program is dependent upon obtaining approval from a potential research supervisor prior to August 31.

Continuation in and graduation from the Honors Psychology program require successful completion of ★24 with a minimum GPA of 3.3 in each Fall/Winter Term. Exceptions to this requirement must be approved by both the Department of Psychology and the Faculty of Science. In addition, students must present a minimum of ★48 (but no more than ★66 senior) in Psychology courses and a minimum of ★72 in Science courses. A student's program of courses must be approved in advance each year by the Honors Psychology advisor.

### Year 1

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- PSYCO 104 - Basic Psychological Processes
- PSYCO 105 - Individual and Social Behavior
- STAT 151 - Introduction to Applied Statistics I
- 
- ★3 from junior Mathematical Sciences
- ★3-6 in approved Science options
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

### Year 2

- STAT 252 - Introduction to Applied Statistics II
- PSYCO 212 - Introduction to Research Methods in Psychology (must be completed by the end of the first term after admittance into the program)

#### ★6 from

- PSYCO 223 - Lifespan Developmental Psychology
- PSYCO 239 - Abnormal Psychology
- PSYCO 241 - Social Psychology

#### ★6 from

- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- PSYCO 282 - Behavior Modification

#### Options

- ★6 from approved courses offered by the Departments of Anthropology, Economics, Linguistics, Political Science and/or Sociology
- ★6 in approved Science options

### Year 3

- PSYCO 309 - Honors Seminar I
- PSYCO 390 - Honors Thesis I: Research Apprenticeship
- 
- PSYCO 303 - History of Ideas in Psychology **OR**
- PSYCO 304 - History of Modern Psychology
- ★3 from
- PSYCO 356 - Research Methods in Cognition
- PSYCO 402
- PSYCO 411 - Cooperative Program Practicum
- PSYCO 413 - Design and Analysis of Experiments in Psychology
- PSYCO 414
- PSYCO 415 - Qualitative Methods in Sociocultural Psychology
- PSYCO 431 - Theory and Practice of Psychometrics
- PSYCO 471 - Neurophysiology: Theory, Methods, and Analysis

#### Options

- ★9-12 in approved Science options
- ★6-9 in approved options
- or other advanced research methods course approved by the Honors Advisor

### Year 4

- PSYCO 409 - Honors Seminar II
- PSYCO 499 - Honors Thesis II: Thesis Research
- ★6 (two of) 400-level substantive content (non-methods) Psychology course approved by the Honors Advisor
- ★9-15 in approved Science options
- ★3-9 in approved options

### Notes

1. In addition to the courses specifically listed above, the program must include, among the student's optional courses, a minimum of ★12 in one or more disciplines relevant to Psychology, e.g., ANTHR, BIOL, CHEM, CMPUT, ECON, GENET, LING, MATH, NEURO, PHIL, PHYS, PHYSL, PMCOL, POL S, SOC, STAT, ZOOL. These courses may not overlap those used to fulfil the Computing/Mathematics/Statistics, Natural Science and Social Science requirements listed above.
2. Under the supervision of a faculty member in the Department of Psychology, students undertake a year-long research apprenticeship (PSYCO 390) during the third year and conduct and write an empirical thesis (PSYCO 490) during the fourth year. Third-year students present their thesis research proposals, and fourth-year students present the results of their thesis research at the annual Honors Psychology Conference in April.
3. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CMPUT 174, PSYCO 104, MATH 114, MATH 115 and ★9 approved Science options (see details of courses).
4. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## BSc Specialization Programs

Four-year programs, comprising a minimum of ★120, provide education to a professional level and lead to the degree of BSc with Specialization.

Specialization programs are available in the Departments of Biochemistry, Biological Sciences, Cell Biology, Chemistry, Computing Science, Earth and Atmospheric Sciences, Mathematical and Statistical Sciences, Pharmacology, Physics, and Psychology.

A five-year (★150) BEd/BSc (Specialization in Science and Education) program with majors and minors in Biological, Mathematical, and Physical Sciences is also available (see BSc Honors and BSc Specialization and BSc (Specialization in Science and Education)/BEd (Secondary) Combined Degrees Program [Science]).

### Admission

See BSc Honors and BSc Specialization Admission Requirements for admission requirements.

### Selection of Courses

**Note:** For success in your chosen program, ensure you have satisfied the pre/corequisite requirements for all courses. Departments have the right to remove students from courses for failing to present a passing grade (or higher, where stipulated) in the prerequisite course(s) and/or for failing to be enrolled in the corequisite course(s). Please see [www.science.ualberta.ca/en/ProspectiveStudents/ScienceDegrees.aspx](http://www.science.ualberta.ca/en/ProspectiveStudents/ScienceDegrees.aspx) for more information.

The following regulations govern Specialization programs:

1. In each year, a Specialization student's program must be approved by a Specialization advisor in the appropriate Department and by the Faculty Office.
2. A minimum of ★72 in Science is required in most Specialization programs. Certain Departments may require more than ★72. BSc Specialization in Planning requires a minimum of ★66 in Science.
3. A student must take at least ★18 in Arts courses as part of the requirements for most Specialization degrees.
4. Normally, no more than ★42 in junior courses are permitted in Specialization programs.
5. Certain non-Arts and non-Science courses appropriate to the program may be permitted in Specialization programs with the prior written approval of the Department directing the student's program.

Applicants to the BSc Specialization program who have taken non-Arts and non-Science courses before application will have the potential transfer credit for such courses assessed at the time of admission to the program.

### Course Load Requirements

To graduate in four years normally requires that BSc Specialization students take the usual full course load of ★30 in each Fall/Winter of the program. Students who wish to extend their programs are still expected to complete at least ★24 in each Fall/Winter of the program. Exceptions to course load requirements must



be approved in advance each year by the Department and the Faculty Office. (See Time Limits for Completion of Program below.)

## Academic Standings and Graduation

The following regulations govern Specialization programs:

1. Continuation in a Specialization program is by recommendation of the Department concerned and requires a GPA of at least 2.3 in each of the preceding Fall/Winter periods. See description of Specialization programs of individual departments for additional requirements relating to promotion in the Specialization program. Students must be in good standing (i.e., meet the continuation requirements) in the Specialization program in order to graduate.
2. A student who fails to attain the standard necessary for continuation in the Specialization program will be required to withdraw from that program. In so doing, the student may apply to transfer to the General program in the Faculty. Students applying to transfer from a Specialization to the General program must meet the continuation GPA of 2.0.
3. A student who fails to complete the requirements for a Specialization degree in the fourth year may be granted the General degree forthwith on application if the courses taken and the standing attained are satisfactory. Such students must apply to transfer to the General program.
4. For graduation, a program of at least ★120 credited to the degree.
5. BSc Specialization degrees with Distinction are awarded when students achieve a GPA of at least 3.5 on the last ★60 if the student was enrolled in a normal course load (minimum ★24) during each Fall/Winter of the last two years. Normally, only UofA courses will be used in the calculation of the GPA for the last ★60 of the program.

## Residence Requirement

A student transferring to the Faculty of Science with advanced standing must complete at least ★60 applicable to the BSc program while registered at the University of Alberta. Normally, at least ★30 of the last ★60 must be completed while registered in the Faculty of Science.

## Time Limits for Completion of Program

All BSc Specialization programs are designed to be four-year programs. However, in some cases the minimum course load requirements have been reduced to allow students the flexibility to complete the degree over a longer time period. Students wishing to extend their programs beyond the time frame dictated by the minimum course load requirement for their program must first obtain the written approval of the Department and the Associate Dean, Undergraduate or designate..

# BSc Specialization Requirements

## Specialization in Biochemistry

Continuation in the Specialization in Biochemistry program requires successful completion of at least ★24 with a minimum GPA of 2.7 in the previous Fall/Winter. In addition, graduation from the program requires a minimum GPA of 2.7 on the last ★60 credited towards the degree.

### Year 1

- BIOL 107 - Introduction to Cell Biology
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I

### ★6 MATH, STAT or PHYS options

- MATH 114 - Elementary Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- MATH 115 - Elementary Calculus II
- MATH 125 - Linear Algebra I
- STAT 151 - Introduction to Applied Statistics I

- STAT 252 - Introduction to Applied Statistics II
- PHYS 124 - Particles and Waves **AND**
- PHYS 126 - Fluids, Fields, and Radiation (or equivalent)
- ★6 in Options (See Note 3)
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

### Year 2

- BIOCH 200 - Introductory Biochemistry (Fall)
- BIOCH 320 - Structure and Catalysis (Winter)
- BIOCH 330 - Nucleic Acids and Molecular Biology (Winter)
- BIOL 201 - Eukaryotic Cellular Biology **OR**
- CELL 201 - Introduction to Molecular Cell Biology
- CHEM 211 - Quantitative Analysis I
- CHEM 213 - Quantitative Analysis II
- CHEM 263 - Organic Chemistry II (Fall)
- ★9 in Options (See Note 3)

### Year 3

- BIOCH 310 - Bioenergetics and Metabolism (Fall)
- BIOCH 401 - Biochemistry Laboratory
- ★6 in senior-level BIOCH courses (See Note 1)
- ★3 in Group A options (See Note 4)
- ★12 in Options (See Note 3)

### Year 4

- ★6 in senior-level BIOCH courses (See Note 1)
- ★3-6 from BIOCH 498 **OR** BIOCH 499 (**OR** BIOCH 497)
- ★15-18 in Options (See Note 3)
- ★3 in Group B options (See Note 4)

### Notes

1. Students must receive a grade of not less than C+ in each of ★33-36 in BIOCH courses credited towards the degree, as follows: BIOCH 200; BIOCH 310, BIOCH 320 and BIOCH 330; four of BIOCH 410, BIOCH 420, BIOCH 425, BIOCH 430, BIOCH 441, BIOCH 450, BIOCH 455, BIOCH 465, BIOCH 481 and BIOCH 482; BIOCH 401; and BIOCH 498 or BIOCH 499 (or BIOCH 497).
2. Students should consult the Department of Biochemistry for advice about course selection throughout the program. Several alternative course schedules are possible.
3. The Specialization program in Biochemistry includes a total of ★45 in Options. ★6 must be SCIENCE options, ★12 must be ARTS options, and the remainder (★27) may be selected from the Faculty of Arts, the Faculty of Science, or any other Faculty of interest to the student.
4. Group A options are selected from BIOCH 398, BIOCH 4XX, CHEM, CMPUT, MATH, PHYS, STAT. Group B options are selected from Group A or BIOIN, CELL, GENET, IMIN, MICRB, PHYSL, PMCOL. Group A and B options may not be junior courses.
5. Students in the specialization program are required to take at least one of BIOCH 498, BIOCH 499, or BIOCH 497.
6. Credit in SCI 100 will be considered equivalent to BIOL 107, CHEM 101, CHEM 102, CHEM 164, MATH 114, PHYS 124, PHYS 126, ★3 junior-level MATH or STAT option and ★3 Science option (see details of courses).
7. Credit in SCI 151 will be considered equivalent to ★3 junior level MATH or STAT option and ★3 Science option.

## Specialization in Biological Sciences

All students in Honors and Specialization programs in Biological Science take a common core of four BIOL courses in the first and second years. Thereafter, they follow the course sequence of one of the areas of concentration in either Honors or Specialization in Biological Sciences identified in Science Chart 2 Course Sequence in Biological Sciences. Students must declare an area of concentration and follow the appropriate course sequence. The title of the area of concentration will appear on their degree. Additional course requirements for Honors students include BIOL 499 and program specific courses. BIOL 499, a directed research project, must be conducted on a topic appropriate to the student's area of concentration. BIOL 499 is a recommended option for Specialization students.

Streams have been developed within several programs in Biological Sciences. These are lists of courses that provide guidance to students wishing to focus further on specific areas of Biology. Students in a program are not required to

declare or follow a stream, and stream designations do not appear on transcripts. On the Course Sequence chart, available streams are noted under Years 3 and 4. Streams are described in full on the Department of Biological Sciences website. Students should consult with advisors in choosing and following streams within their programs.

Students may receive block Transfer in the Biological Sciences at the University of Calgary or the University of Lethbridge if the appropriate courses are completed. Interested students may contact the Department of Biological Sciences for details.

## Specialization in Biological Sciences

Admission to the BSc Specialization in Biological Sciences program see Admissions Chart 7, Faculty of Science.

Continuation in the Specialization in Biological Sciences program requires successful completion of at least ★24 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on all courses credited to the degree.

### First-Year Core for BSc Specialization in Biological Sciences

The following courses are common to all programs:

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 113 - Elementary Calculus I **OR**
- MATH 114 - Elementary Calculus I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 in Arts options (junior level ENGL or WRS recommended)
- ★6 in program-specific courses (see individual programs for requirements and recommendations).

**Note** SCI 100 may be used in lieu of BIOL 107, BIOL 108, CHEM 101, CHEM 164 and MATH 114. SCI 151 may be used in lieu of STAT 151.

## Science Chart 2 Course Sequence in Biological Sciences

### Animal Biology

#### Year 1

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 Arts options (junior level ENGL or junior WRS recommended)
- ★6 Science options (see details of courses)

#### Year 2

- BIOCH 200 - Introductory Biochemistry
- 
- BIOL 201 - Eukaryotic Cellular Biology **OR**
- CELL 201 - Introduction to Molecular Cell Biology
- 
- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- BIOL 221 - Mechanisms of Evolution
- ZOOL 224 - Vertebrate Diversity

- 
- ZOOL 250 - Survey of the Invertebrates **OR**
- ENT 220 - Insect Biology
- 
- ZOOL 241 - Animal Physiology I: Homeostasis **OR**
- ZOOL 242 - Animal Physiology II: Intercellular Communication
- 
- ★3 approved options
- ★3 Arts options

#### Year 3 and 4

- BIOL 331 - Population Ecology **OR**
- BIOL 332 - Community Ecology
- 
- BIOL 380 - Genetic Analysis of Populations **OR**
- GENET 270 - Foundations of Molecular Genetics
- 
- ENT 220 - Insect Biology **OR**
- ZOOL 250 - Survey of the Invertebrates **OR**
- ZOOL 352 - Principles of Parasitism
- 
- ZOOL 303 - Animal Developmental Biology
- ZOOL 325 - Comparative Anatomy of the Vertebrates
- 
- ZOOL 370 - Ethological Mechanisms **OR**
- ZOOL 371 - Behavioral Ecology
- 
- ★9 Arts options
- ★15 from List A
- ★3 from List B (discussion courses)
- ★15 approved options (including additional courses from List A or B)

#### List A:

- BIOL 330 - Introduction to Biological Data
- BIOL 331 - Population Ecology
- BIOL 332 - Community Ecology
- BIOL 335 - Principles of Systematics
- BIOL 341 - Ecotoxicology
- BIOL 361 - Marine Science
- BIOL 367 - Conservation Biology
- BIOL 380 - Genetic Analysis of Populations
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- BIOL 392 - Laboratory Techniques in Molecular Ecology and Systematics
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 430 - Experimental Biology
- BIOL 490 - Individual Study
- BIOL 495 - Special Topics in Biology
- BIOL 498 - Research Project
- BIOL 499 - Research Project
- EAS 230 - Introduction to Invertebrate Paleontology
- ENT 220 - Insect Biology
- ENT 378 - Insect Pathology
- ENT 392 - Medical and Veterinary Entomology
- ENT 327 - Terrestrial Arthropod Diversity
- GENET 270 - Foundations of Molecular Genetics
- INT D 400 - Science Internship Capstone
- MA SC 410 - Marine Invertebrate Zoology
- MA SC 412 - Biology of Fishes
- MA SC 430 - Marine Ecology
- PALEO 201 - Dinosaurs in the Fossil Record
- PALEO 418 - Paleobiology of the Lower Vertebrates
- PALEO 419 - Paleobiology of the Higher Vertebrates
- ZOOL 241 - Animal Physiology I: Homeostasis
- ZOOL 242 - Animal Physiology II: Intercellular Communication
- ZOOL 250 - Survey of the Invertebrates
- ZOOL 303 - Animal Developmental Biology
- ZOOL 340 - Comparative Environmental Physiology
- ZOOL 342 - Neurobiology
- ZOOL 343 - Comparative Endocrinology
- ZOOL 351 - Freshwater Invertebrate Diversity
- ZOOL 352 - Principles of Parasitism
- ZOOL 354 - Wildlife Disease
- ZOOL 370 - Ethological Mechanisms
- ZOOL 371 - Behavioral Ecology
- ZOOL 405 - Biology of Fishes

- ZOOL 406 - Biology of Amphibians and Reptiles
- ZOOL 407 - Biology of Birds
- ZOOL 408 - Biology of Mammals
- ZOOL 350 - Biology and Evolution of Invertebrates
- ZOOL 452 - Topics in Parasitology

**List B:**

- 
- BIOL 409 - Zoonoses
  - BIOL 433 - Plant-Animal Interactions
  - BIOL 434 - Chemical Ecology
  - BIOL 445 - Current Topics in Animal and Cell Physiology
  - BIOL 468 - Problems in Conservation Biology
  - BIOL 495 - Special Topics in Biology (if appropriate topic)
  - ENT 401 - Current Topics in Arthropod Biology
  - GENET 422 - Current Topics in Developmental Genetics
  - MA SC 480 - Seminars and Papers in Marine Science
  - ZOOL 402 - Current Topics in Developmental Biology
  - ZOOL 405 - Biology of Fishes
  - ZOOL 406 - Biology of Amphibians and Reptiles
  - ZOOL 441 - Current Topics on Homeostasis
  - ZOOL 442 - Current Topics in Intercellular Communication
  - ZOOL 350 - Biology and Evolution of Invertebrates
  - ZOOL 452 - Topics in Parasitology
  - ZOOL 472

**Available streams include:**

- 
- entomology,
  - marine biology,
  - parasitology and vertebrate biology

**Notes**

1. MA SC courses on this list are offered at Bamfield Marine Sciences Centre.
2. Honors students are required to take BIOL 499 and reduce approved options by ★6.
3. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108; CHEM 101, CHEM 261; MATH 114; ★6 Science options (see details of courses) and ★6 Approved options. Animal Biology

**Bioinformatics**

Effective September 2016, there will be no further admissions to BSc Honors or BSc Specialization in Bioinformatics. Students who entered one of these programs prior to September 2016 must complete all program requirements by April 30, 2020. Refer to the Calendar in effect at the time you were admitted or readmitted for the regulations governing the degree program requirements. The last BSc Honors or BSc Specialization in Bioinformatics will be granted at Spring Convocation 2020.

**Ecology****Year 1**

- 
- BIOL 107 - Introduction to Cell Biology
  - BIOL 108 - Introduction to Biological Diversity
  - CHEM 101 - Introductory University Chemistry I
  - 
  - CHEM 164 - Organic Chemistry I **OR**
  - CHEM 261 - Organic Chemistry I
  - 
  - MATH 114 - Elementary Calculus I **OR**
  - MATH 117 - Honors Calculus I **OR**
  - MATH 134 - Calculus for the Life Sciences I **OR**
  - MATH 144 - Calculus for the Physical Sciences I **OR**
  - MATH 125 - Linear Algebra I
  - 
  - STAT 151 - Introduction to Applied Statistics I
  - ★6 Arts options (junior level ENGL or junior WRS recommended)
  - ★6 Science options (EAS 100 recommended) (see details of courses)

**Year 2**

- 
- BIOCH 200 - Introductory Biochemistry
  - BIOL 207 - Molecular Genetics and Heredity
  - BIOL 208 - Principles of Ecology
  - BOT 205 - Fundamentals of Plant Biology
  - BIOL 221 - Mechanisms of Evolution
  - MICRB 265 - General Microbiology
  -

- ZOOL 224 - Vertebrate Diversity **OR**
- ZOOL 325 - Comparative Anatomy of the Vertebrates **OR**
- PALEO 201 - Dinosaurs in the Fossil Record
- 
- ZOOL 250 - Survey of the Invertebrates **OR**
- ENT 220 - Insect Biology
- 
- ★6 Arts options

**Year 3 and 4**

- 
- BIOL 330 - Introduction to Biological Data
  - ★6 Arts options
  - ★18 approved options

**★12 from**

- 
- BIOL 331 - Population Ecology
  - BIOL 332 - Community Ecology
  - BIOL 340 - Global Biogeochemistry
  - BOT 332 - Plant Ecology
  - ZOOL 371 - Behavioral Ecology

**★3 from**

- 
- BIOL 380 - Genetic Analysis of Populations
  - BOT 303 - Plant Development
  - BOT 340 - Plant Physiology
  - ENT 321
  - GENET 270 - Foundations of Molecular Genetics
  - GENET 305 - Genetic Analysis
  - IMIN 200 - Infection and Immunity
  - MICRB 311 - Microbial Physiology
  - ZOOL 241 - Animal Physiology I: Homeostasis
  - ZOOL 242 - Animal Physiology II: Intercellular Communication
  - ZOOL 303 - Animal Developmental Biology

**★6 from**

- 
- BIOL 322 - Diversity and Evolution of Microbial Life
  - BOT 314 - Biology of Bryophytes
  - BOT 321 - Flowering Plants
  - BOT 322 - Field Botany
  - BOT 330 - Biodiversity and Ecosystem Function of Algae
  - ENT 327 - Terrestrial Arthropod Diversity
  - ZOOL 351 - Freshwater Invertebrate Diversity
  - ZOOL 352 - Principles of Parasitism
  - ZOOL 405 - Biology of Fishes
  - ZOOL 406 - Biology of Amphibians and Reptiles
  - ZOOL 407 - Biology of Birds
  - ZOOL 408 - Biology of Mammals

**★9 from**

- 
- BIOL 333 - Wetland Science and Management
  - BIOL 361 - Marine Science
  - BIOL 364 - Freshwater Ecology
  - BIOL 366 - Northern Ecology
  - BIOL 367 - Conservation Biology
  - BIOL 381 - A Planet in Crisis
  - BIOL 384 - Global Change and Ecosystems
  - BIOL 398 - Research Project
  - BIOL 399 - Research Project
  - BIOL 430 - Experimental Biology
  - BIOL 433 - Plant-Animal Interactions
  - BIOL 434 - Chemical Ecology
  - BIOL 468 - Problems in Conservation Biology
  - BIOL 471 - Landscape Ecology
  - BIOL 490 - Individual Study
  - BIOL 498 - Research Project
  - BIOL 499 - Research Project
  - MICRB 491 - Environmental Microbiology
  - ZOOL 340 - Comparative Environmental Physiology
  - ZOOL 354 - Wildlife Disease
  - ZOOL 370 - Ethological Mechanisms
  - ZOOL 472

**★3 from**

- 
- BIOL 365 - Methods in Freshwater Ecology
  - BIOL 432 - Field Methods in Ecology
  - MA SC 4XX

**Available streams include:**

- conservation/wildlife biology,
- freshwater biology, and
- plant ecology.

**Notes**

1. MA SC courses on this list are offered at Bamfield Marine Sciences Centre.
2. Honors students are required to take BIOL 430 and BIOL 499 and reduce approved options by ★9.
3. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108; CHEM 101, CHEM 164; EAS 100; MATH 114; ★3 Science options (see details of courses) and ★6 Approved options.

**Evolutionary Biology****Year 1**

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 Arts options (junior level ENGL or junior WRS recommended)
- ★6 Science options (see details of courses)

**Year 2**

- BIOCH 200 - Introductory Biochemistry
  - BIOL 207 - Molecular Genetics and Heredity
  - BIOL 208 - Principles of Ecology
  - BIOL 221 - Mechanisms of Evolution
  - ★3 Arts option
  - ★6 approved options
- ★6 from**
- BOT 205 - Fundamentals of Plant Biology
  - ENT 220 - Insect Biology
  - MICRB 265 - General Microbiology
  - PALEO 201 - Dinosaurs in the Fossil Record
- ZOOL 224 - Vertebrate Diversity
  - ZOOL 250 - Survey of the Invertebrates

**★3 from**

- BOT 340 - Plant Physiology
- ENT 321
- ZOOL 241 - Animal Physiology I: Homeostasis
- ZOOL 242 - Animal Physiology II: Intercellular Communication

**Year 3 and 4**

- BIOL 335 - Principles of Systematics
- BIOL 380 - Genetic Analysis of Populations
- BIOL 392 - Laboratory Techniques in Molecular Ecology and Systematics
- ★9 Arts options
- ★12 approved options

**★3 from**

- BOT 411 - Paleobotany
- PALEO 400 - Paleontology Field School
- PALEO 414 - Paleontology
- PALEO 418 - Paleobiology of the Lower Vertebrates
- PALEO 419 - Paleobiology of the Higher Vertebrates

**★3 from**

- BIOL 331 - Population Ecology
- BIOL 332 - Community Ecology
- BOT 332 - Plant Ecology

**★3 from**

- GENET 270 - Foundations of Molecular Genetics
- GENET 390 - Gene Manipulation

**★6 from**

- BIOL 322 - Diversity and Evolution of Microbial Life
- BOT 314 - Biology of Bryophytes
- BOT 321 - Flowering Plants
- ENT 327 - Terrestrial Arthropod Diversity
- MICRB 423 - Extreme Microbiology
- ZOOL 325 - Comparative Anatomy of the Vertebrates
- ZOOL 405 - Biology of Fishes
- ZOOL 406 - Biology of Amphibians and Reptiles
- ZOOL 407 - Biology of Birds
- ZOOL 408 - Biology of Mammals
- ZOOL 350 - Biology and Evolution of Invertebrates

**★15 from list below**

- Recommended options include, but are not restricted to additional courses from above, and the list below:
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 421 - Molecular Evolution and Systematics
- BIOL 430 - Experimental Biology
- BIOL 433 - Plant-Animal Interactions
- BIOL 490 - Individual Study
- BIOL 495 - Special Topics in Biology
- BIOL 498 - Research Project
- BIOL 499 - Research Project
- BOT 303 - Plant Development
- BOT 308 - Plant Anatomy
- BOT 322 - Field Botany
- BOT 330 - Biodiversity and Ecosystem Function of Algae
- EAS 100 - Planet Earth
- EAS 105 - The Dynamic Earth Through Time
- EAS 230 - Introduction to Invertebrate Paleontology
- GENET 270 - Foundations of Molecular Genetics
- GENET 305 - Genetic Analysis
- INT D 400 - Science Internship Capstone
- MA SC 410 - Marine Invertebrate Zoology
- MA SC 412 - Biology of Fishes
- MA SC 430 - Marine Ecology
- ZOOL 303 - Animal Developmental Biology
- ZOOL 340 - Comparative Environmental Physiology
- ZOOL 351 - Freshwater Invertebrate Diversity
- ZOOL 352 - Principles of Parasitism
- ZOOL 354 - Wildlife Disease
- ZOOL 371 - Behavioral Ecology
- ZOOL 402 - Current Topics in Developmental Biology
- ZOOL 472

**Notes**

1. Marine Science courses on this list are offered at Bamfield Marine Sciences Centre.
2. Honors students are required to take BIOL 499 and reduce approved options by ★6.
3. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108; CHEM 101, CHEM 261; MATH 114; ★6 Science options (see details of courses) and ★6 Approved options

**Microbiology****Year 1**

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 Arts options (junior level ENGL or junior WRS recommended)
- ★3 Science options (details of courses)

**Year 2**

- BIOCH 200 - Introductory Biochemistry
- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- CHEM 263 - Organic Chemistry II
- GENET 270 - Foundations of Molecular Genetics
- IMIN 200 - Infection and Immunity
- MICRB 265 - General Microbiology
- ★3 in Science options (details of courses)
- ★6 in Arts options

**Notes**

1. A minimum grade of B- is required in MICRB 265 and MICRB 311 to stay in Microbiology Honors program.
2. BIOL 201 highly recommended in Year 2.

**Year 3 and 4**

- BIOL 201 - Eukaryotic Cellular Biology
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- GENET 390 - Gene Manipulation
- MICRB 311 - Microbial Physiology
- MICRB 316 - Molecular Microbiology
- ★6 in Arts options
- ★12 in Microbiology options (List A)
- ★15 in Science options (List A or B) (details of courses)
- ★12 in Approved options (List A, B or C)

**Recommended options include, but are not restricted to the following:**

**List A: Microbiology options:**

- BIOL 322 - Diversity and Evolution of Microbial Life
- GENET 415 - Current Topics in Bacterial Genetics
- IMIN 324 - Basic Virology
- IMIN 371 - Introduction to Immunology
- IMIN 372 - Research Techniques in Immunology
- IMIN 452 - Advanced Immunology
- MICRB 315 - Applied Microbiology and Biotechnology
- MICRB 320 - Microbial Ecology
- MICRB 343 - Analysis of Microbial Macromolecules
- MICRB 345 - Microbial Laboratory Techniques
- MICRB 392 - Environmental Microbiology Laboratory
- MICRB 410 - Bacterial Structure and Virulence Factors
- MICRB 423 - Extreme Microbiology
- MICRB 491 - Environmental Microbiology
- NU FS 361 - Food Microbiology
- NU FS 363 - Food Microbiology
- NU FS 402 - Brewing, Enology, and Food Fermentations
- NU FS 480 - Foodborne Pathogens
- MMI 351 - Bacterial Pathogenesis
- MMI 352 - Microbial Pathogenesis
- MMI 405 - Advanced Microbial Pathogenicity
- MMI 415 - Advanced Viral Pathogenesis

**List B: Science options:**

- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- BIOCH 401 - Biochemistry Laboratory
- BIOCH 410 - Signal Transduction
- BIOCH 420 - Proteins: Structure, Function, and Regulation
- BIOCH 430 - Biochemistry of Eukaryotic Gene Expression
- BIOCH 441 - Structure and Function of Biological Membranes
- BIOCH 450 - The Molecular Biology of Mammalian Viruses
- BIOCH 455 - Biochemistry of Lipids and Lipoproteins
- BIOIN 301 - Bioinformatics I
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 490 - Individual Study
- BIOL 495 - Special Topics in Biology
- BIOL 498 - Research Project
- BIOL 499 - Research Project
- CHEM 211 - Quantitative Analysis I
- CHEM 213 - Quantitative Analysis II
- CHEM 303 - Environmental Chemistry I
- CHEM 361 - Organic Chemistry
- CHEM 363 - Organic Chemistry

- CHEM 371 - Energetics of Chemical Reactions
- CHEM 373 - Physical Properties and Dynamics of Chemical Systems
- CMPUT 101 - Introduction to Computing
- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- ENT 378 - Insect Pathology
- GENET 301 - Organization of Simple Genomes
- GENET 302 - Organization of Complex Genomes
- GENET 304 - Gene Expression and its Regulation
- GENET 305 - Genetic Analysis
- GENET 375 - Introduction to Molecular Genetics Techniques
- GENET 408 - Replication, Repair, and Recombination
- GENET 420 - Research Techniques in Molecular Genetics
- IMIN 401 - Comparative Immunology
- INT D 400 - Science Internship Capstone
- PHYS 124 - Particles and Waves
- PHYS 126 - Fluids, Fields, and Radiation
- ZOOL 352 - Principles of Parasitism
- ZOOL 452 - Topics in Parasitology

**List C: Approved options:**

- BIOL 380 - Genetic Analysis of Populations
- BOT 205 - Fundamentals of Plant Biology
- BOT 380 - Drug Plants
- BOT 382 - Plant Biotechnology
- CELL 300 - Advanced Cell Biology I
- CELL 301 - Advanced Cell Biology II
- EAS 201 - Earth Science I
- PHYSL 210 - Human Physiology
- PSYCO 104 - Basic Psychological Processes
- REN R 210 - Introduction to Soil Science and Soil Resources
- REN R 442 - Soil Biogeochemistry

**Notes**

1. Honors students are required to take BIOL 499, MICRB 343 and MICRB 345 and reduce the number of Science (see details of courses) and Microbiology options each by ★6.
2. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108; CHEM 101, CHEM 102, CHEM 261; CMPUT 174; MATH 114; PHYS 144 and PHYS 146.
3. CHEM 211 and CHEM 213 are highly recommended.

**Molecular Genetics****Year 1**

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- BIOL 207 - Molecular Genetics and Heredity
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 Arts options (junior level ENGL or junior WRS recommended)

**Note:** Although BIOL 207 is recommended in Year 1, alternatively, BIOL 201 (or CELL 201) may be taken in Year 1. BIOL 207 must be completed before Winter term of Year 2.

**Year 2**

- BIOCH 200 - Introductory Biochemistry
- 
- BIOL 201 - Eukaryotic Cellular Biology **OR**
- CELL 201 - Introduction to Molecular Cell Biology
- 
- BIOL 208 - Principles of Ecology
- CHEM 263 - Organic Chemistry II
- GENET 270 - Foundations of Molecular Genetics
- MICRB 265 - General Microbiology

- ★6 Arts options
- ★6 Science options (details of courses)

**Note:** GENET 270 must be taken during Year 2 to permit completion of the program in four years.

### Year 3 and 4

#### ★3 from

- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis (BIOCH 320 strongly recommended)
- BIOCH 330 - Nucleic Acids and Molecular Biology
- CELL 300 - Advanced Cell Biology I

#### Students are required to take at least

- ★9 from List A
- ★3 from List B
- ★15 from List C
- ★6 in Arts options
- ★12 in approved options

#### ★6 from

- GENET 301 - Organization of Simple Genomes
- GENET 302 - Organization of Complex Genomes
- GENET 304 - Gene Expression and its Regulation

#### ★6 from

- BIOL 380 - Genetic Analysis of Populations
- GENET 305 - Genetic Analysis
- GENET 390 - Gene Manipulation

#### List A:

- GENET 364 - Plant Genetics
- GENET 408 - Replication, Repair, and Recombination
- GENET 412 - Genetic Control of Animal Development
- GENET 415 - Current Topics in Bacterial Genetics
- GENET 418 - Human Genetics
- 
- GENET 422 - Current Topics in Developmental Genetics **OR**
- GENET 424 - Ethical Issues in Genetics
- List B:
- 
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- GENET 375 - Introduction to Molecular Genetics Techniques
- GENET 420 - Research Techniques in Molecular Genetics

#### List C:

- Including, but not restricted to the following:
- ANAT 400 - Human Embryonic Development
- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- BIOCH 401 - Biochemistry Laboratory
- BIOCH 410 - Signal Transduction
- BIOCH 420 - Proteins: Structure, Function, and Regulation
- BIOCH 430 - Biochemistry of Eukaryotic Gene Expression
- BIOCH 450 - The Molecular Biology of Mammalian Viruses
- BIOL 315 - Biology: An Historical Perspective
- BIOL 221 - Mechanisms of Evolution
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 490 - Individual Study
- BIOL 495 - Special Topics in Biology
- BIOL 498 - Research Project
- BIOL 499 - Research Project
- BOT 303 - Plant Development
- BOT 382 - Plant Biotechnology
- BOT 445 - Molecular Plant Physiology
- BOT 464 - Plant Functional Genomics
- CELL 300 - Advanced Cell Biology I
- CELL 301 - Advanced Cell Biology II
- CELL 402 - The Birth and Death of a Cell
- CELL 445 - Current Topics in Cell Biology
- CHEM 371 - Energetics of Chemical Reactions
- CHEM 373 - Physical Properties and Dynamics of Chemical Systems
- ENT 321
- GENET 301 - Organization of Simple Genomes

- GENET 302 - Organization of Complex Genomes
- GENET 304 - Gene Expression and its Regulation
- GENET 305 - Genetic Analysis
- GENET 364 - Plant Genetics
- GENET 375 - Introduction to Molecular Genetics Techniques
- GENET 390 - Gene Manipulation
- GENET 408 - Replication, Repair, and Recombination
- GENET 412 - Genetic Control of Animal Development
- GENET 418 - Human Genetics
- GENET 420 - Research Techniques in Molecular Genetics
- GENET 422 - Current Topics in Developmental Genetics
- GENET 424 - Ethical Issues in Genetics
- IMIN 200 - Infection and Immunity
- IMIN 324 - Basic Virology
- IMIN 371 - Introduction to Immunology
- IMIN 401 - Comparative Immunology
- INT D 400 - Science Internship Capstone
- MICRB 311 - Microbial Physiology
- MICRB 316 - Molecular Microbiology
- MICRB 320 - Microbial Ecology
- MICRB 343 - Analysis of Microbial Macromolecules
- MICRB 345 - Microbial Laboratory Techniques
- MICRB 392 - Environmental Microbiology Laboratory
- ONCOL 320 - Introduction to Oncology
- ONCOL 425 - Advanced Topics in Cancer Research
- PHYSL 210 - Human Physiology
- ZOOL 241 - Animal Physiology I: Homeostasis
- ZOOL 242 - Animal Physiology II: Intercellular Communication
- ZOOL 303 - Animal Developmental Biology
- ZOOL 340 - Comparative Environmental Physiology
- ZOOL 342 - Neurobiology
- ZOOL 402 - Current Topics in Developmental Biology
- ZOOL 441 - Current Topics on Homeostasis
- ZOOL 442 - Current Topics in Intercellular Communication

#### Notes

1. Honors students are required to take BIOL 499 and reduce approved options by ★6.
2. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108; CHEM 101, CHEM 102, CHEM 261; MATH 114, ★3 Science options (see details of courses) and ★6 Approved options.

## Physiology and Developmental Biology

### Year 1

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 Arts options (junior level ENGL or junior WRS recommended)
- ★6 Science options (see details of courses)

### Year 2

- BIOCH 200 - Introductory Biochemistry
- 
- BIOL 201 - Eukaryotic Cellular Biology **OR**
- CELL 201 - Introduction to Molecular Cell Biology
- 
- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- ZOOL 241 - Animal Physiology I: Homeostasis
- ZOOL 242 - Animal Physiology II: Intercellular Communication
- ZOOL 250 - Survey of the Invertebrates
- ★3 Arts option
- ★6 approved options

**Note:** Students intending to take BIOCH 310, BIOCH 320 or BIOCH 330 are required to take CHEM 263

### Year 3 and 4

- ZOOL 303 - Animal Developmental Biology
- ZOOL 325 - Comparative Anatomy of the Vertebrates
- ZOOL 344 - Laboratory Exercises in Animal Physiology
- ★9 Arts options
- ★12 approved options
- ★15 from list below

#### ★3 from

- BIOL 445 - Current Topics in Animal and Cell Physiology
- ZOOL 402 - Current Topics in Developmental Biology
- ZOOL 441 - Current Topics on Homeostasis
- ZOOL 442 - Current Topics in Intercellular Communication
- ZOOL 350 - Biology and Evolution of Invertebrates

#### ★3 from

- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- CELL 300 - Advanced Cell Biology I

#### ★9 from

- BIOL 341 - Ecotoxicology
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- ZOOL 340 - Comparative Environmental Physiology
- ZOOL 342 - Neurobiology
- ZOOL 343 - Comparative Endocrinology
- ZOOL 352 - Principles of Parasitism

**Recommended options include, but are not restricted to additional courses from above and the following:**

- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- BIOL 341 - Ecotoxicology
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 490 - Individual Study
- BIOL 495 - Special Topics in Biology
- BIOL 498 - Research Project
- BIOL 499 - Research Project
- BIOL 545 - Advanced Topics in Animal and Cell Physiology
- BOT 303 - Plant Development
- BOT 340 - Plant Physiology
- BOT 445 - Molecular Plant Physiology
- CELL 300 - Advanced Cell Biology I
- CELL 301 - Advanced Cell Biology II
- CELL 402 - The Birth and Death of a Cell
- ENT 321
- ENT 378 - Insect Pathology
- GENET 270 - Foundations of Molecular Genetics
- GENET 301 - Organization of Simple Genomes
- GENET 302 - Organization of Complex Genomes
- GENET 304 - Gene Expression and its Regulation
- GENET 375 - Introduction to Molecular Genetics Techniques
- GENET 390 - Gene Manipulation
- GENET 412 - Genetic Control of Animal Development
- GENET 418 - Human Genetics
- GENET 420 - Research Techniques in Molecular Genetics
- IMIN 200 - Infection and Immunity
- IMIN 371 - Introduction to Immunology
- IMIN 372 - Research Techniques in Immunology
- IMIN 401 - Comparative Immunology
- IMIN 452 - Advanced Immunology
- INT D 400 - Science Internship Capstone
- MA SC 403 - Directed Studies in Marine Science
- MA SC 415 - Structure and Function in Animals
- MICRB 265 - General Microbiology
- MICRB 311 - Microbial Physiology
- NEURO 443 - Neuroendocrine Concepts
- NEURO 472 - Autonomic Nervous System
- PHYSL 372 - Systems Neuroscience
- PHYSL 403 - Neuroendimmunomodulation

- PHYSL 404 - Cardiovascular Physiology
- PHYSL 545 - Physiology of Transport Systems
- PMCOL 371 - Cellular Neuroscience
- ZOOL 340 - Comparative Environmental Physiology
- ZOOL 342 - Neurobiology
- ZOOL 343 - Comparative Endocrinology
- ZOOL 352 - Principles of Parasitism
- ZOOL 370 - Ethological Mechanisms
- ZOOL 402 - Current Topics in Developmental Biology
- ZOOL 441 - Current Topics on Homeostasis
- ZOOL 442 - Current Topics in Intercellular Communication
- ZOOL 350 - Biology and Evolution of Invertebrates
- ZOOL 452 - Topics in Parasitology

### Notes

1. MA SC courses on this list are offered at Bamfield Marine Sciences Centre.
2. Honors students are required to take BIOL 499 and reduce approved options by ★6.
3. The above program is distinct from the Honors Physiology Program offered by the Department of Physiology, Faculty of Medicine and Dentistry. Applicants should contact the current Advisor in the Department of Biological Sciences to ensure that this is the Program for which they wish to register.
4. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108; CHEM 101, CHEM 261; MATH 114, ★6 Science options (see details of courses) and ★6 Approved options.

## Plant Biology

### Year 1

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 Arts options (junior level ENGL or junior WRS recommended)
- ★6 Science options (see details of courses)

### Year 2

- BIOCH 200 - Introductory Biochemistry
- BIOL 201 - Eukaryotic Cellular Biology
- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- BIOL 221 - Mechanisms of Evolution
- BOT 205 - Fundamentals of Plant Biology
- CHEM 102 - Introductory University Chemistry II
- ★3 Arts option
- ★6 approved options

### Year 3 and 4

- BOT 308 - Plant Anatomy
- BOT 321 - Flowering Plants
- BOT 332 - Plant Ecology
- BOT 340 - Plant Physiology
- MICRB 265 - General Microbiology
- ★9 Arts options

#### ★3 from

- GENET 270 - Foundations of Molecular Genetics
- GENET 364 - Plant Genetics
- GENET 390 - Gene Manipulation

#### ★33 from the list below

- Approved options include, but are not restricted to the following:
- BIOL 330 - Introduction to Biological Data
- BIOL 333 - Wetland Science and Management
- BIOL 335 - Principles of Systematics

- BIOL 340 - Global Biogeochemistry
- BIOL 364 - Freshwater Ecology
- BIOL 367 - Conservation Biology
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 430 - Experimental Biology
- BIOL 433 - Plant-Animal Interactions
- BIOL 490 - Individual Study
- BIOL 495 - Special Topics in Biology
- BIOL 498 - Research Project
- BIOL 499 - Research Project
- BOT 303 - Plant Development
- BOT 314 - Biology of Bryophytes
- BOT 322 - Field Botany
- BOT 330 - Biodiversity and Ecosystem Function of Algae
- BOT 340 - Plant Physiology
- BOT 380 - Drug Plants
- BOT 382 - Plant Biotechnology
- BOT 411 - Paleobotany
- BOT 445 - Molecular Plant Physiology
- BOT 464 - Plant Functional Genomics
- BOT 545 - Advanced Molecular Plant Physiology
- GENET 364 - Plant Genetics
- INT D 400 - Science Internship Capstone
- PL SC 355 - Cereal, Oilseed, and Pulse Crops
- PL SC 380 - Principles of Plant Pathology
- PL SC 385
- REN R 421 - Advanced Tree Physiology
- REN R 468 - Conservation of Genetic Resources

#### Notes

1. Honors students are required to take BIOL 499 and reduce approved options by ★6. Honors students are required to take one of the following discussion courses and reduce approved options by ★3: BOT 403, BOT 445, BOT 506, BOT 511, BOT 545; or BIOL 495 (if appropriate topic).
2. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108; CHEM 101, CHEM 102, CHEM 261; MATH 114; ★6 Science options and ★3 Approved options..

## Specialization in Cell Biology

Continuation in the Specialization in Cell Biology program requires successful completion of at least ★24 with a minimum 2.3 GPA in each preceding Fall/Winter..

#### Year 1

- BIOL 107 - Introduction to Cell Biology
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I
- 
- PHYS 124 - Particles and Waves
- PHYS 126 - Fluids, Fields, and Radiation
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★3 in approved options

#### Year 2

- BIOCH 200 - Introductory Biochemistry
- BIOL 207 - Molecular Genetics and Heredity
- 
- CELL 201 - Introduction to Molecular Cell Biology **OR**
- BIOL 201 - Eukaryotic Cellular Biology
- 
- CHEM 263 - Organic Chemistry II
- GENET 270 - Foundations of Molecular Genetics
- MICRB 265 - General Microbiology
- 
- STAT 151 - Introduction to Applied Statistics I
- 
- ★3 in an Arts option
- ★6 in approved options

#### Year 3

- CELL 300 - Advanced Cell Biology I
- CELL 301 - Advanced Cell Biology II

#### ★3 from

- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology

#### Options

- ★6 from Group A Cell Biology options (BIOCH 401 recommended)
- ★9 in approved options
- ★6 in Arts options

**Note:** Cell Biology students should take BIOCH 320 in Winter Term of Year 2 if selecting BIOCH 401 option; BIOCH 330 is not required for Cell Biology students.

#### Year 4

- ★3 from a 400-level CELL course
- ★9 from Cell Biology Group A options
- ★3 400-level Cell Biology Group A options
- ★12 in approved options
- ★3 in an Arts option

#### Notes

1. Students are required to consult the Department of Cell Biology for selection and approval of all options.
2. Students are encouraged to select approved options from the Cell Biology Group A or recommended options list, but may also follow a course of study tailored to their interests (must be approved by a Cell Biology advisor).
3. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, CHEM 102, CHEM 164, MATH 114, MATH 115, PHYS 124, PHYS 126.
4. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

#### Cell Biology Group A Options:

- BIOCH 401 - Biochemistry Laboratory
- BIOCH 410 - Signal Transduction
- BIOCH 420 - Proteins: Structure, Function, and Regulation
- BIOCH 425 - Proteomics
- BIOCH 441 - Structure and Function of Biological Membranes
- BIOCH 450 - The Molecular Biology of Mammalian Viruses
- BIOCH 481 - Design and Construction of Synthetic Biological Systems I
- BIOCH 482 - Design and Construction of Synthetic Biological Systems II
- 
- BIOCH 430 - Biochemistry of Eukaryotic Gene Expression **OR**
- GENET 304 - Gene Expression and its Regulation
- 
- BIOL 421 - Molecular Evolution and Systematics
- CELL 310 - Evolution and Diversity of the Cell
- CELL 398 - Research Project
- CELL 402 - The Birth and Death of a Cell
- CELL 405 - Cell Biology of Disease
- CELL 425 - Systems Biology
- CELL 445 - Current Topics in Cell Biology
- CELL 498 - Research Project
- CELL 499 - Research Project
- CHEM 282 - Atomic and Molecular Structure
- CHEM 371 - Energetics of Chemical Reactions
- CHEM 373 - Physical Properties and Dynamics of Chemical Systems
- CHEM 464 - Biocjugate Chemistry
- GENET 305 - Genetic Analysis
- GENET 375 - Introduction to Molecular Genetics Techniques
- GENET 420 - Research Techniques in Molecular Genetics
- IMIN 200 - Infection and Immunity
- IMIN 324 - Basic Virology
- IMIN 372 - Research Techniques in Immunology
- IMIN 405 - Innate Immunity
- IMIN 452 - Advanced Immunology
- MICRB 316 - Molecular Microbiology
- MMI 391 - Current Methods in Molecular Biology
- MMI 436 - Inflammation
- MMI 490 - Advanced Techniques in Microbiology and Immunology
- ONCOL 320 - Introduction to Oncology
- ONCOL 425 - Advanced Topics in Cancer Research



- PMCOL 371 - Cellular Neuroscience **OR**
- ZOOL 342 - Neurobiology
- ANAT 402 - Human Histology
- ZOOL 303 - Animal Developmental Biology **OR**
- BOT 303 - Plant Development

#### Cell Biology Recommended Options:

- ANAT 200 - Human Morphology
- ANAT 400 - Human Embryonic Development
- ANAT 401 - Human Neuroanatomy
- ANAT 402 - Human Histology
- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- BIOCH 455 - Biochemistry of Lipids and Lipoproteins
- BIOCH 465 - Methods in Molecular Biophysics
- BIOL 108 - Introduction to Biological Diversity
- BIOL 208 - Principles of Ecology
- BIOL 221 - Mechanisms of Evolution
- BIOL 315 - Biology: An Historical Perspective
- BIOL 322 - Diversity and Evolution of Microbial Life
- BIOL 335 - Principles of Systematics
- BIOL 380 - Genetic Analysis of Populations
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- BIOL 430 - Experimental Biology
- BOT 382 - Plant Biotechnology
- CHEM 361 - Organic Chemistry
- CHEM 363 - Organic Chemistry
- GENET 301 - Organization of Simple Genomes
- GENET 302 - Organization of Complex Genomes
- GENET 364 - Plant Genetics
- GENET 390 - Gene Manipulation
- GENET 408 - Replication, Repair, and Recombination
- GENET 412 - Genetic Control of Animal Development
- IMIN 371 - Introduction to Immunology
- IMIN 401 - Comparative Immunology
- IMIN 410 - Bioinformatics for Molecular Biologists
- MATH 115 - Elementary Calculus II
- MATH 125 - Linear Algebra I
- MICRB 311 - Microbial Physiology
- MICRB 315 - Applied Microbiology and Biotechnology
- MICRB 343 - Analysis of Microbial Macromolecules
- MICRB 410 - Bacterial Structure and Virulence Factors
- MMI 351 - Bacterial Pathogenesis
- MMI 352 - Microbial Pathogenesis
- MMI 405 - Advanced Microbial Pathogenicity
- MMI 415 - Advanced Viral Pathogenesis
- MMI 426 - Medical Parasitology
- MMI 445 - Clinical Microbiology and Human Health
- PHYSL 210 - Human Physiology
- PHYSL 212 - Human Physiology I
- PHYSL 214 - Human Physiology II
- PHYSL 372 - Systems Neuroscience
- PHYSL 403 - Neuroendimmunomodulation
- PHYSL 404 - Cardiovascular Physiology
- PHYSL 405 - Sensory Physiology
- PMCOL 201 - Introductory Pharmacology
- PMCOL 202
- PMCOL 343 - Scientific Basis of Pharmacology: Part I
- PMCOL 344 - Scientific Basis of Pharmacology: Part II
- PMCOL 412 - Drugs and the Nervous System
- PMCOL 415 - Cardiovascular Pharmacology
- PMCOL 425 - Problem Solving in Pharmacology and Therapeutics
- PMCOL 450 - Diabetes and Its Pharmacotherapy
- PMCOL 475 - Signal Transduction Systems as Pharmacological Targets
- STAT 337 - Biostatistics
- ZOOL 241 - Animal Physiology I: Homeostasis
- ZOOL 242 - Animal Physiology II: Intercellular Communication
- ZOOL 343 - Comparative Endocrinology
- ZOOL 442 - Current Topics in Intercellular Communication

## Specialization in Chemistry

Continuation in the Specialization in Chemistry program requires successful completion of at least ★18 with a minimum 2.3 GPA and a minimum 2.3 GPA on all CHEM courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★90 credited to the degree.

The Specialization Chemistry degree is accredited by the Canadian Society for Chemistry.

### Year 1

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- MATH 114 - Elementary Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- MATH 115 - Elementary Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- PHYS 144 - Newtonian Mechanics and Relativity **AND**
- PHYS 146 - Fluids and Waves (recommended)
- **OR**
- PHYS 124 - Particles and Waves **AND**
- PHYS 126 - Fluids, Fields, and Radiation
- ★6 in junior ENGL or WRS or ★3 junior ENGL and ★3 in Arts option
- ★3 in Science option (see details of courses)

### Year 2

- CHEM 211 - Quantitative Analysis I
- CHEM 241 - Introduction to Inorganic Chemistry
- CHEM 243 - Advanced Inorganic Chemistry
- CHEM 263 - Organic Chemistry II
- CHEM 282 - Atomic and Molecular Structure
- CHEM 298 - Introductory Spectroscopy
- MATH 214 - Intermediate Calculus I
- MATH 125 - Linear Algebra I **OR**
- MATH 215 - Intermediate Calculus II **OR**
- STAT 151 - Introduction to Applied Statistics I
- ★6 in Arts options

### Years 3 and 4

- CHEM 313 - Instrumentation in Chemical Analysis
- CHEM 361 - Organic Chemistry
- CHEM 371 - Energetics of Chemical Reactions
- CHEM 373 - Physical Properties and Dynamics of Chemical Systems
- CHEM 398 - Molecular Spectroscopy
- BIOCH 200 - Introductory Biochemistry
- ★9 in senior chemistry courses (with at least ★3 taken at the 400-level).
- ★12 in Science options (see details of courses)
- ★6 in Arts options
- ★15 in approved options

### Senior Courses in Chemistry

- BIOCH 310 - Bioenergetics and Metabolism
- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- CHEM 303 - Environmental Chemistry I
- CHEM 305 - Environmental Chemistry II
- CHEM 333 - Inorganic Materials Chemistry
- CHEM 363 - Organic Chemistry
- CHEM 401 - Introduction to Chemical Research
- CHEM 403 - Chemical Research
- CHEM 405 - Special Topics in Chemistry
- CHEM 419 - Bioanalytical Chemistry
- CHEM 424 - Optical Spectroscopy and Electrochemistry
- CHEM 425 - Separations and Mass Spectrometry
- CHEM 434 - X-ray Crystallography
- CHEM 436 - Synthesis and Applications of Inorganic and Nano-materials

- CHEM 437 - Transition Metal Chemistry
- CHEM 438 - Solid State Chemistry
- CHEM 443 - Asymmetric Catalysis
- CHEM 444 - Characterization Methods in Nanoscience
- CHEM 461 - Qualitative Organic Analysis
- CHEM 462 - Physical Organic Chemistry
- CHEM 463 - Organic Synthesis
- CHEM 464 - Bioconjugate Chemistry
- CHEM 477 - Molecular Symmetry and Spectroscopy
- CHEM 479 - Molecular Kinetics
- CHEM 483
- CHEM 489
- CHEM 493 - Computational Chemistry
- CHEM 495 - Molecular Dynamics and its Applications

#### Notes

1. Approved options are normally chosen from offerings within the Faculty of Science.
2. All options must be selected in consultation with the Department of Chemistry.
3. Credit in SCI 100 will be considered equivalent to BIOL 107, CHEM 101, CHEM 102, CHEM 164, MATH 114, MATH 115, PHYS 144, PHYS 146 and ★3 Science option (see details of courses). Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option..

## Specialization in Computing Science

For admission requirements, see Faculty of Science.

There are many routes to the study of Computing Science. Students should visit our website at [www.cs.ualberta.ca](http://www.cs.ualberta.ca). Each student is expected to develop their program of study in consultation with an advisor. All Honors and Specialization programs require annual approval by the department.

### Specialization in Computing Science

The Specialization in Computing Science program is designed for students to pursue the concentrated study of Computing Science, or to combine the study of Computing Science with another discipline. Students should consider the Science Internship Program.

Continuation in the Specialization in Computing Science program requires successful completion of at least ★18 with a minimum 2.3 GPA and a minimum 2.3 GPA on all CMPUT courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★60 and a minimum 2.3 GPA on all CMPUT courses credited towards the degree.

Specialization students must complete a minimum of ★24 in CMPUT courses at the 300- or 400-level offered at the University of Alberta.

Students can take a maximum of ★42 in 100-level courses.

Course selections in other departments and Faculties may be subject to enrolment management and GPA requirements.

#### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I (See Note 5)
- CMPUT 175 - Introduction to the Foundations of Computation II
- MATH 114 - Elementary Calculus I (See Note 5)
- MATH 115 - Elementary Calculus II (See Note 5)
- ★6 in junior ENGL or ★3 in junior ENGL and ★3 junior WRS
- ★12 in options (see Notes 1, 2, 5)

#### Year 2

- MATH 125 - Linear Algebra I

##### ★6 from

- CMPUT 201 - Practical Programming Methodology
- CMPUT 204 - Algorithms I
- CMPUT 229 - Computer Organization and Architecture I
- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 291 - Introduction to File and Database Management

##### Options

- ★6 in Statistics (see Notes 3, 6)
- ★15 in options (see Notes 1, 2)

#### Year 3

- ★12 in CMPUT at the 300-level or 400- level (see Note 4)

- ★18 in options (see Notes 1,2)

#### Year 4

- ★12 in CMPUT at the 300-level or 400- level (see Note 4)
- ★18 in options (see Notes 1, 2)

#### Notes

1. Options consist of Science options (see details of courses), Arts options, and other approved options. The options must satisfy at least ★21 from Science (see details of courses) and at least ★12 from Arts; ★30 can be chosen from Science (see details of courses), Arts or another Faculty. At least ★9 in options must be at the 300-level or higher.
2. Higher level CMPUT courses may require specific CMPUT, MATH or STAT courses as prerequisites. Therefore, prerequisites for higher level CMPUT courses must be considered when choosing options.
3. Students must have ★6 in introductory statistics and probability. This can be satisfied by selecting STAT 151 or STAT 235) and STAT 252, or the more advanced sequence of STAT 265 and STAT 266.
4. At least ★6 in CMPUT must be at the 400-level.
5. Credit in SCI 100 will be considered equivalent to CMPUT 174, MATH 114, MATH 115 and ★18 Science options (see details of courses).
6. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option (see details of courses)..

## Specialization in Computing Science—Minor in Business

For admission requirements, see Faculty of Science.

There are many routes to the study of Computing Science. Students should visit our website at [www.cs.ualberta.ca](http://www.cs.ualberta.ca). Each student is expected to develop their program of study in consultation with an advisor. All Honors and Specialization programs require annual approval by the department.

### Specialization in Computing Science—Minor in Business

The minor in Business program is for students interested in a career that combines Computing Science and Business. Students in the program have access to a limited number of reserved places in Business courses. Business minor students should consider the Science Internship Program.

Continuation in the Specialization in Computing Science - Minor in Business program requires successful completion of at least ★18 with a minimum 2.3 GPA and a minimum 2.3 GPA on all CMPUT and Business courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★60 and a minimum 2.3 GPA on all CMPUT and Business courses credited towards the degree. (Note that ECON courses are not counted as Business courses.)

Specialization with Business minor students must complete a minimum of ★24 in CMPUT courses at the 300- or 400-level offered at the University of Alberta.

Students can take a maximum of ★42 in 100-level courses.

Course selections in other departments and Faculties may be subject to enrolment management policies and GPA requirements.

Students who choose not to continue in the Specialization Computing Science program lose their status as “pursuing a Business Minor”. Upon reapplication, students may be able to pursue the Business minor in the General Program if they meet the competitive admission GPA for this minor.

#### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- MATH 114 - Elementary Calculus I
- MATH 115 - Elementary Calculus II
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★6 in options (See Notes 1, 5, and 6)

#### Year 2

- CMPUT 201 - Practical Programming Methodology
- CMPUT 204 - Algorithms I
- CMPUT 229 - Computer Organization and Architecture I
- CMPUT 272 - Formal Systems and Logic in Computing Science
- CMPUT 291 - Introduction to File and Database Management

- MATH 125 - Linear Algebra I
- ★6 in Statistics (See Notes 2 and 7)
- ★6 in options (See Note 1 and 6)

### Year 3

- CMPUT 300 - Computers and Society
- CMPUT 301 - Introduction to Software Engineering
- CMPUT 379 - Operating System Concepts
- ACCTG 311 - Introduction to Accounting for Financial Performance
- SMO 301 - Behavior in Organizations
- ★6 in CMPUT at the 300-level or higher (see Notes 3 and 4)
- ★9 in options (See Note 1 and 6)

### Year 4

#### ★6 from

- FIN 301 - Introduction to Finance
- MARK 301 - Introduction to Marketing
- OM 352 - Operations Management
- SMO 321 - Introduction to Strategic Management and Organization Design

#### Options

- ★9 in CMPUT at the 300-level or higher (see Notes 3 and 4)
- ★6 approved Business options (See Note 6)
- ★9 in options (See Note 1 and 6)

### Notes

- Options consist of Science options (see details of courses), Arts options, Business options, and approved options from any Faculty. The options must satisfy at least ★12 from Science (see details of courses) and ★6 from Arts, and an additional ★12 that may be chosen from Science (see details of courses), Arts or another Faculty. Higher level CMPUT courses may require specific CMPUT, MATH or STAT courses as prerequisites. Therefore, prerequisites for higher level CMPUT courses must be considered when choosing options.
- Students must have ★6 in introductory statistics and probability. This can be satisfied by selecting (STAT 151 or STAT 235) and STAT 252, or the more advanced sequence of STAT 265 and STAT 266.
- Students must take ★3 in Group A courses which include CMPUT 304, CMPUT 325, CMPUT 340 and CMPUT 474. A complete list of Group A courses to be offered in a given year is available from the department.
- Students must take ★3 in Group B project courses which include CMPUT 404, CMPUT 401, CMPUT 410, CMPUT 412, CMPUT 414, CMPUT 415, CMPUT 422, and CMPUT 466. The department may approve variations in the above requirement on application.
- Credit in SCI 100 will be considered equivalent to CMPUT 174, MATH 114, MATH 115 and ★18 options (see details of courses).
- Credit cannot be obtained for MIS 311, MIS 415, MIS 419, MIS 435 and MGTSC 312.
- Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option (see details of courses).

## Computing Science Specialization in Software Practice

For admission requirements, see Faculty of Science.

There are many routes to the study of Computing Science. Students should visit our website at [www.cs.ualberta.ca](http://www.cs.ualberta.ca). Each student is expected to develop their program of study in consultation with an advisor. All Honors and Specialization programs require annual approval by the department.

### Computing Science Specialization in Software Practice

The Software Practice program is for students interested in a career as a software professional. It gives students the ability to focus on topics in Computing Science that are most relevant to software professionals while pursuing relatively broad interests in Computing Science and in other disciplines. Students use the required Arts and approved options to build a foundation in disciplines related to, or influenced by, Computing Science. Course selections in other departments and Faculties may be subject to enrolment management policies and GPA requirements.

The Software Practice program includes the Science Internship Program component. Therefore, students are eligible to apply for ISP (Information Systems Professional) certification upon completing 24 months of work experience in the software industry and SIP experience counts towards this work experience. The ISP is a registered designation under the Professional and Occupational Associations Registration Act in Alberta. It was registered in February 1997, and is administered by the Registrar of CIPS Alberta.

Continuation in the Specialization in Computing Science in Software Practice program requires successful completion of at least ★18 with a minimum 2.3 GPA and a minimum 2.3 GPA on all CMPUT and Business courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★60 and a minimum 2.3 GPA on all CMPUT and Business courses credited towards the degree. (Note that ECON courses are not counted as Business courses.)

Specialization students in the Software Practice program must complete a minimum of ★24 in CMPUT courses at the 300- or 400-level offered at the University of Alberta.

### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I (See Note 5)
- CMPUT 175 - Introduction to the Foundations of Computation II
- CMPUT 272 - Formal Systems and Logic in Computing Science (See Note 1)
- MATH 114 - Elementary Calculus I (See Note 5)
- MATH 115 - Elementary Calculus II (See Note 5)
- ★6 in junior ENGL or ★3 in junior ENGL and ★3 junior WRS
- ★6 in Science options (see details of courses) (See Notes 5 and 7)
- ★3 in an approved option (see Note 6)

### Year 2

- CMPUT 201 - Practical Programming Methodology
- CMPUT 204 - Algorithms I
- CMPUT 229 - Computer Organization and Architecture I
- CMPUT 291 - Introduction to File and Database Management
- MATH 125 - Linear Algebra I
- ★6 in Statistics (See Notes 3 and 7)
- ★6 in Arts options
- ★3 in an approved option (see Note 6)

### Year 3

- CMPUT 300 - Computers and Society
- CMPUT 301 - Introduction to Software Engineering
- CMPUT 379 - Operating System Concepts
- ★6 in CMPUT at the 300-level or higher (see Note 4)
- ★6 in Business options (see Note 2)
- ★3 in an Arts option
- ★6 in Science options (see details of courses)

### Year 4

- SIP -8, 12, or 16 month Science Internship (Note: Students in the program who fail to obtain placement in the SIP must withdraw from the program, and must reapply to continue as a Specialization or Honors students).

### Year 5

- CMPUT 325 - Non-Procedural Programming Languages
- CMPUT 401 - Software Process and Product Management
- CMPUT 402 - Software Quality
- ★3 in CMPUT at the 300-level or higher (see Note 4)
- ★6 in Business electives (see Note 2)
- ★3 in an approved option (see Note 6)
- ★3 in a Science option (see details of courses)
- ★3 in an Arts option

### Notes

- CMPUT 272 can be taken in second year. Please consult department for advice.
- Students must choose ★6 of their Business options from Management Information Systems (MIS), Management Science (MGTSC) or Operations Management (OM), with the exception of MIS 311, MIS 415, MIS 419, MIS 435 and MGTSC 312. Students are required to have their selection approved by the student's advisor.
- Students must have ★6 in introductory statistics and probability. This can be satisfied by selecting (STAT 151 or STAT 235) and STAT 252, or the more advanced sequence of STAT 265 and STAT 266.
- Students must take ★3 in Group A courses which include CMPUT 304, CMPUT 340 and CMPUT 474. A complete list of Group A courses to be offered in a given year is available from the department.

5. Credit in SCI 100 will be considered equivalent to CMPUT 174, MATH 114, MATH 115 and ★18 options (see details of courses).
6. Credit cannot be obtained in approved options for MIS 311, MIS 415, MIS 419, MIS 435 and MGTSC 312.
7. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Computing Science Specialization Stream in Bioinformatics

Effective September 2016, there will be no further admissions to BSc Honors or BSc Specialization in Bioinformatics. Students who entered one of these programs prior to September 2016 must complete all program requirements by April 30, 2020. Refer to the Calendar in effect at the time you were admitted or readmitted for the regulations governing the degree program requirements. The last BSc Honors or BSc Specialization in Bioinformatics will be granted at Spring Convocation 2020.

## BSc Specialization in Computing Science After an Undergraduate Degree (other than a BSc from the Faculty of Science at the University of Alberta)

For admission requirements, see Faculty of Science.

There are many routes to the study of Computing Science. Students should visit our website at [www.cs.ualberta.ca](http://www.cs.ualberta.ca). Each student is expected to develop their program of study in consultation with an advisor. All Honors and Specialization programs require annual approval by the department.

## BSc Specialization in Computing Science After an Undergraduate Degree (other than a BSc from the Faculty of Science at the University of Alberta)

In addition to the requirements set out in After Degrees, a student pursuing this designation must also complete a minimum of ★24 in CMPUT courses at the 300- or 400-level offered at the University of Alberta as part of their ★60.

## Specialization in Atmospheric Sciences

Earth and Atmospheric Sciences encompass the study of the atmosphere, surface and interior of the earth. The Department administers 12 academic programs: Honors and Specialization in Atmospheric Sciences, Honors and Specialization in Environmental Earth Sciences, Honors and Specialization in Geology, Honors and Specialization in Paleontology, BSc Specialization in Planning, BA Major and Minor in Human Geography, and BA Major in Planning. **For details on the Major and Minor in Human Geography and on the BA Major in Planning, see Faculty of Arts listing.**

### Specialization in Atmospheric Sciences

Continuation in the Specialization in Atmospheric Sciences program requires successful completion of at least ★18 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★60 credited to the degree.

A student enrolling in the Specialization program should confer with the Atmospheric Sciences program student advisor before registration each year.

#### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- EAS 100 - Planet Earth
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 

- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- PHYS 144 - Newtonian Mechanics and Relativity
- 
- PHYS 146 - Fluids and Waves
- 
- STAT 151 - Introduction to Applied Statistics I
- 
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

#### Year 2

- EAS 212 - The Oceans
- EAS 221 - Introduction to Geographical Information Systems and Remote Sensing
- EAS 270 - The Atmosphere
- 
- EAS 294 **OR**
- HGP 250 - Natural Resources and Environmental Management
- 
- MATH 214 - Intermediate Calculus I
- MATH 215 - Intermediate Calculus II
- PHYS 244 - Mechanics
- PHYS 281 - Electricity and Magnetism
- ★3 in an Arts option
- ★3 in a Science option (details of courses)

#### Year 3

- EAS 327 - Environmental Instrumentation
- EAS 370 - Applied Atmospheric Physics
- EAS 371 - Dynamics of the Atmosphere and Ocean I
- EAS 372 - Weather Analysis and Forecasting
- EAS 373 - The Climate System
- PHYS 234 - Introductory Computational Physics
- ★6 in Arts options
- ★3 in Science option (see Note 1 below) (see details of courses)
- ★3 in Open option (see Note 2 below)

#### Year 4

- EAS 470 - Clouds and Storms
- EAS 471 - Atmospheric Modelling
- EAS 475 - Dynamics of the Atmosphere and Ocean II
- ★18 in Science options (see Note 1 below) (see details of courses)
- ★3 in Open option (see Note 2 below)

#### Notes

1. Students are recommended to consult Advisor for approved Science options.
2. Open option - Chosen from any credit course offered by the University of Alberta.
3. Recommended Arts options include any HGP courses.
4. For students entering Atmospheric Science Specialization, credit in SCI 100 will be considered equivalent to CMPUT 174, EAS 100, MATH 114, MATH 115, PHYS 144, PHYS 146 and ★9 Science options (see details of courses) equivalent to CHEM 101, CHEM 102 and EAS 105. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Specialization in Environmental Earth Sciences

Earth and Atmospheric Sciences encompass the study of the atmosphere, surface and interior of the earth. The Department administers 12 academic programs: Honors and Specialization in Atmospheric Sciences, Honors and Specialization in Environmental Earth Sciences, Honors and Specialization in Geology, Honors and Specialization in Paleontology, BSc Specialization in Planning, BA Major and Minor in Human Geography, and BA Major in Planning. **For details on the Major and Minor in Human Geography and on the BA Major in Planning, see Faculty of Arts listing.**

### Specialization in Environmental Earth Sciences

Continuation in the Specialization in Environmental Earth Sciences program requires successful completion of at least ★18 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★60 credited to the degree.

A student enrolling in the Specialization program should confer with the Environmental Earth Sciences Program student advisor before registration.

### Year 1

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- EAS 100 - Planet Earth
- EAS 105 - The Dynamic Earth Through Time
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- PHYS 124 - Particles and Waves **AND**
- PHYS 126 - Fluids, Fields, and Radiation
- **OR**
- PHYS 144 - Newtonian Mechanics and Relativity **AND**
- PHYS 146 - Fluids and Waves
- 
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

### Year 2

- BIOL 108 - Introduction to Biological Diversity
- EAS 221 - Introduction to Geographical Information Systems and Remote Sensing
- EAS 222 - Stratigraphy and Sedimentation
- EAS 224 - Mineralogy I
- EAS 225 - Earth Surface Processes and Landforms
- EAS 233 - Geologic Structures
- EAS 234 - Geology Field School
- HGP 250 - Natural Resources and Environmental Management
- STAT 151 - Introduction to Applied Statistics I
- 
- EAS 212 - The Oceans **OR**
- EAS 270 - The Atmosphere

### Year 3

- BIOL 208 - Principles of Ecology
- EAS 250 - Biogeography
- EAS 320 - Geochemistry I
- EAS 323 - Introduction to Hydrogeology
- EAS 324 - Quaternary Geoscience and Terrain Analysis
- EAS 354 - Environmental Earth Science Field School
- GEOPH 223 - Environmental Geophysics

#### ★6 from

- EAS 327 - Environmental Instrumentation
- EAS 351 - Environmental Applications of Geographical Information Systems
- EAS 451 - Digital Remote Sensing

#### Options

- ★3 in an Arts option

### Year 4

- EAS 425 - Contaminant Hydrogeology **OR**
- EAS 468 - Geochemical Processes

#### ★6 from

- EAS 457 - Global Change
- EAS 458 - Cold Regions Geoscience

#### Options

- ★6 in Arts options
- ★15 Science (see details of courses) and related options

### Notes

1. EAS 458 may be taken more than once for credit. Science and related options require the approval of the Environmental Earth Sciences advisor.
2. For students entering Environmental Earth Science Specialization, credit in SCI 100 will be considered equivalent to BIOL 108, CHEM 101, CHEM 102, EAS 100, EAS 105, MATH 114, MATH 115, PHYS 144 and PHYS 146. Credit

in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Specialization in Geology

Earth and Atmospheric Sciences encompass the study of the atmosphere, surface and interior of the earth. The Department administers 12 academic programs: Honors and Specialization in Atmospheric Sciences, Honors and Specialization in Environmental Earth Sciences, Honors and Specialization in Geology, Honors and Specialization in Paleontology, BSc Specialization in Planning, BA Major and Minor in Human Geography, and BA Major in Planning. For details on the Major and Minor in Human Geography and on the BA Major in Planning, see Faculty of Arts listing.

### Specialization in Geology

Continuation in the Specialization in Geology program requires successful completion of at least ★18 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★60 credited to the degree.

A student enrolling in the Specialization program should consult the Geology program student advisor before registration each year.

### Year 1

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- EAS 100 - Planet Earth
- EAS 105 - The Dynamic Earth Through Time
- 
- MATH 113 - Elementary Calculus I **OR**
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- PHYS 124 - Particles and Waves **AND**
- PHYS 126 - Fluids, Fields, and Radiation
- **OR**
- PHYS 144 - Newtonian Mechanics and Relativity **AND**
- PHYS 146 - Fluids and Waves
- 
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

### Year 2

- EAS 221 - Introduction to Geographical Information Systems and Remote Sensing
- EAS 222 - Stratigraphy and Sedimentation
- EAS 224 - Mineralogy I
- EAS 225 - Earth Surface Processes and Landforms
- EAS 230 - Introduction to Invertebrate Paleontology
- EAS 232 - Mineralogy II
- EAS 233 - Geologic Structures
- EAS 234 - Geology Field School
- ★3 Arts option
- ★3 Option

### Year 3

- EAS 320 - Geochemistry I
- EAS 323 - Introduction to Hydrogeology
- EAS 331 - Igneous Petrology
- EAS 332 - Metamorphic Petrology
- EAS 333 - Advanced Geology Field School
- EAS 336 - Sedimentary Systems
- 
- EAS 364 - Petroleum Geology and Subsurface Methods **OR**
- EAS 368 - Ore Deposits Geology
- 
- GEOPH 210 - Physics of the Earth **OR**
- GEOPH 223 - Environmental Geophysics **OR**
- GEOPH 224 - Geophysical Exploration Techniques
- 
- ★3 Arts option

- ★3 Science option (see details of courses)

#### Year 4

- GEOPH 210 - Physics of the Earth **OR**
- GEOPH 223 - Environmental Geophysics **OR**
- GEOPH 224 - Geophysical Exploration Techniques
- 
- ★15 EAS Science courses numbered 300 or higher
- ★6 Arts options
- ★3 Science option (see details of courses)
- ★3 Option

#### Notes

1. Recommended Arts options include anyHGP courses.
2. For students entering Geology Specialization, credit in SCI 100 will be considered equivalent to BIOL 108, CHEM 101, CHEM 102, EAS 100, EAS 105, MATH 114, MATH 115, PHYS 144 and PHYS 146. Credit in SCI 151 will be considered equivalent to ★6 Science options.

#### Science Internship Program

A Science Internship Program is offered to students in the General, Specialization or Honors programs in Earth and Atmospheric Sciences (see Science Internship Program for guidelines to the program). The Science Internship designation will appear on the degree parchments of students who have participated in the program and who have also successfully completed EAS 401.

## Specialization in Planning

Earth and Atmospheric Sciences encompass the study of the atmosphere, surface and interior of the earth. The Department administers 12 academic programs: Honors and Specialization in Atmospheric Sciences, Honors and Specialization in Environmental Earth Sciences, Honors and Specialization in Geology, Honors and Specialization in Paleontology, BSc Specialization in Planning, BA Major and Minor in Human Geography, and BA Major in Planning. For details on the Major and Minor in Human Geography and on the BA Major in Planning, see Faculty of Arts listing.

### Specialization in Planning

The Planning program educates students in the scientific, aesthetic, and orderly disposition of land, resources, facilities and services with a view to securing the physical, economic and social efficiency, health and well-being of communities. Planners work for all levels of government and in professional planning consultancies

The Department of Earth and Atmospheric Sciences offers a BA major in Planning and a BSc Specialization in Planning. Students interested in focusing on natural science elements of planning, including environmental management and the use of geographic information sciences, should consider the BSc program and those interested in the aesthetic, economic, and social issues of planning should consider the BA program (see Planning of the Calendar).

Continuation in the Specialization in Planning program requires a minimum 2.3 GPA on at least ★18 in the previous Fall/Winter. To graduate in four years, a student needs ★30 per year.

Graduation requires a minimum 2.3 GPA on the last ★60 credited to the degree. A student enrolling in the Specialization program should confer with the Planning program student advisor before registration.

#### Year 1

- BIOL 108 - Introduction to Biological Diversity
- EAS 100 - Planet Earth
- EAS 105 - The Dynamic Earth Through Time
- ECON 101 - Introduction to Microeconomics
- HGP 100 - Introduction to Human Geography and Planning
- 
- MATH 113 - Elementary Calculus I **OR**
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 120
- 
- STAT 141 - Introduction to Statistics **OR**
- STAT 151 - Introduction to Applied Statistics I
- 
- ★3 Science options (see details of courses)

- ★6 junior ENGL/WRS

#### Year 2

- BIOL 208 - Principles of Ecology
- EAS 221 - Introduction to Geographical Information Systems and Remote Sensing
- EAS 225 - Earth Surface Processes and Landforms
- EAS 250 - Biogeography
- HGP 210 - Introductory Planning History and Practice
- HGP 211 - Introduction to Design Fundamentals for Planners
- HGP 240 - Cities and Urbanism
- HGP 250 - Natural Resources and Environmental Management
- ★3 Science option and ★3 Open option (see details of courses)

#### Year 3

- EAS 351 - Environmental Applications of Geographical Information Systems
- HGP 310 - Land Use Planning and Policy
- HGP 315 - Community Planning and Engagement
- HGP 316 - Planning Law
- HGP 317 - Planning Theory
- HGP 355 - Environmental Planning (see Note 3)
- HGP 399 - Research Methods in Human Geography and Planning
- ★6 Approved courses (see Note 1 below)
- ★3 Science options (see Note 3) (see details of courses)

#### Year 4

- HGP 410 - Professional Planning Practice and Ethics
- HGP 412 - Finance for Planners
- HGP 470 - Geographical Information Systems and Advanced Cartography for Social Science (see Note 3)
- HGP 495 - Planning Studio
- ★9 from List A (see Note 1 below)
- ★6 Science option and ★3 Open option (see Note 3 below) (see details of courses)

#### Notes

1. List A courses include: BIOL 299, BIOL 330, BIOL 331, BIOL 332, BIOL 333, BIOL 364, BIOL 365, BIOL 366, BIOL 381, BIOL 464 and BIOL 470; EAS 323, EAS 324, EAS 327, EAS 401, EAS 425, EAS 427, EAS 428, EAS 451, EAS 452, EAS 457, EAS 458.
2. For students entering the Science Internship Program: EAS 401, WKEXP 955, WKEXP 956 are required.
3. HGP 355, HGP 381, HGP 470 and HGP 485 may be used as a Science courses by students in the BSc Specialization in Planning program.
4. For students entering Planning Specialization, credit in SCI 100 will be considered equivalent to BIOL 108, CHEM 101, CHEM 102, EAS 100, EAS 105, MATH 113, MATH 115, PHYS 144 and PHYS 146. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option..

## Specialization in Immunology and Infection

Continuation in the Specialization in Immunology and Infection program requires successful completion of at least ★24 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on all courses credited to the degree.

#### Year 1

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- 
- ★3 Approved Option
- ★6 Arts options (junior level ENGL or junior WRS recommended)

**Year 2**

- BIOCH 200 - Introductory Biochemistry
- BIOL 201 - Eukaryotic Cellular Biology
- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- CHEM 263 - Organic Chemistry II
- IMIN 200 - Infection and Immunity
- MICRB 265 - General Microbiology

**★3 from**

- (see Note 1)
- GENET 270 - Foundations of Molecular Genetics
- BIOCH 330 - Nucleic Acids and Molecular Biology

**Options**

- ★6 Arts options

**Years 3 and 4**

- ZOOL 241 - Animal Physiology I: Homeostasis **AND**
- ZOOL 242 - Animal Physiology II: Intercellular Communication
- **OR**
- PHYSL 210 - Human Physiology
- **OR**
- PHYSL 212 - Human Physiology I **AND**
- PHYSL 214 - Human Physiology II
- 
- IMIN 324 - Basic Virology
- IMIN 371 - Introduction to Immunology
- IMIN 452 - Advanced Immunology
- MMI 351 - Bacterial Pathogenesis
- ZOOL 352 - Principles of Parasitism

**★3 from:**

- BIOCH 430 - Biochemistry of Eukaryotic Gene Expression
- **OR**
- GENET 304 - Gene Expression and its Regulation
- 
- MICRB 316 - Molecular Microbiology

**Options**

- ★6 Arts options
- ★9 from the List below (see Note 2)
- ★21 in approved options from the List below or options approved by an advisor (see Note 3)

**List**

- BIOCH 320 - Structure and Catalysis
- BIOCH 330 - Nucleic Acids and Molecular Biology
- BIOCH 430 - Biochemistry of Eukaryotic Gene Expression
- BIOCH 450 - The Molecular Biology of Mammalian Viruses
- BIOL 391 - Techniques in Molecular Biology and Bioinformatics
- BIOL 409 - Zoonoses
- CELL 300 - Advanced Cell Biology I
- ENT 378 - Insect Pathology
- GENET 304 - Gene Expression and its Regulation
- IMIN 372 - Research Techniques in Immunology
- IMIN 401 - Comparative Immunology
- IMIN 405 - Innate Immunity
- IMIN 410 - Bioinformatics for Molecular Biologists
- MICRB 316 - Molecular Microbiology
- MICRB 410 - Bacterial Structure and Virulence Factors
- MMI 352 - Microbial Pathogenesis
- MMI 391 - Current Methods in Molecular Biology
- MMI 405 - Advanced Microbial Pathogenicity
- MMI 415 - Advanced Viral Pathogenesis
- MMI 426 - Medical Parasitology
- MMI 436 - Inflammation
- MMI 445 - Clinical Microbiology and Human Health
- ZOOL 354 - Wildlife Disease
- ZOOL 452 - Topics in Parasitology

**Notes**

1. GENET 270 is the prerequisite for GENET 304, MICRB 316; while BIOCH 320 and BIOCH 330 are prerequisites for BIOCH 430.
2. At least ★3 must be in a course with a laboratory component.

3. Normally only ★12 are allowed outside the Faculties of Science and Arts in the entire program. See details of courses for courses outside the Faculty of Science that will be considered as Science options.
4. Credit in SCI 100 is considered equivalent to BIOL 107, BIOL 108, CHEM 101, CHEM 102, CHEM 164, MATH 114 and ★9 approved options.
5. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

**Specialization in Mathematics**

Continuation in the Specialization in Mathematics program requires successful completion of at least ★24 with a minimum 2.3 GPA and a minimum 2.3 GPA on all MATH courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on all courses credited towards the degree and a minimum 2.3 GPA on all MATH courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated.

**Year 1**

- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- ★6 in junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★3 in an approved Science option (see details of courses)
- ★6 in approved options

**Year 2**

- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- 
- MATH 228 - Algebra: Introduction to Ring Theory
- ★3 in an approved MATH option
- ★3 in an approved Science option (see details of courses)
- ★6 in approved Arts options
- ★6 in approved options

**Year 3**

- MATH 314 - Analysis I (See Note 3)
- MATH 414 - Analysis II (See Note 3)
- ★6 in approved MATH options
- ★6 in approved Science options (see details of courses)
- ★6 in approved Arts options
- ★6 in approved options

**Year 4**

- ★12 in approved MATH options at the 300-level or higher
- ★6 in approved Science options (see details of courses)
- ★12 in approved options

**Notes**

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences.
2. Students are encouraged to take at least ★6 in MATH in each Fall/Winter of the program.
3. A student presenting the Honors Calculus sequence MATH 117/MATH 118/MATH 217/MATH 317 must substitute MATH options for MATH 314 and MATH 414.
4. Credit will not be given for ECON 299, ECON 386 or ECON 387.

- Credit for SCI 100 will be considered equivalent to MATH 114, MATH 115, CMPUT 174 and ★18 Science options (see details of courses).
- Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Specialization in Mathematics - Computational Science

Continuation in the Specialization in Mathematics - Computational Science program requires successful completion of at least ★24 with a minimum 2.3 GPA and a minimum 2.3 GPA on all CMPUT, MATH and STAT courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on all courses credited towards the degree and a minimum 2.3 GPA on all CMPUT, MATH and STAT courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated.

### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- ★6 in a junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★9 in approved options

### Year 2

- CMPUT 201 - Practical Programming Methodology
- CMPUT 204 - Algorithms I
- CMPUT 272 - Formal Systems and Logic in Computing Science
- 
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- MATH 222 - Introduction to Discrete Mathematics
- 
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- 
- STAT 265 - Statistics I
- ★6 in approved Arts options

### Year 3

- CMPUT 229 - Computer Organization and Architecture I
- CMPUT 291 - Introduction to File and Database Management
- MATH 228 - Algebra: Introduction to Ring Theory
- MATH 381 - Numerical Methods I
- STAT 266 - Statistics II
- ★3 in approved MATH or STAT options
- ★3 in approved Arts options
- ★9 in approved options

### Year 4

- ★6 in CMPUT at 300-level or higher
- ★6 in MATH or STAT at 300-level or higher
- ★3 in an option at 300-level or higher
- ★3 in approved Arts options
- ★12 in approved options

## Notes

- Each student's program must have the approval of the Department of Mathematical and Statistical Sciences.

- The program must contain at least ★72 in Science (see details of courses) and ★18 in Arts.
- Recommended MATH options include MATH 314, MATH 322, MATH 324, MATH 325, MATH 334, MATH 337, MATH 373, MATH 414, MATH 421, MATH 422, MATH 481.
- Recommended CMPUT options include CMPUT 301, CMPUT 304, CMPUT 313, CMPUT 325, CMPUT 379, CMPUT 391, CMPUT 401, CMPUT 411.
- Recommended STAT options include STAT 368, STAT 371, STAT 378, STAT 471, STAT 479.
- Credit will not be given for ECON 299, ECON 386 or ECON 387.
- Credit in SCI 100 will be considered equivalent to CMPUT 174, MATH 114, MATH 115 and ★18 options.
- Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Specialization in Mathematics and Economics

Continuation in the Specialization in Mathematics and Economics program requires successful completion of at least ★24 with a minimum 2.3 GPA and a minimum 2.3 GPA on all ECON, MATH and STAT courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on all courses credited towards the degree and a minimum 2.3 GPA on all ECON, MATH and STAT courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated.

### Year 1

- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★3 in an approved Science option (see details of courses)
- ★3 in an approved option

### Year 2

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- 
- ECON 281 - Intermediate Microeconomic Theory I
- ECON 282 - Intermediate Macroeconomic Theory I
- 
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- 
- STAT 265 - Statistics I
- STAT 266 - Statistics II
- ★3 in an approved option

### Years 3 and 4

- ECON 384 - Intermediate Microeconomic Theory II (or an approved ECON option at the 400-level or higher)
- ECON 385 - Intermediate Macroeconomic Theory II (or an approved ECON option at the 400-level or higher)
- ECON 399 - Introductory Econometrics
- ★15 in approved ECON options, of which at least ★3 must be at the 400-level or higher



- ★18 in approved MATH or STAT options, of which at least ★12 must be at the 300-level or higher
- ★3 in an approved Science option (see details of courses)
- ★15 in approved options

#### Notes

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences.
2. Credit will not be given for ECON 299, ECON 386 or ECON 387.
3. Students who are considering graduate work in Economics should take ECON 497.
4. Students are encouraged to take at least ★6 in ECON, MATH, or STAT in each Fall/Winter of the program.
5. Credit in SCI 100 will be considered equivalent to MATH 114, MATH 115, CMPUT 174, ★12 Science options (see details of courses) and ★6 options.
6. Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Specialization in Mathematics and Finance

Continuation in the Specialization in Mathematics and Finance program requires successful completion of at least ★24 with a minimum 2.3 GPA and a minimum 2.3 GPA on all ACCTG, ECON, FIN, MATH, MGTSC, OM and STAT courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on all courses credited towards the degree and a minimum 2.3 GPA on all ACCTG, ECON, FIN, MATH, MGTSC, OM and STAT courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated

#### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- ECON 101 - Introduction to Microeconomics
- ECON 102 - Introduction to Macroeconomics
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

#### Year 2

- ACCTG 311 - Introduction to Accounting for Financial Performance
- ECON 281 - Intermediate Microeconomic Theory I
- 
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- MATH 225 - Linear Algebra II
- MATH 253 - Theory of Interest
- OM 352 - Operations Management
- STAT 265 - Statistics I
- STAT 266 - Statistics II
- ★3 in approved options

#### Year 3

- FIN 301 - Introduction to Finance
- MATH 314 - Analysis I (see Note 4)
- MATH 356 - Introduction to Mathematical Finance I
- MATH 357 - Introduction to Mathematical Finance II
- STAT 371 - Probability and Stochastic Processes
- ★3 in an approved FIN option

- ★12 in approved options

#### Year 4

- ECON 399 - Introductory Econometrics **OR**
- STAT 378 - Applied Regression Analysis
- 
- MATH 373 - Mathematical Programming and Optimization I
- STAT 471 - Probability I
- ★6 in approved FIN options
- ★15 in approved options

#### Notes

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences and must include:
  - a. ★18 in Arts courses
  - b. ★63 in Science courses
  - c. ★33 in ACCTG, ECON, FIN, MGTSC or OM, including ★9 in 400-level FIN.
2. Approved ACCTG, ECON, FIN and MGTSC options include ACCTG 322, ACCTG 412, ACCTG 432; ECON 282, ECON 384, ECON 385, ECON 399, ECON 481, ECON 482, ECON 497; FIN 412, FIN 413, FIN 414, FIN 416, FIN 422, FIN 434, FIN 442; MGTSC 405. Credit will not be given for ECON 299, ECON 386 or ECON 387.
3. Recommended Science options include: MATH 334, MATH 337, MATH 381, MATH 432, MATH 481; STAT 353, STAT 472, STAT 479.
4. A student presenting the Honors Calculus sequence MATH 117, MATH 118, MATH 217, MATH 317 must substitute a MATH option for MATH 314.
5. Credit in SCI 100 will be considered equivalent to CMPUT 174, MATH 114, MATH 115 and ★18 options.
6. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Specialization in Statistics

Continuation in the Specialization in Statistics program requires successful completion of at least ★24 with a minimum 2.3 GPA and a minimum 2.3 GPA on all MATH and STAT courses completed in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on all courses credited towards the degree and a minimum 2.3 GPA on all MATH and STAT courses credited towards the degree.

The program must contain the following courses. It is recommended that these courses be taken in the years indicated.

#### Year 1

- CMPUT 174 - Introduction to the Foundations of Computation I
- CMPUT 175 - Introduction to the Foundations of Computation II
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 118 - Honors Calculus II **OR**
- MATH 146 - Calculus for the Physical Sciences II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★6 in approved options

#### Year 2

- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- 
- STAT 252 - Introduction to Applied Statistics II

- STAT 265 - Statistics I
- STAT 266 - Statistics II
- ★6 in approved Arts options
- ★6 in approved Science options (see details of courses)
- ★3 in approved options

### Years 3 and 4

- STAT 361 - Sampling Techniques
- STAT 368 - Introduction to Design and Analysis of Experiments
- STAT 371 - Probability and Stochastic Processes
- STAT 372 - Mathematical Statistics
- STAT 378 - Applied Regression Analysis
- ★12 in STAT options at 300- and 400-level
- ★6 in approved Arts options
- ★6 in approved Science options (see details of courses)
- ★18 in approved options

### Notes

1. Each student's program must have the approval of the Department of Mathematical and Statistical Sciences.
2. Credit will not be granted for ECON 299, ECON 386 or ECON 387.
3. Credit in SCI 100 will be considered equivalent to CMPUT 174, MATH 114, MATH 115 and ★18 approved Science options (see details of courses).
4. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Specialization in Paleontology

Paleontology is a basic science concerned with the evolutionary history of life. Students are required to have a broad knowledge base of biological and geological knowledge. Areas of detailed knowledge will include vertebrate and invertebrate paleobiology, paleobotany, evolutionary biology, systematics, functional morphology, sedimentology, stratigraphy, and plate tectonics. Paleontologists usually hold advanced research degrees and work as research scientists and teachers in universities, museums, and industrial laboratories.

### Specialization in Paleontology

Continuation in the Specialization in Paleontology program requires successful completion of at least ★18 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on all courses credited to the degree.

#### Year 1

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- 
- CHEM 101 - Introductory University Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- 
- EAS 100 - Planet Earth
- EAS 105 - The Dynamic Earth Through Time
- 
- MATH 114 - Elementary Calculus I **OR**
- MATH 117 - Honors Calculus I **OR**
- MATH 134 - Calculus for the Life Sciences I **OR**
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 125 - Linear Algebra I
- 
- STAT 151 - Introduction to Applied Statistics I
- 
- ★3 Science option (see details of courses)
- ★6 junior ENGL or ★3 junior ENGL and ★3 junior WRS

#### Years 2, 3, and 4

- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- BIOL 221 - Mechanisms of Evolution
- BIOL 335 - Principles of Systematics
- EAS 222 - Stratigraphy and Sedimentation
- EAS 230 - Introduction to Invertebrate Paleontology
- EAS 233 - Geologic Structures
- EAS 234 - Geology Field School
- 
- EAS 336 - Sedimentary Systems **OR**

- ZOOL 325 - Comparative Anatomy of the Vertebrates
- 
- ZOOL 224 - Vertebrate Diversity **OR**
- ZOOL 250 - Survey of the Invertebrates
- 
- ★6 PALEO 4XX and/or EAS 4XX
- ★21 in Science from approved courses below (see note)
- ★12 in approved Arts options
- ★21 Open options [including Science courses (see details of courses) below]

### Recommended option courses for Vertebrate Paleontology:

- BIOL 315 - Biology: An Historical Perspective
- BIOL 361 - Marine Science
- BIOL 364 - Freshwater Ecology
- BIOL 421 - Molecular Evolution and Systematics
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 498 - Research Project
- MA SC 412 - Biology of Fishes
- PALEO 400 - Paleontology Field School
- PALEO 412 - Selected Topics in Paleontology
- PALEO 414 - Paleontology
- PALEO 418 - Paleobiology of the Lower Vertebrates
- PALEO 419 - Paleobiology of the Higher Vertebrates
- ZOOL 224 - Vertebrate Diversity
- ZOOL 325 - Comparative Anatomy of the Vertebrates
- ZOOL 405 - Biology of Fishes
- ZOOL 406 - Biology of Amphibians and Reptiles
- ZOOL 407 - Biology of Birds
- ZOOL 408 - Biology of Mammals

### Recommended option courses for Invertebrate Paleontology:

- BIOL 315 - Biology: An Historical Perspective
- BIOL 361 - Marine Science
- BIOL 364 - Freshwater Ecology
- BIOL 421 - Molecular Evolution and Systematics
- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 498 - Research Project
- BOT 205 - Fundamentals of Plant Biology
- BOT 308 - Plant Anatomy
- BOT 321 - Flowering Plants
- EAS 110 - Earth Science Field School
- EAS 208 - Introduction to Global Change
- EAS 225 - Earth Surface Processes and Landforms
- EAS 270 - The Atmosphere
- EAS 320 - Geochemistry I
- EAS 336 - Sedimentary Systems
- EAS 364 - Petroleum Geology and Subsurface Methods
- EAS 373 - The Climate System
- EAS 421 - Structural Geology and Tectonics
- EAS 457 - Global Change
- EAS 460 - Geobiology
- EAS 462 - Stratigraphy and Sedimentary Basins
- EAS 465 - Sedimentology
- ENT 220 - Insect Biology
- ENT 327 - Terrestrial Arthropod Diversity
- MA SC 410 - Marine Invertebrate Zoology
- PALEO 412 - Selected Topics in Paleontology
- PALEO 414 - Paleontology
- ZOOL 250 - Survey of the Invertebrates

### Notes

1. Some courses are offered in alternate years only, so plan your schedule appropriately.
2. Approved Arts options: ANTHR 209, ANTHR 390, ANTHR 391, CHRTC 350, PHIL 265, PHIL 317.
3. Approved options: BIOL 299, BIOL 315, BIOL 361, BIOL 364, BIOL 421, BIOL 398, BIOL 399, BIOL 498, BIOL 499; BOT 205, BOT 308, BOT 314, BOT 321; EAS 110, EAS 207, EAS 208, EAS 221, EAS 224, EAS 225, EAS 250, EAS 270, EAS 320, EAS 336, EAS 364, EAS 373, EAS 421, EAS 426, EAS 427, EAS 428, EAS 457, EAS 460, EAS 462, EAS 465; ENT 220, EAS 427; GEOPH 223, GEOPH 224; MA SC 410, MA SC 412, MA SC 430; PALEO 400, PALEO 412, PALEO 414, PALEO 418, PALEO 419; ZOOL 224, ZOOL 250, ZOOL 325, ZOOL 405, ZOOL 406, ZOOL 407, ZOOL 408. For information regarding additional approved options, please consult your program advisor.

- For students entering Paleontology Specialization, credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, EAS 100, EAS 105, MATH 113, MATH 115, PHYS 144 and PHYS 146. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.
- Please refer to the Association of Professional Engineers and Geoscientists of Alberta (APEGA) course requirements when choosing courses if you wish to apply to APEGA for Professional Geoscientist status following the completion of your degree.

## Specialization in Pharmacology

The program leading to a Specialization degree in Pharmacology is for students who want to pursue further studies in the health sciences and those who want to prepare for a career in the Pharmaceutical industry. Although not as rigorous as an Honors program, the Specialization program is a solid background for advanced study leading to a career in academia or research.

Continuation and graduation in the Specialization in Pharmacology program requires successful completion of at least ★24 with a minimum 2.7 GPA, a minimum 2.7 GPA on all Science courses taken and a minimum 2.7 GPA on all PMCOL courses taken in each previous Fall/Winter.

### Year 1

- BIOL 107 - Introduction to Cell Biology
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- CHEM 164 - Organic Chemistry I **OR**
- CHEM 261 - Organic Chemistry I
- STAT 151 - Introduction to Applied Statistics I
- ★6 in Arts options ENGL recommended
- ★9 in Science options from BIOCH, BIOL, CHEM, GENET, MATH, MICRB, PHYS, PHYSL, PMCOL, STAT or ZOOL

### Year 2

- BIOCH 200 - Introductory Biochemistry
- CHEM 263 - Organic Chemistry II
- PHYSL 210 - Human Physiology **OR**
- PHYSL 212 - Human Physiology I **AND**
- PHYSL 214 - Human Physiology II
- PMCOL 201 - Introductory Pharmacology
- ★6 in Arts options
- ★9 in Science options as indicated in Year 1

### Year 3

- PMCOL 303 - Introduction to Toxicology
- PMCOL 305 - An Introduction to the Pharmacology of Drug Abuse
- PMCOL 337 - Experimental Procedures in Pharmacology
- PMCOL 343 - Scientific Basis of Pharmacology: Part I
- PMCOL 344 - Scientific Basis of Pharmacology: Part II
- BIOCH 320 - Structure and Catalysis
- ★6 in Science options as indicated in Year 1
- ★3 in Arts options
- ★3 in approved options

### Year 4

#### ★12 from

- PMCOL 401 - Pharmacology Tutorial
- PMCOL 402 - Pharmacology Tutorial
- PMCOL 412 - Drugs and the Nervous System
- PMCOL 415 - Cardiovascular Pharmacology
- PMCOL 416 - Current Topics in Endocrine Pharmacology
- PMCOL 425 - Problem Solving in Pharmacology and Therapeutics
- PMCOL 450 - Diabetes and Its Pharmacotherapy
- PMCOL 475 - Signal Transduction Systems as Pharmacological Targets

#### Options

- ★6 in Science options as indicated in Year 1
- ★3 in Arts options
- ★9 in approved options

### Notes

- Students must consult the Chair of the Department or designee for approval of the selection of options. Students will not be permitted to take 400-level pharmacology courses unless all prerequisites have been met.
- Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, CHEM 102, CHEM 164, MATH 114, MATH 115 and ★6 Science options (see details of courses).
- Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.
- Recommended Science options: BIOCH 310, BIOCH 330, BIOCH 401, BIOCH 410, BIOCH 420, BIOCH 430, BIOCH 441, BIOCH 450, CHEM 211, CHEM 213, CHEM 313, CHEM 419, GENET 270, GENET 301, GENET 304, GENET 390, GENET 408, MATH 113, or MATH 114 and MATH 115, PHYSL 372, PHYSL 401, PHYSL 402, PHYSL 403, PHYSL 404, PMCOL 371, STAT 252.
- The following courses may be used by students in the Faculty of Science as science courses: PMCOL 201, PMCOL 202, PMCOL 303, PMCOL 305, PMCOL 337, PMCOL 343, PMCOL 344, PMCOL 371, PMCOL 401, PMCOL 402, PMCOL 412, PMCOL 415, PMCOL 416, PMCOL 425, PMCOL 450, PMCOL 475 and PMCOL 498.

## Specialization in Physics

Continuation in the Specialization in Physics program requires successful completion of at least ★24 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★90 credited to the degree.

### Year 1

- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 117 - Honors Calculus I
- MATH 146 - Calculus for the Physical Sciences II **OR**
- MATH 118 - Honors Calculus II
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves
- ★6 in Science options (see details of courses) (CMPUT 174 recommended if a student has no computing background)
- ★6 in Arts options (see Note 1)

### Year 2

- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- PHYS 234 - Introductory Computational Physics
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 281 - Electricity and Magnetism
- PHYS 295 - Experimental and Statistical Methods of Physics
- PHYS 297 - Classic Experiments in Physics
- ★6 in an Arts option (see Note 1)

### Year 3

- MATH 334 - Introduction to Differential Equations
- MATH 337 - Introduction to Partial Differential Equations
- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 311 - Statistical Physics
- PHYS 372 - Quantum Mechanics A
- PHYS 381 - Electromagnetic Theory I
- PHYS 397 - Projects in Experimental Physics
- ★3 in Arts options (see Note 1)
- ★3 in PS Senior Science option (see Note 2)
- ★3 in PS Pool A option (see Note 3)

### Year 4

- ★6 in PS Senior Science options (see Note 2)

- ★15 in PS Pool A options (see Note 3)
- ★6 in PS Pool B options (see Note 4)
- ★3 in Arts option (see Note 1)

### Notes

1. By the end of their programs, students must have taken ★18 of Arts options.
2. PS Senior Science options: Any 200- or higher level course offered by the Faculty of Science (see details of courses).
3. PS Pool A: PHYS 301, PHYS 362, PHYS 364, all 300- and 400-level ASTRO, GEOPH, MA PH, and MATH courses; all 400-level PHYS courses. Other courses may be taken with prior consent of Department.
4. PS Pool B: all 400-level ASTRO, GEOPH, MA PH, and PHYS. Other courses may be taken with prior consent of Department.
5. Credit in SCI 100 is considered equivalent to MATH 114, MATH 115, PHYS 144, PHYS 146 and ★6 Science options (see details of courses).
6. Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Specialization in Astrophysics

Continuation in the Specialization in Astrophysics program requires successful completion of at least ★24 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★90 credited to the degree.

### Year 1

- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 117 - Honors Calculus I
- 
- MATH 146 - Calculus for the Physical Sciences II **OR**
- MATH 118 - Honors Calculus II
- 
- MATH 125 - Linear Algebra I **OR**
- MATH 127 - Honors Linear Algebra I
- 
- MATH 225 - Linear Algebra II **OR**
- MATH 227 - Honors Linear Algebra II
- 
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves
- ★6 in Science options (recommended options are ASTRO 120, ASTRO 122, or CMPUT 174 if a student has no computing background) (see details of courses)
- ★6 in Arts options

### Year 2

- ASTRO 320 - Stellar Astrophysics I
- 
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- PHYS 234 - Introductory Computational Physics
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 281 - Electricity and Magnetism
- PHYS 295 - Experimental and Statistical Methods of Physics
- PHYS 297 - Classic Experiments in Physics
- ★3 in Arts options

### Year 3

- ASTRO 322 - Galactic and Extragalactic Astrophysics
- MATH 334 - Introduction to Differential Equations
- MATH 337 - Introduction to Partial Differential Equations
- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 311 - Statistical Physics
- PHYS 372 - Quantum Mechanics A
- PHYS 381 - Electromagnetic Theory I
- ★3 in AS Senior Science option (see Note 2)
- ★3 in AS Pool option
- ★3 Arts option

### Year 4

#### ★6 from

- ASTRO 429 - Upper Atmosphere and Space Physics
- ASTRO 430 - Physical Cosmology
- ASTRO 465 - Stellar Astrophysics II

#### Options

- ★6 in AS Senior Science options (see Note 2)
- ★12 in AS Pool options (see Note 3)
- ★6 in Arts options

### Notes

1. Students must take a total of ★18 in Arts options.
2. AS Senior Science options: Any 200-, 300-, or 400-level course offered by the Faculty of Science (see details of courses).
3. AS Pool options: PHYS 301, PHYS 362, PHYS 364, PHYS 397; all 300- and 400-level GEOPH, MA PH, MATH, and PHYS courses; all 400- level ASTRO courses. Other courses may be taken with prior consent of Department.
4. Credit in SCI 100 is considered equivalent to MATH 114, MATH 115, PHYS 144, PHYS 146 and ★6 Science options (see details of courses).
5. Credit in SCI 151 will be considered equivalent to ★6 Science options.

## Specialization in Geophysics

Continuation in the Specialization in Geophysics program requires successful completion of at least ★24 with a minimum 2.3 GPA in the previous Fall/Winter. In addition, graduation requires a minimum 2.3 GPA on the last ★90 credited to the degree.

### Year 1

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- GEOPH 110 - Introduction to Geophysics
- 
- MATH 144 - Calculus for the Physical Sciences I **OR**
- MATH 117 - Honors Calculus I
- 
- MATH 146 - Calculus for the Physical Sciences II **OR**
- MATH 118 - Honors Calculus II
- 
- MATH 125 - Linear Algebra I
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 146 - Fluids and Waves
- ★6 in Arts options

### Year 2

- EAS 105 - The Dynamic Earth Through Time
- EAS 233 - Geologic Structures
- 
- MATH 214 - Intermediate Calculus I **OR**
- MATH 217 - Honors Advanced Calculus I
- 
- MATH 215 - Intermediate Calculus II **OR**
- MATH 317 - Honors Advanced Calculus II
- 
- PHYS 234 - Introductory Computational Physics
- PHYS 244 - Mechanics
- PHYS 271 - Introduction to Modern Physics
- PHYS 281 - Electricity and Magnetism
- PHYS 295 - Experimental and Statistical Methods of Physics
- ★3 in an Arts or approved Science option (see Note 1). CMPUT 174 in Fall Term is recommended if a student has no computing background.

### Year 3

- EAS 222 - Stratigraphy and Sedimentation
- GEOPH 325 - Gravity, Magnetic, and Electrical Geophysics
- GEOPH 326 - Seismic Imaging
- MATH 311 - Theory of Functions of a Complex Variable (or equivalent)
- 
- MATH 334 - Introduction to Differential Equations **OR**
- MATH 201 - Differential Equations (or equivalent)
- 
- MATH 337 - Introduction to Partial Differential Equations **OR**
- MATH 300 - Advanced Boundary Value Problems I (or equivalent)

- 
- PHYS 381 - Electromagnetic Theory I
- ★9 in approved Science or Arts options or Specialization Pools A or B courses (see Notes 1, 2 and 3)

#### Year 4

- GEOPH 424 - Electromagnetic Methods in Geophysics
- GEOPH 426 - Signal Processing in Geophysics
- GEOPH 436 - Geophysics Field School
- GEOPH 438 - Seismic Data Processing
- ★15 in approved Science options or Specialization Pools A or B courses (see Notes 1, 2 and 3)
- ★3 in Arts option (see Note 1).

#### Notes

1. In addition to the specific courses listed in the program, students must take a minimum of ★3 from specialization Pool B, ★6 from specialization Pools A or B, ★15 in approved Science options and ★12 in Arts options.
2. Specialization Pool A courses: ASTRO 429; EAS 221, EAS 320, EAS 323, EAS 324, EAS 425; GEOPH 332, GEOPH 421, GEOPH 431, GEOPH 440; MIN E 323; PET E 365, PET E 477; PHYS 308, PHYS 499. Students in Geophysics will not have the formal prerequisites for many of the EAS, MIN E, and PET E courses, and must request permission to register in those courses from the department offering the particular course. GEOPH courses are recommended.
3. Specialization Pool B courses: EAS 224, PHYS 261, PHYS 310 (recommended), PHYS 362, PHYS 420, PHYS 467, STAT 151.
4. Not all 300-level and 400-level courses are offered every year. Students must consult the Department of Physics for approval of programs.
5. Students entering this program after first year may take GEOPH 210 in lieu of GEOPH 110. However, students will not receive credit for both GEOPH 110 and GEOPH 210.
6. Credit in SCI 100 will be considered equivalent to CHEM 101, CHEM 102, EAS 105, MATH 114, MATH 115, PHYS 144 and PHYS 146.
7. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## Specialization in Psychology

Continuation in the Specialization in Psychology program requires the successful completion of ★24 with a minimum GPA of 2.3 in the preceding Fall/Winter. Graduation requires a minimum GPA of 2.3 on all courses credited to the degree..

#### Year 1

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- PSYCO 104 - Basic Psychological Processes
- PSYCO 105 - Individual and Social Behavior
- ★6 in junior ENGL or ★3 junior ENGL and ★3 junior WRS
- ★6 from junior courses offered in the departments of Computing Science and Mathematics
- ★6 from junior courses offered in the departments of Chemistry and Physics

#### Year 2

- STAT 151 - Introduction to Applied Statistics I

##### ★6 from

- PSYCO 223 - Lifespan Developmental Psychology
- PSYCO 239 - Abnormal Psychology
- PSYCO 241 - Social Psychology

##### ★6 from

- PSYCO 258 - Cognitive Psychology
- PSYCO 275 - Brain and Behavior
- PSYCO 282 - Behavior Modification

##### Options

- ★15 in approved options

#### Year 3

- ★6 from 300-level or above Arts Psychology courses
- ★6 from 300-level or above Science Psychology courses
- ★18 in approved options

#### Year 4

- ★30 in approved options

#### Notes

1. To fulfill the degree requirements, students must complete a minimum of ★36 in Psychology courses. At least ★6 must be at the 400-level. A minimum of ★72 in Science (see details of courses) is required (see BSc Specialization Programs).
2. Credit in SCI 100 will be considered equivalent to BIOL 107, BIOL 108, CHEM 101, CMPUT 174, MATH 114, PHYS 144, PSYCO 104 and ★6 Approved options.
3. Credit in SCI 151 will be considered equivalent to STAT 151 and ★3 Science option.

## BSc (Specialization in Science and Education)/BEd (Secondary) Combined Degrees Program

The Faculties of Science and Education offer a combined degrees program that is more highly structured than a BSc followed by a BEd After Degree (a six year route). It provides less flexibility in course choice and scheduling than taking the degrees sequentially because it is designed to meet the minimum requirements of both degrees in five years. In addition, it must meet teacher certification requirements within this time frame.

To accommodate the variety in subject studies needed in secondary school teaching, students in the BSc (Specialization in Science and Education)/BEd (Secondary) program will select both a major/minor from the following areas:

Biological Sciences: Biology, Botany, Entomology, Genetics, Immunology and Infection, Marine Science, Microbiology, Neuroscience, Paleontology, Pharmacology, Physiology, Zoology.

Physical Sciences: Astronomy, Chemistry, Mathematical Physics, Physics.

Mathematical Sciences: Computing Science, Mathematics, Statistics.

### Admission

Students apply to the Faculty of Science for admission to the BSc (Specialization in Science and Education)/BEd (Secondary) program and normally spend the first two years of the five-year combined degrees program registered in the Faculty of Science. [See BSc/BEd–BSc (Specialization in Science and Education) and BEd (Secondary) Combined Degree].

### Selection of Courses

Note: For success in your chosen program, ensure you have satisfied the pre/corequisite requirements for all courses. Departments have the right to remove students from courses for failing to present a passing grade (or higher, where stipulated) in the prerequisite course(s) and/or for failing to be enrolled in the corequisite course(s). Please see [www.uofa.ualberta.ca/science/programs/undergraduate/admission-to-science](http://www.uofa.ualberta.ca/science/programs/undergraduate/admission-to-science) for more information.

The following regulations govern the BSc (Specialization in Science and Education)/BEd (Secondary) program:

1. A student's program must be approved by an advisor in the appropriate Faculty prior to the start of each Fall/Winter.
2. Within the ★150 program, a student must complete a minimum of ★72 in Science (see details of courses), ★48 in Education and ★18 in Arts.
3. In the major, at least ★12 must be in 300-level or higher courses taken while registered in the BSc (Specialization in Science and Education)/BEd (Secondary) program at the University of Alberta.
4. In the minor, at least ★6 must be in 300-level or higher courses taken while registered in the BSc (Specialization in Science and Education)/BEd (Secondary) program at the University of Alberta.
5. No more than ★42 at the 100-level are permitted in the BSc (Specialization in Science and Education)/BEd (Secondary) program.

## Course Load Requirements

To complete the ★150 and graduate in five years, students must take a full course load of ★30 in each Fall/Winter of the program. The minimum load for students in the BSc (Specialization in Science and Education)/BEd (Secondary) program is at least ★24 in each Fall/Winter. A course load of less than ★24 requires annual approval by both the Dean of Education and the Dean of Science.

## Academic Standing and Graduation

The following regulations govern the combined degrees program:

- Continuation in the combined degrees program requires a GPA of at least 2.3 on ★24 in each Fall/Winter of the five-year program.
- Graduation from the combined degrees program requires a minimum GPA of 2.3 in the declared major.
- Students who fail to achieve a minimum GPA of 2.3 in their major at the end of Year 2 in the program will not be promoted to the Faculty of Education.
- A student who fails to attain the standard necessary for continuation or graduation may appeal to be granted one further Fall/Winter to achieve the required standing and requires the written approval of the Dean of Science and the Dean of Education.
- Students who cannot attain the standard necessary for continuation or graduation in the combined degrees program will be required to withdraw from the program. Such students may apply to transfer to a different BSc program in the Faculty of Science or the BEd program in the Faculty of Education.
- Normally, a student transferring from the combined degrees program to a BEd program after Year 2 or 3 should be able to complete the degree in one or two years. However, transfer to a BSc program must be made after Year 2 at the latest to avoid loss of credit.
- The BSc (Specialization in Science and Education) degree With Distinction is awarded when students achieve a GPA of at least 3.5 on the last ★60 if the student was enrolled in at least (★24) during each Fall/Winter of the last two years.

## Residence Requirement

A student transferring into the combined degrees program with transfer credit normally will be required to complete at least ★90 (normally the last ★90) while registered in the combined degrees program.

## Time Limits for Completion of Program

The combined degrees program is a five-year program. A student may complete the requirements of the combined degree over a period longer than five years or meet the requirements in a shorter time by attending Spring/Summer. An extension beyond six years is not normally permitted and requires the written approval of the Dean of Science and the Dean of Education.

## Science Chart 1 BSc (Specialization in Science and Education)/BEd

**Note:** Year 1 and Year 2 are completed in the Faculty of Science. Years 3, 4 and 5 are completed in the Faculty of Education.

### Biological Sciences Major/Mathematical Sciences Minor (★150)

#### Core Program Requirements

- Education: ★51
- Major: ★45
- Minor: ★24
- 100-level: ★30 (Maximum ★42)

#### Graduation Requirements:

- GPA of 2.3 on all courses
- GPA of 2.3 on Major courses

#### Area "B"

- ANTHR 230 - Anthropology of Science, Technology, and Environment
- BIOL 315 - Biology: An Historical Perspective
- CHRTC 350 - Science and Religion: Christian Perspectives

- CHRTC 352 - Bioethical Issues: Christian Perspectives
- CLASS 294 - Ancient Science, Technology, and Medicine
- HIST 294 - An Introduction to the History of Sciences, Technology, and Medicine
- HIST 391 - History of Technology
- HIST 394 - History of Astronomy and Cosmology from Stonehenge to the Space Age
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- HIST 496 - Topics in the History of Science
- PHIL 217 - Biology, Society, and Values
- PHIL 265 - Philosophy of Science
- PHIL 317 - Philosophy of Biology
- PHIL 375 - Science and Society
- STS 200 - Introduction to Studies in Science, Technology and Society
- WGS 250 - Gender and Science

**Note:** It is the student's responsibility to ensure that all prerequisites for higher level courses are met.

#### Year 1 (★30)

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- 
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- 
- MATH 114 - Elementary Calculus I
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 125 - Linear Algebra I **OR**
- STAT 151 - Introduction to Applied Statistics I
- 
- EDU 100 - Contexts of Education
- ★3 junior ENGL or WRS
- ★6 Arts options

#### Year 2 (★30)

- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- BIOCH 200 - Introductory Biochemistry
- EDU 211 - Aboriginal Education and Contexts for Professional and Personal Engagement
- 
- MATH 115 - Elementary Calculus II **OR**
- MATH 125 - Linear Algebra I **OR**
- STAT 151 - Introduction to Applied Statistics I
- 
- ★6 in Biological Sciences at the 200-level
- ★6 in Mathematical Sciences at the 200-level
- ★3 junior ENGL or WRS

#### Year 3 (★30)

- MATH 115 - Elementary Calculus II **OR**
- MATH 125 - Linear Algebra I **OR**
- STAT 151 - Introduction to Applied Statistics I
- 
- EDPY 304 - Adolescent Development and Learning
- EDU 210 - Introduction to Educational Technology
- ★6 in Biological Sciences at the 200-level
- ★6 Area "B"
- ★6 Arts options
- ★3 Mathematical Sciences at the 300- or 400-level

#### Year 4 (★30)

- EDFX 350 - Secondary Route Field Experience for the Introductory Professional Term (5 weeks)
- EDSE 352 (Major)
- EDSE 307 - Language, Literacy and Society in Educational Contexts
- EDPY 303 - Educational Assessment
- EDSE 338 - Curriculum and Teaching for Secondary School Mathematics Minors (Minor)
- EDPY 301 - Introduction to Inclusive Education: Adapting Classroom Instruction for Students with Special Needs
- EDPS 410 - Ethics and Law in Teaching
- ★6 in Biological Sciences at the 200-, 300- or 400-level

**Note:** First four courses above constitute the Introductory Professional Term and must be taken concurrently.

### Year 5 (★30)

- EDFX 450 - Secondary Route: Advanced Field Experience (9 weeks)
- EDSE 451 - Integrating Theory and Classroom Practice in the Advanced Professional Term
- EDSE 452 (Major)
- ★12 in Biological Sciences at the 300- or 400-level
- ★3 in Mathematical Sciences at the 300- or 400-level

**Note:** First three courses above constitute the Advanced Professional Term and must be taken concurrently.

### Year 5 (★30)

- EDFX 450 - Secondary Route: Advanced Field Experience (9 weeks)
- EDSE 451 - Integrating Theory and Classroom Practice in the Advanced Professional Term
- EDSE 452 - Curriculum and Teaching for Secondary School Biological Sciences Majors II (Major)
- ★12 in Biological Sciences at the 300- or 400-level
- ★3 in Mathematical Sciences at the 300- or 400-level

**Note:** First three courses above constitute the Advanced Professional Term and must be taken concurrently

## Biological Sciences Major/Physical Sciences Minor (★150)

### Core Program Requirements

- Education ★51
- Major: ★42
- Minor: ★27
- 100-level: ★33 (Maximum ★42)

### Graduation Requirements:

- GPA of 2.3 on all courses
- GPA of 2.3 on Major courses

### Area “A”

- CHEM 211 - Quantitative Analysis I
- CHEM 263 - Organic Chemistry II
- PHYS 208 - Aspects of Modern Physics
- PHYS 271 - Introduction to Modern Physics

### Area “B”

- ANTHR 230 - Anthropology of Science, Technology, and Environment
- BIOL 315 - Biology: An Historical Perspective
- CHRTC 350 - Science and Religion: Christian Perspectives
- CHRTC 352 - Bioethical Issues: Christian Perspectives
- CLASS 294 - Ancient Science, Technology, and Medicine
- HIST 294 - An Introduction to the History of Sciences, Technology, and Medicine
- HIST 391 - History of Technology
- HIST 394 - History of Astronomy and Cosmology from Stonehenge to the Space Age
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- HIST 496 - Topics in the History of Science
- PHIL 217 - Biology, Society, and Values
- PHIL 265 - Philosophy of Science
- PHIL 317 - Philosophy of Biology
- PHIL 375 - Science and Society
- STS 200 - Introduction to Studies in Science, Technology and Society
- WGS 250 - Gender and Science

### Area “C”

- ASTRO 320 - Stellar Astrophysics I
- ASTRO 322 - Galactic and Extragalactic Astrophysics
- PHYS 301 - Particles, Nuclei, and the Cosmos
- PHYS 308 - Statistical, Molecular, and Solid State Physics
- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 311 - Statistical Physics
- PHYS 362 - Optics and Lasers
- PHYS 364 - Environmental Physics II or any 300-level CHEM.

**Note:** It is the student's responsibility to ensure all prerequisites for 300-level courses are met.

### Year 1 (★30)

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- CHEM 261 - Organic Chemistry I **OR**
- CHEM 164 - Organic Chemistry I
- MATH 114 - Elementary Calculus I
- MATH 115 - Elementary Calculus II
- PHYS 124 - Particles and Waves **OR**
- PHYS 144 - Newtonian Mechanics and Relativity
- PHYS 126 - Fluids, Fields, and Radiation **OR**
- PHYS 146 - Fluids and Waves
- EDU 100 - Contexts of Education
- ★3 junior ENGL or WRS

### Year 2 (★30)

- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- CHEM 102 - Introductory University Chemistry II
- BIOCH 200 - Introductory Biochemistry
- EDU 211 - Aboriginal Education and Contexts for Professional and Personal Engagement
- ★3 Area “A”
- ★3 in Biological Sciences at the 200-level
- ★6 Arts options
- ★3 junior ENGL or WRS

### Year 3 (★30)

- EDU 210 - Introduction to Educational Technology
- PHYS 261 - Physics of Energy
- EDPY 304 - Adolescent Development and Learning
- ★6 in Biological Sciences at the 200-level
- ★6 Area “B”
- ★6 in Arts options
- ★3 Area “C”

### Year 4 (★30)

- EDFX 350 - Secondary Route Field Experience for the Introductory Professional Term (5 weeks)
- EDSE 352 (Major)
- EDSE 307 - Language, Literacy and Society in Educational Contexts
- EDPY 303 - Educational Assessment
- EDSE 305 - Curriculum and Teaching in Secondary Schools (Minor)
- EDPS 410 - Ethics and Law in Teaching
- EDPY 301 - Introduction to Inclusive Education: Adapting Classroom Instruction for Students with Special Needs
- ★6 in Biological Sciences at the 200-, 300- or 400-level

**Note:** First four courses above constitute the Introductory Professional Term and must be taken concurrently.

### Year 5 (★30)

- EDFX 450 - Secondary Route: Advanced Field Experience (9 weeks)
- EDSE 451 - Integrating Theory and Classroom Practice in the Advanced Professional Term
- EDSE 452 (Major)
- ★12 in Biological Sciences at the 300- or 400-level
- ★3 Area “C”

**Note:** First three courses above constitute the Advanced Professional Term and must be taken concurrently.

## Mathematical Sciences Major/Biological Sciences Minor (★150)

### Core Program Requirements

- Education: ★51
- Major: ★42
- Minor: ★27
- 100-level: ★33 (Maximum ★42)

**Graduation Requirements:**

- GPA of 2.3 on all courses
- GPA of 2.3 on Major courses

**Area "B"**

- ANTHR 230 - Anthropology of Science, Technology, and Environment
- BIOL 315 - Biology: An Historical Perspective
- CHRTC 350 - Science and Religion: Christian Perspectives
- CHRTC 352 - Bioethical Issues: Christian Perspectives
- CLASS 294 - Ancient Science, Technology, and Medicine
- HIST 294 - An Introduction to the History of Sciences, Technology, and Medicine
- HIST 391 - History of Technology
- HIST 394 - History of Astronomy and Cosmology from Stonehenge to the Space Age
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- HIST 496 - Topics in the History of Science
- PHIL 217 - Biology, Society, and Values
- PHIL 265 - Philosophy of Science
- PHIL 317 - Philosophy of Biology
- PHIL 375 - Science and Society
- PHYS 261 - Physics of Energy
- STS 200 - Introduction to Studies in Science, Technology and Society
- WGS 250 - Gender and Science

**Note:** It is the student's responsibility to ensure that all prerequisites for higher level courses are met.

**Year 1 (★30)**

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- EDU 100 - Contexts of Education
- MATH 114 - Elementary Calculus I
- MATH 115 - Elementary Calculus II
- MATH 125 - Linear Algebra I
- STAT 151 - Introduction to Applied Statistics I
- ★3 junior ENGL or WRS
- ★6 in Physical Sciences at the 100-level

**Year 2 (★30)**

- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- EDU 211 - Aboriginal Education and Contexts for Professional and Personal Engagement
- MATH 214 - Intermediate Calculus I
- MATH 215 - Intermediate Calculus II
- MATH 228 - Algebra: Introduction to Ring Theory
- MATH 241 - Geometry
- ★6 Arts options
- ★3 junior ENGL or WRS

**Year 3 (★30)**

- EDU 210 - Introduction to Educational Technology
- ★3 in Biological Sciences at the 200-level
- ★6 in Mathematical Sciences at the 200- or 300- or 400-level
- ★6 in Biological Sciences at the 200- or 300- or 400-level
- ★6 Arts options
- ★6 Area "B"

**Year 4 (★30)**

- EDFX 350 - Secondary Route Field Experience for the Introductory Professional Term (5 weeks)
- EDSE 337 - Curriculum and Teaching for Secondary School Mathematics Majors I (Major)
- EDSE 307 - Language, Literacy and Society in Educational Contexts
- EDPY 303 - Educational Assessment
- EDSE 353 (Minor)
- EDPS 410 - Ethics and Law in Teaching
- ★6 in Biological Sciences at the 300- or 400-level
- ★3 in Mathematical Sciences at the 300- or 400-level

**Note:** First four courses above constitute the Introductory Professional Term and must be taken concurrently.

**Year 5 (★30)**

- EDFX 450 - Secondary Route: Advanced Field Experience (9 weeks)

- EDSE 451 - Integrating Theory and Classroom Practice in the Advanced Professional Term
- EDSE 437 - Curriculum and Teaching for Secondary School Mathematics Majors II (Major)
- EDPY 304 - Adolescent Development and Learning
- EDPY 301 - Introduction to Inclusive Education: Adapting Classroom Instruction for Students with Special Needs
- ★9 in Mathematical Sciences at the 300- or 400- level

**Note:** First three courses above constitute the Advanced Professional Term and must be taken concurrently

**Mathematical Sciences Major/Physical Sciences Minor (★150)****Core Program Requirements**

- Education: ★51
- Major: ★42
- Minor: ★30
- 100-level: ★39 (Maximum ★42)

**Graduation Requirements:**

- GPA of 2.3 on all courses
- GPA of 2.3 on Major courses

**Area "A"**

- BIOCH 200 - Introductory Biochemistry
- CHEM 211 - Quantitative Analysis I
- CHEM 263 - Organic Chemistry II

**Area "B"**

- ANTHR 230 - Anthropology of Science, Technology, and Environment
- BIOL 315 - Biology: An Historical Perspective
- CHRTC 350 - Science and Religion: Christian Perspectives
- CHRTC 352 - Bioethical Issues: Christian Perspectives
- CLASS 294 - Ancient Science, Technology, and Medicine
- HIST 294 - An Introduction to the History of Sciences, Technology, and Medicine
- HIST 391 - History of Technology
- HIST 394 - History of Astronomy and Cosmology from Stonehenge to the Space Age
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- HIST 496 - Topics in the History of Science
- PHIL 217 - Biology, Society, and Values
- PHIL 265 - Philosophy of Science
- PHIL 317 - Philosophy of Biology
- PHIL 375 - Science and Society
- PHYS 261 - Physics of Energy
- STS 200 - Introduction to Studies in Science, Technology and Society
- WGS 250 - Gender and Science

**Area "C"**

- ASTRO 320 - Stellar Astrophysics I
- ASTRO 322 - Galactic and Extragalactic Astrophysics
- PHYS 301 - Particles, Nuclei, and the Cosmos
- PHYS 308 - Statistical, Molecular, and Solid State Physics
- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 311 - Statistical Physics
- PHYS 362 - Optics and Lasers
- PHYS 364 - Environmental Physics II or any 300-level CHEM

**Note:** It is the student's responsibility to ensure all prerequisites for 300-level courses are met.

**Year 1 (★30)**

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- EDU 100 - Contexts of Education
- MATH 114 - Elementary Calculus I
- MATH 115 - Elementary Calculus II
- MATH 125 - Linear Algebra I
- STAT 151 - Introduction to Applied Statistics I

**★6 chosen from**

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II



- PHYS 124 - Particles and Waves **OR**
- PHYS 144 - Newtonian Mechanics and Relativity
- 
- PHYS 126 - Fluids, Fields, and Radiation **OR**
- PHYS 146 - Fluids and Waves

#### Options

- ★3 junior ENGL or WRS

#### Year 2 (★30)

- CHEM 261 - Organic Chemistry I
- EDU 211 - Aboriginal Education and Contexts for Professional and Personal Engagement
- MATH 214 - Intermediate Calculus I
- MATH 215 - Intermediate Calculus II
- MATH 228 - Algebra: Introduction to Ring Theory
- MATH 241 - Geometry

#### ★6 chosen from

- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- 
- PHYS 124 - Particles and Waves **OR**
- PHYS 144 - Newtonian Mechanics and Relativity
- 
- PHYS 126 - Fluids, Fields, and Radiation **OR**
- PHYS 146 - Fluids and Waves

#### Options

- ★3 junior ENGL or WRS
- ★3 Arts option

#### Year 3 (★30)

- EDPY 304 - Adolescent Development and Learning
- EDU 210 - Introduction to Educational Technology
- 
- PHYS 208 - Aspects of Modern Physics **OR**
- PHYS 271 - Introduction to Modern Physics
- 
- ★3 Area "A"
- ★6 in Mathematical Sciences at the 200, 300 or 400-level
- ★6 in Arts Options
- ★6 Area "B"

**Note:** Students wishing to take PHYS 364 as their Area "C" option must take PHYS 261 as an Area "B" option.

#### Year 4 (★30)

- EDFX 350 - Secondary Route Field Experience for the Introductory Professional Term (5 weeks)
- EDSE 337 - Curriculum and Teaching for Secondary School Mathematics Majors I (Major)
- EDSE 307 - Language, Literacy and Society in Educational Contexts
- EDPY 303 - Educational Assessment
- EDPS 410 - Ethics and Law in Teaching
- ★3 in Mathematical Sciences at the 300- or 400-level
- ★3 Area "A"
- ★3 Area "C"

**Note:** First four courses above constitute the Introductory Professional Term and must be taken concurrently.

#### Year 5 (★30)

- EDFX 450 - Secondary Route: Advanced Field Experience (9 weeks)
- EDSE 451 - Integrating Theory and Classroom Practice in the Advanced Professional Term
- EDSE 437 - Curriculum and Teaching for Secondary School Mathematics Majors II (Major)
- EDPY 301 - Introduction to Inclusive Education: Adapting Classroom Instruction for Students with Special Needs
- ★9 in Mathematical Sciences at the 300- or 400- level
- ★3 Area "C"

**Note:** First three courses above constitute the Advanced Professional Term and must be taken concurrently.

## Physical Sciences Major/Biological Sciences Minor

### Chemistry Concentration (★150)

#### Core Program Requirements

- Education: ★51
- Major: ★42
- Minor: ★24
- 100-level: ★33 (Maximum ★42)

#### Graduation Requirements:

- GPA of 2.3 on all courses
- GPA of 2.3 on Major courses

#### Area "B"

- ANTHR 230 - Anthropology of Science, Technology, and Environment
- BIOL 315 - Biology: An Historical Perspective
- CHRTC 350 - Science and Religion: Christian Perspectives
- CHRTC 352 - Bioethical Issues: Christian Perspectives
- CLASS 294 - Ancient Science, Technology, and Medicine
- HIST 294 - An Introduction to the History of Sciences, Technology, and Medicine
- HIST 391 - History of Technology
- HIST 394 - History of Astronomy and Cosmology from Stonehenge to the Space Age
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- HIST 496 - Topics in the History of Science
- PHIL 217 - Biology, Society, and Values
- PHIL 265 - Philosophy of Science
- PHIL 317 - Philosophy of Biology
- PHIL 375 - Science and Society
- PHYS 261 - Physics of Energy
- STS 200 - Introduction to Studies in Science, Technology and Society
- WGS 250 - Gender and Science

#### Area "C"

- ASTRO 320 - Stellar Astrophysics I
- ASTRO 322 - Galactic and Extragalactic Astrophysics
- PHYS 301 - Particles, Nuclei, and the Cosmos
- PHYS 308 - Statistical, Molecular, and Solid State Physics
- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 311 - Statistical Physics
- PHYS 362 - Optics and Lasers
- PHYS 364 - Environmental Physics II or any 300-level CHEM.

**Note:** It is the student's responsibility to ensure all prerequisites for 300-level courses are met.

#### Year 1 (★30)

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- EDU 100 - Contexts of Education
- MATH 114 - Elementary Calculus I
- MATH 115 - Elementary Calculus II
- 
- PHYS 124 - Particles and Waves **OR**
- PHYS 144 - Newtonian Mechanics and Relativity
- 
- PHYS 126 - Fluids, Fields, and Radiation **OR**
- PHYS 146 - Fluids and Waves
- 
- ★3 junior ENGL or WRS

#### Year 2 (★30)

- BIOL 207 - Molecular Genetics and Heredity
- BIOL 208 - Principles of Ecology
- CHEM 261 - Organic Chemistry I
- EDU 210 - Introduction to Educational Technology
- EDU 211 - Aboriginal Education and Contexts for Professional and Personal Engagement
- 
- PHYS 208 - Aspects of Modern Physics **OR**
- PHYS 271 - Introduction to Modern Physics
-

- CHEM 211 - Quantitative Analysis I **OR**
- PHYS 294 - General Physics Laboratory
- 
- ★3 junior ENGL or WRS
- ★6 Arts options

### Year 3 (★30)

- 
- CHEM 263 - Organic Chemistry II
  - MATH 214 - Intermediate Calculus I
  - 
  - CHEM 211 - Quantitative Analysis I **OR**
  - PHYS 294 - General Physics Laboratory
  - 
  - PHYS 281 - Electricity and Magnetism
  - ★6 in Biological Sciences at the 200-level
  - ★3 Arts option
  - ★6 Area "B"
  - ★3 Area "C"

**Note:** Students wishing to take PHYS 364 as their Area "C" option must take PHYS 261 as an Area "B" option.

### Year 4 (★30)

- 
- EDFX 350 - Secondary Route Field Experience for the Introductory Professional Term (5 weeks)
  - EDSE 307 - Language, Literacy and Society in Educational Contexts
  - EDSE 364 (Major)
  - EDPY 303 - Educational Assessment
  - EDPS 410 - Ethics and Law in Teaching
  - EDSE 305 - Curriculum and Teaching in Secondary Schools (Minor)
  - ★6 in Biological Sciences at the 300- or 400-level
  - ★3 Arts option

**Note:** First four courses above constitute the Introductory Professional Term and must be taken concurrently.

### Year 5 (★30)

- 
- EDFX 450 - Secondary Route: Advanced Field Experience (9 weeks)
  - EDSE 451 - Integrating Theory and Classroom Practice in the Advanced Professional Term
  - EDSE 460 (Major)
  - EDPY 304 - Adolescent Development and Learning
  - EDPY 301 - Introduction to Inclusive Education: Adapting Classroom Instruction for Students with Special Needs
  - ★9 Area "C"

**Note:** First three courses above constitute the Advanced Professional Term and must be taken concurrently.

## Physical Sciences Major/Biological Sciences Minor

### Physics Concentration (★150)

#### Core Program Requirements

- Education: ★51
- Major: ★42
- Minor: ★24
- 100-level: ★33 (Maximum ★42)

#### Graduation Requirements:

- GPA of 2.3 on all courses
- GPA of 2.3 on Major courses

#### Area "B"

- 
- ANTHR 230 - Anthropology of Science, Technology, and Environment
  - BIOL 315 - Biology: An Historical Perspective
  - CHRTC 350 - Science and Religion: Christian Perspectives
  - CHRTC 352 - Bioethical Issues: Christian Perspectives
  - CLASS 294 - Ancient Science, Technology, and Medicine
  - HIST 294 - An Introduction to the History of Sciences, Technology, and Medicine
  - HIST 391 - History of Technology
  - HIST 394 - History of Astronomy and Cosmology from Stonehenge to the Space Age
  - HIST 397 - History of Science I
  - HIST 398 - History of Science II
  - HIST 496 - Topics in the History of Science
  - PHIL 217 - Biology, Society, and Values

- PHIL 265 - Philosophy of Science
- PHIL 317 - Philosophy of Biology
- PHIL 375 - Science and Society
- PHYS 261 - Physics of Energy
- STS 200 - Introduction to Studies in Science, Technology and Society
- WGS 250 - Gender and Science

#### Area "C"

- 
- ASTRO 320 - Stellar Astrophysics I
  - ASTRO 322 - Galactic and Extragalactic Astrophysics
  - PHYS 301 - Particles, Nuclei, and the Cosmos
  - PHYS 308 - Statistical, Molecular, and Solid State Physics
  - PHYS 310 - Thermodynamics and Kinetic Theory
  - PHYS 311 - Statistical Physics
  - PHYS 362 - Optics and Lasers
  - PHYS 364 - Environmental Physics II or any 300-level CHEM.

**Note:** It is the student's responsibility to ensure all prerequisites for 300-level courses are met.

### Year 1 (★30)

- 
- BIOL 107 - Introduction to Cell Biology
  - BIOL 108 - Introduction to Biological Diversity
  - CHEM 101 - Introductory University Chemistry I
  - CHEM 102 - Introductory University Chemistry II
  - EDU 100 - Contexts of Education
  - MATH 114 - Elementary Calculus I
  - MATH 115 - Elementary Calculus II
  -

- PHYS 124 - Particles and Waves **OR**
- PHYS 144 - Newtonian Mechanics and Relativity
- 

- PHYS 126 - Fluids, Fields, and Radiation **OR**
- PHYS 146 - Fluids and Waves
- 

- ★3 junior ENGL or WRS

### Year 2 (★30)

- 
- BIOL 207 - Molecular Genetics and Heredity
  - BIOL 208 - Principles of Ecology
  - CHEM 261 - Organic Chemistry I
  - EDU 210 - Introduction to Educational Technology
  - EDU 211 - Aboriginal Education and Contexts for Professional and Personal Engagement
  -

- PHYS 208 - Aspects of Modern Physics **OR**
- PHYS 271 - Introduction to Modern Physics
- 

- MATH 214 - Intermediate Calculus I
- 

- CHEM 211 - Quantitative Analysis I **OR**
- PHYS 294 - General Physics Laboratory
- 

- ★3 Arts option
- ★3 junior ENGL or WRS

### Year 3 (★30)

- 
- CHEM 263 - Organic Chemistry II
  - 
  - CHEM 211 - Quantitative Analysis I **OR**
  - PHYS 294 - General Physics Laboratory
  -

- MATH 215 - Intermediate Calculus II
- PHYS 281 - Electricity and Magnetism
- ★6 in Biological Sciences at the 200-level
- ★6 Arts options
- ★3 Area "B"
- ★3 Area "C"

**Note:** Students wishing to take PHYS 364 as their Area "C" option must take PHYS 261 as an Area "B" option.

### Year 4 (★30)

- 
- EDFX 350 - Secondary Route Field Experience for the Introductory Professional Term (5 weeks)
  - EDPY 303 - Educational Assessment
  - EDSE 307 - Language, Literacy and Society in Educational Contexts
  - EDSE 364 (Major)

- EDPS 410 - Ethics and Law in Teaching
- EDSE 305 - Curriculum and Teaching in Secondary Schools (Minor)
- ★6 in Biological Sciences at the 300- or 400-level
- ★3 Arts option

**Note:** First four courses above constitute the Introductory Professional Term and must be taken concurrently.

#### Year 5 (★30)

- EDFX 450 - Secondary Route: Advanced Field Experience (9 weeks)
- EDSE 451 - Integrating Theory and Classroom Practice in the Advanced Professional Term
- EDSE 460 (Major)
- EDPY 304 - Adolescent Development and Learning
- EDPY 301 - Introduction to Inclusive Education: Adapting Classroom Instruction for Students with Special Needs
- ★9 Area "C"

**Note:** First three courses above constitute the Advanced Professional Term and must be taken concurrently..

### Physical Sciences Major/Mathematical Sciences Minor (★150)

#### Core Program Requirements

- Education: ★51
- Major: ★42
- Minor: ★24
- 100-level: ★36 (Maximum ★42)

#### Graduation Requirements:

- GPA of 2.3 on all courses
- GPA of 2.3 on Major courses

#### Area "B"

- ANTHR 230 - Anthropology of Science, Technology, and Environment
- BIOL 315 - Biology: An Historical Perspective
- CHRTC 350 - Science and Religion: Christian Perspectives
- CHRTC 352 - Bioethical Issues: Christian Perspectives
- CLASS 294 - Ancient Science, Technology, and Medicine
- HIST 294 - An Introduction to the History of Sciences, Technology, and Medicine
- HIST 391 - History of Technology
- HIST 394 - History of Astronomy and Cosmology from Stonehenge to the Space Age
- HIST 397 - History of Science I
- HIST 398 - History of Science II
- HIST 496 - Topics in the History of Science
- PHIL 217 - Biology, Society, and Values
- PHIL 265 - Philosophy of Science
- PHIL 317 - Philosophy of Biology
- PHIL 375 - Science and Society
- STS 200 - Introduction to Studies in Science, Technology and Society
- WGS 250 - Gender and Science

#### Area "C"

- ASTRO 320 - Stellar Astrophysics I
- ASTRO 322 - Galactic and Extragalactic Astrophysics
- PHYS 301 - Particles, Nuclei, and the Cosmos
- PHYS 308 - Statistical, Molecular, and Solid State Physics
- PHYS 310 - Thermodynamics and Kinetic Theory
- PHYS 311 - Statistical Physics
- PHYS 362 - Optics and Lasers
- PHYS 364 - Environmental Physics II or any 300-level CHEM.

**Note:** It is the student's responsibility to ensure all prerequisites for 300-level courses are met.

#### Year 1 (★30)

- BIOL 107 - Introduction to Cell Biology
- BIOL 108 - Introduction to Biological Diversity
- CHEM 101 - Introductory University Chemistry I
- CHEM 102 - Introductory University Chemistry II
- EDU 100 - Contexts of Education
- MATH 114 - Elementary Calculus I
- MATH 115 - Elementary Calculus II
- 
- PHYS 124 - Particles and Waves **OR**

- PHYS 144 - Newtonian Mechanics and Relativity
- 
- PHYS 126 - Fluids, Fields, and Radiation **OR**
- PHYS 146 - Fluids and Waves
- 
- ★3 junior ENGL or WRS

#### Year 2 (★30)

- EDU 210 - Introduction to Educational Technology
- EDU 211 - Aboriginal Education and Contexts for Professional and Personal Engagement
- CHEM 261 - Organic Chemistry I
- MATH 125 - Linear Algebra I
- MATH 214 - Intermediate Calculus I
- 
- PHYS 261 - Physics of Energy **OR**
- PHYS 281 - Electricity and Magnetism
- 
- PHYS 208 - Aspects of Modern Physics **OR**
- PHYS 271 - Introduction to Modern Physics
- 
- CHEM 211 - Quantitative Analysis I **OR**
- PHYS 294 - General Physics Laboratory
- 
- ★3 junior ENGL or WRS
- ★3 Arts option

#### Year 3 (★30)

- CHEM 263 - Organic Chemistry II
- MATH 228 - Algebra: Introduction to Ring Theory
- MATH 215 - Intermediate Calculus II
- 
- CHEM 211 - Quantitative Analysis I **OR**
- PHYS 294 - General Physics Laboratory
- 
- ★6 Arts options
- ★6 Area "B"
- ★6 Area "C"

#### Year 4 (★30)

- EDFX 350 - Secondary Route Field Experience for the Introductory Professional Term (5 weeks)
- EDPY 303 - Educational Assessment
- EDSE 307 - Language, Literacy and Society in Educational Contexts
- EDSE 364 (Major)
- EDPS 410 - Ethics and Law in Teaching
- EDSE 338 - Curriculum and Teaching for Secondary School Mathematics Minors (Minor)
- ★6 in Mathematical Sciences at the 300- or 400-level
- ★3 Science options

**Note:** First four courses above constitute the Introductory Professional Term and must be taken concurrently.

#### Year 5 (★30)

- EDFX 450 - Secondary Route: Advanced Field Experience (9 weeks)
- EDSE 451 - Integrating Theory and Classroom Practice in the Advanced Professional Term
- EDSE 460 (Major)
- EDPY 301 - Introduction to Inclusive Education: Adapting Classroom Instruction for Students with Special Needs
- EDPY 304 - Adolescent Development and Learning
- ★3 Arts option
- ★6 Area "C"

**Note:** First three courses above constitute the Advanced Professional Term and must be taken concurrently.

## Certificates

### Certificate in Engaged Leadership and Citizenship in Arts and Science

The Certificate in Engaged Leadership and Citizenship in Arts and Science is a joint certificate offered by the Faculties of Arts and Science and is open to any undergraduate student at the University of Alberta. (See the Certificate in Engaged Leadership and Citizenship in Arts and Science).

### Research Certificate in Science (Biological Sciences)

A Research Certificate in Science will provide an opportunity for undergraduate students to engage in authentic research in their discipline and acquire skills beyond what a normal research experience in an Honors or Specialization program may allow.

#### Research Certificate in Science (Biological Sciences)

A Research Certificate in Science (Biological Sciences) will provide an opportunity for undergraduate students to engage in authentic and focused research

This certificate is open to undergraduate students in the Faculty of Science with preference given to BSc Honors and Specialization students in the Department of Biological Sciences and BSc General students (Biological Sciences major). Consent of the Department of Biological Sciences is required. Normally, a student will be able to fulfill the requirements for this certificate as part of a BSc program; some students may need to complete more than the minimum number of credits required in order to qualify for both the degree and the certificate.

Students wishing to pursue the Research Certificate in Science (Biological Sciences) must apply through the Department of Biological Sciences Student Services Office (BS CW-312) for acceptance into BIOL 298. Application for this course does not guarantee a position in this program or the awarding of a certificate.

Students may pursue the Research Certificate in Science (Biological Sciences) by fulfilling the existing requirements for their program and by completing ★21 as follows:

- BIOL 298 - Understanding Biological Research

#### ★6 from

- BIOL 398 - Research Project
- BIOL 399 - Research Project
- BIOL 498 - Research Project
- BIOL 499 - Research Project
- MA SC 400
- MA SC 403 - Directed Studies in Marine Science
- ★3 from a list of 300- and 400-level approved options in data handling courses in Biological Sciences
- ★3 from a list of 300- and 400-level approved options in practical skills and techniques courses in Biological Sciences Presentation at a conference either on or off campus

**Note** Students wishing to receive the Research Certificate in Science (Biological Sciences) must apply through Undergraduate Student Services in the Faculty of Science by the application deadline for convocation (see Academic Schedule). MA SC Courses are offered at the Bamfield Marine Sciences Centre.

### Research Certificate in Science (Psychology)

A Research Certificate in Science (Psychology) will provide an opportunity for students to engage in authentic and focused research while pursuing their program.

Normally a student will be able to fulfill the requirements for this certificate as part of their degree; some students may need to complete more than the minimum number of credits required in order to qualify for both the degree and the certificate.

**Students may pursue the Research Certificate in Science (Psychology) by fulfilling the existing requirements for their program and by completing ★21 as follows:**

#### ★3 in 200- or 300-level research class:

- PSYCO 299 - Research Opportunity Program in Psychology
- PSYCO 300 - Honors Seminar I
- PSYCO 309 - Honors Seminar I
- PSYCO 396
- PSYCO 398 - Individual Study I

#### ★9 in 300- or 400-level research class:

- PSYCO 390 - Honors Thesis I: Research Apprenticeship
- PSYCO 396
- PSYCO 398 - Individual Study I
- PSYCO 399 - Honors Thesis I: Research Apprenticeship
- PSYCO 400 - Honors Seminar II
- PSYCO 409 - Honors Seminar II
- PSYCO 490 - Honors Thesis II: Thesis Research
- PSYCO 496 - Individual Research
- PSYCO 498 - Individual Study II
- PSYCO 499 - Honors Thesis II: Thesis Research

#### ★9 in

- PSYCO 212 - Introduction to Research Methods in Psychology
- STAT 252 - Introduction to Applied Statistics II

#### and a 300 or 400-level PSYCO methods class

- PSYCO 356 - Research Methods in Cognition
- PSYCO 411 - Cooperative Program Practicum
- PSYCO 413 - Design and Analysis of Experiments in Psychology
- PSYCO 415 - Qualitative Methods in Sociocultural Psychology
- PSYCO 431 - Theory and Practice of Psychometrics
- PSYCO 471 - Neurophysiology: Theory, Methods, and Analysis
- PSYCO 476
- PSYCO 482
- or other advanced research methods course approved by the Honors Advisor

#### Presentation

- Presentation at a conference either on or off campus