

Biology

This section presents the requirements for programs in:

- **Bioinformatics B.Sc. Honours**
- **Biology B.Sc. Honours**
- **Biology with Concentration in Ecology, Evolution and Behaviour B.Sc. Honours**
- **Biology with Concentration in Health Science B.Sc. Honours**
- **Biology with Concentration in Molecular and Cellular Biology B.Sc. Honours**
- **Biology with Concentration in Physiology B.Sc. Honours**
- **Biology B.Sc. Major**
- **Biology B.Sc. General**
- **Biology and Biotechnology B.Sc. Honours**
- **Biology and Earth Sciences B.Sc. Combined Honours**
- **Biology and Physics B.Sc. Combined Honours**
- **Neuroscience B.Sc. Combined Honours**
- **Biology B.A. Honours**
- **Biology B.A. General**
- **Biology B.A. Combined Honours**
- **Minor in Biology**

Program Requirements

Course Categories for Biology Programs

The program descriptions below make use of the following course categories that are defined in the Bachelor of Science Regulations in this Calendar.

- Science Faculty Electives
- Advanced Science Faculty Electives
- Science Continuation
- Science Geography
- Science Psychology
- Approved Courses Outside the Faculties of Science and Engineering and Design
- Free Electives
- Restricted Courses: Biology General, Major, and Honours students (except students in the B.A. General, B.A. Honours and Combined Honours programs) may use Technology, Society, Environment courses TSES 3001, TSES 3002, TSES 3500, TSES 4001, TSES 4002, TSES 4003, TSES 4005, TSES 4006, TSES 4007 to fulfill degree requirements, but only as free electives.

Bioinformatics

B.Sc. Honours (20.0 credits)

A. Credits included in the Major CGPA (12.5 credits)

1. 4.0 credits in:	4.0
BIOL 1103 [0.5]	Foundations of Biology I
BIOL 1104 [0.5]	Foundations of Biology II
BIOL 2104 [0.5]	Introductory Genetics
BIOL 2200 [0.5]	Cellular Biochemistry

BIOL 3104 [0.5]	Molecular Genetics	
BIOL 4106 [0.5]	Advances in Molecular Biology	
BIOL 4905 [1.0]	Honours Workshop	
or BIOC 4906 [1.0]	Interdisciplinary Research Project	
or BIOL 4907 [1.0]	Honours Essay and Research Proposal	
or BIOL 4908 [1.0]	Honours Research Thesis	
2. 0.5 credit from:		0.5
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
BIOL 2303 [0.5]	Microbiology	
BIOL 3102 [0.5]	Mycology	
BIOL 3305 [0.5]	Human and Comparative Physiology	
BIOL 3306 [0.5]	Human Anatomy and Physiology	
3. 3.5 credits from:		3.5
BIOC 2300 [0.5]	Physical Biochemistry	
BIOC 3008 [0.5]	Bioinformatics	
BIOC 3101 [0.5]	General Biochemistry I	
BIOC 3102 [0.5]	General Biochemistry II	
BIOC 3202 [0.5]	Biophysical Techniques and Applications	
BIOC 4008 [0.5]	Computational Systems Biology	
BIOL 4104 [0.5]	Evolutionary Genetics	
BIOC 4202 [0.5]	Mutagenesis and DNA Repair	
4. 1.0 credit in BIOL or BIOC or COMP or MATH or STAT at the 3000-level or higher		1.0
5. 0.5 credit from:		0.5
BIOL 3901 [0.5]	Research Proposal	
BIOL 4901 [0.5]	Directed Special Studies	
or 4000-level BIOL		
6. 3.0 credits in		3.0
COMP 1005 [0.5]	Introduction to Computer Science I	
COMP 1006 [0.5]	Introduction to Computer Science II	
COMP 2401 [0.5]	Introduction to Systems Programming	
COMP 2402 [0.5]	Abstract Data Types and Algorithms	
COMP 2404 [0.5]	Introduction to Software Engineering	
COMP 2406 [0.5]	Fundamentals of Web Applications	
B. Credits not included in the Major CGPA (7.5)		
7. 2.0 credits in:		2.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II	
CHEM 2203 [0.5]	Organic Chemistry I	
& CHEM 2204 [0.5]	Organic Chemistry II	
See Note: below		
8. 1.0 credit from:		1.0
PHYS 1007 [0.5]	Elementary University Physics I	
& PHYS 1008 [0.5]	Elementary University Physics II	
PHYS 1003 [0.5]	Introductory Mechanics and Thermodynamics	
& PHYS 1004 [0.5]	Introductory Electromagnetism and Wave Motion	
9. 2.0 credits in:		2.0
MATH 1007 [0.5]	Elementary Calculus I	
MATH 1107 [0.5]	Linear Algebra I	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	

STAT 2509 [0.5]	Introduction to Statistical Modeling II	
10. 2.0 credits in	Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)	2.0
11. 0.5 credit in	free electives.	0.5
Total Credits		20.0

Note: for **Item 7** above, CHEM 1001 and CHEM 1002 are strongly recommended for this program. Students may substitute CHEM 1001 and CHEM 1002 with CHEM 1005 and CHEM 1006, respectively. Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM. Students completing CHEM 1005 with a grade of B- or higher are encouraged to register for CHEM 1002.

Biology

B.Sc. Honours (20.0 credits)

A. Credits included in the Major CGPA (11.0 credits)

1. 2.0 credits in:		2.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 4905 [1.0]	Honours Workshop	
	or BIOL 4907 [1.0] Honours Essay and Research Proposal	
	or BIOL 4908 [1.0] Honours Research Thesis	
2. 2.5 credits from:		2.5
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
BIOL 2104 [0.5]	Introductory Genetics	
BIOL 2200 [0.5]	Cellular Biochemistry	
BIOL 2303 [0.5]	Microbiology	
BIOL 2600 [0.5]	Introduction to Ecology	
3. 0.5 credit from:		0.5
BIOL 3201 [0.5]	Cell Biology	
BIOL 3205 [0.5]	Plant Biochemistry and Physiology	
BIOL 3303 [0.5]	Experimental Microbiology	
BIOL 3305 [0.5]	Human and Comparative Physiology	
4. 1.0 credit in	BIOL at the 2000-level or higher	1.0
5. 3.5 credits in	BIOL or BIOC at the 3000-level or higher	3.5
6. 0.5 credit from		0.5
BIOL 3901 [0.5]	Research Proposal	
BIOL 4901 [0.5]	Directed Special Studies	
	or 4000-level BIOL	
7. 1.0 credit in	Advanced Science Faculty Electives	1.0
B. Credits not included in the Major CGPA (9.0 credits)		
8. 1.0 credit in		1.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II (See Note 2, below)	
9. 1.0 credit in:		1.0
BIOL 1105 [0.5]	Biological Methods, Analysis and Interpretation	
MATH 1007 [0.5]	Elementary Calculus I	
10. 1.0 credit from:		1.0
COMP 1005 [0.5]	Introduction to Computer Science I	
COMP 1006 [0.5]	Introduction to Computer Science II	

MATH 1107 [0.5]	Linear Algebra I	
PHYS 1007 [0.5]	Elementary University Physics I	
	or PHYS 1003 [0.5] Introductory Mechanics and Thermodynamics	
PHYS 1008 [0.5]	Elementary University Physics II	
	or PHYS 1004 [0.5] Introductory Electromagnetism and Wave Motion	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
11. 1.0 credit in	Science Faculty Electives	1.0
12. 2.0 credits in	Science Continuation (not in BIOL)	2.0
13. 2.0 credits in	Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)	2.0
14. 1.0 credit in	free electives.	1.0
Total Credits		20.0

Notes:

- Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
- For **Item 8** above, CHEM 1001 and CHEM 1002 are strongly recommended for this program. Students may substitute CHEM 1001 and CHEM 1002 with CHEM 1005 and CHEM 1006, respectively. Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM. Students completing CHEM 1005 with a grade of B- or higher are encouraged to register for CHEM 1002.
- Students in the B.Sc. Honours Biology program may elect to focus their studies in one of the following concentrations: 1) Ecology, Evolution and Behaviour, 2) Health Science, 3) Molecular and Cellular Biology, or 4) Physiology.

Biology with Concentration in Ecology, Evolution and Behaviour

B.Sc. Honours (20.0 credits)

A. Credits Included in the Major CGPA (11.0 credits)

1. 2.0 credits in:		2.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 4905 [1.0]	Honours Workshop	
	or BIOL 4907 [1.0] Honours Essay and Research Proposal	
	or BIOL 4908 [1.0] Honours Research Thesis	
2. 2.5 credits in:		2.5
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
BIOL 2104 [0.5]	Introductory Genetics	
BIOL 2200 [0.5]	Cellular Biochemistry	
BIOL 2600 [0.5]	Introduction to Ecology	
3. 0.5 credit from:		0.5
BIOL 3201 [0.5]	Cell Biology	
BIOL 3205 [0.5]	Plant Biochemistry and Physiology	
BIOL 3303 [0.5]	Experimental Microbiology	
BIOL 3305 [0.5]	Human and Comparative Physiology	
4. 1.0 credit from:		1.0

BIOL 3609 [0.5]	Evolutionary Concepts	
BIOL 3611 [0.5]	Evolutionary Ecology	
BIOL 3802 [0.5]	Animal Behaviour	
5. 2.0 credits from:		2.0
BIOL 3004 [0.5]	Insect Diversity	
BIOL 3104 [0.5]	Molecular Genetics	
BIOL 3601 [0.5]	Ecosystems and Environmental Change	
BIOL 3602 [0.5]	Conservation Biology	
BIOL 3604 [0.5]	Analysis of Ecological Relationships	
BIOL 3605 [0.5]	Field Course I	
BIOL 3609 [0.5]	Evolutionary Concepts	
BIOL 3608 [0.5]	Principles of Biogeography	
BIOL 3611 [0.5]	Evolutionary Ecology	
BIOL 3612 [0.5]	Computational Methods in Ecology and Evolution	
BIOL 3801 [0.5]	Plants and Herbivores	
BIOL 3802 [0.5]	Animal Behaviour	
BIOL 3804 [0.5]	Social Evolution	
6. 2.0 credits from:		2.0
BIOL 4102 [0.5]	Molecular Ecology	
BIOL 4103 [0.5]	Population Genetics	
BIOL 4104 [0.5]	Evolutionary Genetics	
BIOL 4203 [0.5]	Evolution of Sex	
BIOL 4317 [0.5]	Neuroethology: The Neural Basis of Animal Behaviour	
BIOL 4318 [0.5]	Adaptations to Extreme Environments	
BIOL 4500 [0.5]	Ornithology I	
BIOL 4501 [0.5]	Ornithology II	
BIOL 4503 [0.5]	Fish Ecology, Conservation and Management	
BIOL 4504 [0.5]	Ecology of Freshwater Invertebrates	
BIOL 4602 [0.5]	Evolutionary Applications across Disciplines: From Medicine to Conservation	
BIOL 4604 [0.5]	Landscape Ecology	
BIOL 4802 [0.5]	Advanced Animal Behaviour	
7. 0.5 credit in BIOL at the 2000-level or higher		0.5
8. 0.5 credit from		0.5
BIOL 3901 [0.5]	Research Proposal	
or BIOL 4901 [0.5]	Directed Special Studies	
or 4000-level BIOL		
B. Credits Not Included in the Major CGPA (9.0 credits)		
9. 1.0 credit in:		1.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II (See Note 2, below)	
10. 1.0 credit in:		1.0
BIOL 1105 [0.5]	Biological Methods, Analysis and Interpretation	
MATH 1007 [0.5]	Elementary Calculus I	
11. 1.0 credit from:		1.0
COMP 1005 [0.5]	Introduction to Computer Science I	
COMP 1006 [0.5]	Introduction to Computer Science II	
MATH 1107 [0.5]	Linear Algebra I	
PHYS 1007 [0.5]	Elementary University Physics I	

or PHYS 1003 [0.5] Introductory Mechanics and Thermodynamics

PHYS 1008 [0.5]	Elementary University Physics II	
or PHYS 1004 [0.5]	Introductory Electromagnetism and Wave Motion	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
12. 1.0 credit in Science Faculty Electives		1.0
13. 2.0 credits in Science Continuation courses (not in BIOL)		2.0
14. 2.0 credits in Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)		2.0
15. 1.0 credit in free electives.		1.0
Total Credits		20.0

Notes:

1. Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
2. For **Item 9** above, CHEM 1001 and CHEM 1002 are strongly recommended for this program. Students may substitute CHEM 1001 and CHEM 1002 with CHEM 1005 and CHEM 1006, respectively. Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM. Students completing CHEM 1005 with a grade of B- or higher are encouraged to register for CHEM 1002.

Biology with Concentration in Health Science B.Sc. Honours (20.0 credits)

A. Credits included in the Major CGPA (11.0 credits)

1. 2.0 credits in:		2.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 4905 [1.0]	Honours Workshop	
or BIOL 4907 [1.0]	Honours Essay and Research Proposal	
or BIOL 4908 [1.0]	Honours Research Thesis	
2. 2.0 credits in:		2.0
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2104 [0.5]	Introductory Genetics	
BIOL 2200 [0.5]	Cellular Biochemistry	
BIOL 2303 [0.5]	Microbiology	
3. 1.0 credit in:		1.0
BIOL 3305 [0.5]	Human and Comparative Physiology	
BIOL 3307 [0.5]	Advanced Human Anatomy and Physiology	
4. 1.0 credit in:		1.0
BIOC 3101 [0.5]	General Biochemistry I	
BIOC 3102 [0.5]	General Biochemistry II	
5. 1.0 credit from:		1.0
BIOL 3008 [0.5]	Bioinformatics	
BIOL 3104 [0.5]	Molecular Genetics	
BIOL 3201 [0.5]	Cell Biology	
BIOL 3202 [0.5]	Principles of Developmental Biology	
BIOL 3303 [0.5]	Experimental Microbiology	

BIOL 3501 [0.5]	Biomechanics	
BIOL 4201 [0.5]	Advanced Cell Culture and Tissue Engineering	
BIOL 4207 [0.5]	Advanced Embryology & Developmental Biology	
BIOL 4303 [0.5]	Advances in Microbiology	
BIOL 4318 [0.5]	Adaptations to Extreme Environments	
6. 1.0 credit from:		1.0
BIOC 4009 [0.5]	Biochemistry of Disease	
BIOC 4708 [0.5]	Principles of Toxicology	
BIOL 4106 [0.5]	Advances in Molecular Biology	
BIOL 4200 [0.5]	Immunology	
BIOL 4202 [0.5]	Mutagenesis and DNA Repair	
BIOL 4306 [0.5]	Animal Neurophysiology	
7. 1.0 credit from BIOL or BIOC at the 3000-level or higher		1.0
8. 0.5 credit from:		0.5
BIOL 3901 [0.5]	Research Proposal	
BIOL 4901 [0.5]	Directed Special Studies or 4000-level BIOL	
9. 1.0 credit from:		1.0
NEUR 2201 [0.5]	Cellular and Molecular Neuroscience	
NEUR 2202 [0.5]	Neurodevelopment and Plasticity	
NEUR 3204 [0.5]	Neuropharmacology	
PSYC 2301 [0.5]	Introduction to Health Psychology	
10. 0.5 credit from:		0.5
PHIL 2408 [0.5]	Bioethics	
GEOG 3206 [0.5]	Health, Environment, and Society	
ANTH 3310 [0.5]	Studies in Medical Anthropology	
SOCI 3050 [0.5]	Studies in the Sociology of Health	
SOCI 3056 [0.5]	Women and Health	
B. Credits not included in the Major CGPA (9.0 credits)		
11. 2.0 credits from:		2.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II	
CHEM 2203 [0.5]	Organic Chemistry I	
& CHEM 2204 [0.5]	Organic Chemistry II	
CHEM 2207 [0.5]	Introduction to Organic Chemistry I	
& CHEM 2208 [0.5]	Introduction to Organic Chemistry II	
See Note 2, below		
12. 1.0 credit in:		1.0
BIOL 1105 [0.5]	Biological Methods, Analysis and Interpretation	
MATH 1007 [0.5]	Elementary Calculus I	
13. 1.0 credit from:		1.0
COMP 1006 [0.5]	Introduction to Computer Science II	
COMP 1005 [0.5]	Introduction to Computer Science I	
MATH 1107 [0.5]	Linear Algebra I	
PHYS 1007 [0.5]	Elementary University Physics I	
or PHYS 1003 [0.5]	Introductory Mechanics and Thermodynamics	
PHYS 1008 [0.5]	Elementary University Physics II	
or PHYS 1004 [0.5]	Introductory Electromagnetism and Wave Motion	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
14. 1.0 credit in:		1.0

PSYC 1001 [0.5]	Introduction to Psychology I	
PSYC 1002 [0.5]	Introduction to Psychology II	
15. 1.0 credit in Science Faculty Electives		1.0
16. 1.0 credit in Science Continuation courses (not in BIOL)		1.0
17. 1.0 credit in Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)		1.0
18. 1.0 credit in free electives.		1.0
Total Credits		20.0

Notes:

- Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
- For **Item 11** above, CHEM 1001 and CHEM 1002 are strongly recommended for this program. Students may substitute CHEM 1001 and CHEM 1002 with CHEM 1005 and CHEM 1006, respectively. Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM. Students completing CHEM 1005 with a grade of B- or higher are encouraged to register for CHEM 1002.
- In order to meet the prerequisite requirements for courses in Items 9 and 10, students should ensure that they have chosen appropriate courses in Items 15, 16, 17 and 18.
- Students intending to apply to medical schools should be aware of the requirements of different medical schools for chemistry courses with laboratories, and for English courses. This may influence the choice of courses chosen to meet the requirements in Items 11, 17, and 18.

Biology with Concentration in Molecular and Cellular Biology B.Sc. Honours (20.0 credits)

A. Credits included in the Major CGPA (11.0 credits)

1. 2.0 credits in:		2.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 4905 [1.0]	Honours Workshop	
or BIOL 4907 [1.0]	Honours Essay and Research Proposal	
or BIOL 4908 [1.0]	Honours Research Thesis	
2. 2.5 credits in:		2.5
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
BIOL 2104 [0.5]	Introductory Genetics	
BIOL 2200 [0.5]	Cellular Biochemistry	
BIOL 2303 [0.5]	Microbiology	
3. 0.5 credit from:		0.5
BIOL 3205 [0.5]	Plant Biochemistry and Physiology	
BIOL 3303 [0.5]	Experimental Microbiology	
BIOL 3305 [0.5]	Human and Comparative Physiology	
4. 1.0 credit in:		1.0
BIOC 3101 [0.5]	General Biochemistry I	

BIOC 3102 [0.5]	General Biochemistry II	
5. 1.0 credit in:		1.0
BIOL 3104 [0.5]	Molecular Genetics	
BIOL 3201 [0.5]	Cell Biology	
6. 2.0 credits from:		2.0
BIOL 3008 [0.5]	Bioinformatics	
BIOL 4106 [0.5]	Advances in Molecular Biology	
BIOL 4109 [0.5]	Laboratory Techniques in Molecular Genetics	
BIOL 4200 [0.5]	Immunology	
BIOL 4202 [0.5]	Mutagenesis and DNA Repair	
BIOL 4201 [0.5]	Advanced Cell Culture and Tissue Engineering	
BIOL 4207 [0.5]	Advanced Embryology & Developmental Biology	
BIOL 4303 [0.5]	Advances in Microbiology	
7. 0.5 credit in	BIOL or BIOC at the 2000-level or higher	0.5
8. 1.0 credit in	BIOL or BIOC at the 3000-level or higher	1.0
9. 0.5 credit from:		0.5
BIOL 3901 [0.5]	Research Proposal	
BIOL 4901 [0.5]	Directed Special Studies	
	or 4000-level BIOL	
B. Credits Not Included in the Major CGPA (9.0 credits)		
10. 2.0 credits in:		2.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II	
CHEM 2203 [0.5]	Organic Chemistry I	
& CHEM 2204 [0.5]	Organic Chemistry II	
	See Note 2, below	
11. 1.0 credit in:		1.0
BIOL 1105 [0.5]	Biological Methods, Analysis and Interpretation	
MATH 1007 [0.5]	Elementary Calculus I	
12. 1.0 credit from:		1.0
COMP 1005 [0.5]	Introduction to Computer Science I	
COMP 1006 [0.5]	Introduction to Computer Science II	
MATH 1107 [0.5]	Linear Algebra I	
PHYS 1007 [0.5]	Elementary University Physics I	
	or PHYS 1003 [0.5] Introductory Mechanics and Thermodynamics	
PHYS 1008 [0.5]	Elementary University Physics II	
	or PHYS 1004 [0.5] Introductory Electromagnetism and Wave Motion	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
13. 1.0 credit in	Science Faculty Electives	1.0
14. 1.0 credit in	Science Continuation courses (not in BIOL)	1.0
15. 2.0 credits in	Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)	2.0
16. 1.0 credit in	free electives.	1.0
Total Credits		20.0

Notes:

- Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
- For Item 10 above, CHEM 1001 and CHEM 1002 are strongly recommended for this program. Students

may substitute CHEM 1001 and CHEM 1002 with CHEM 1005 and CHEM 1006, respectively. Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM. Students completing CHEM 1005 with a grade of B- or higher are encouraged to register for CHEM 1002.

Biology with Concentration in Physiology B.Sc. Honours (20.0 credits)

A. Credits Included in the Major CGPA (11.0 credits)

1. 2.0 credits in:		2.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 4905 [1.0]	Honours Workshop	
	or BIOL 4907 [1.0] Honours Essay and Research Proposal	
	or BIOL 4908 [1.0] Honours Research Thesis	
2. 2.0 credits in:		2.0
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
BIOL 2104 [0.5]	Introductory Genetics	
BIOL 2200 [0.5]	Cellular Biochemistry	
3. 1.5 credits in:		1.5
BIOL 3205 [0.5]	Plant Biochemistry and Physiology	
BIOL 3305 [0.5]	Human and Comparative Physiology	
BIOL 3307 [0.5]	Advanced Human Anatomy and Physiology	
4. 1.5 credits in:		1.5
BIOC 2300 [0.5]	Physical Biochemistry	
BIOC 3101 [0.5]	General Biochemistry I	
BIOC 3102 [0.5]	General Biochemistry II	
5. 2.0 credits from:		2.0
BIOL 3201 [0.5]	Cell Biology	
BIOL 3202 [0.5]	Principles of Developmental Biology	
BIOL 3501 [0.5]	Biomechanics	
BIOL 3802 [0.5]	Animal Behaviour	
BIOL 4008 [0.5]	Molecular Plant Development	
BIOL 4201 [0.5]	Advanced Cell Culture and Tissue Engineering	
BIOC 4203 [0.5]	Advanced Metabolism	
BIOL 4209 [0.5]	Advanced Plant Physiology	
BIOL 4306 [0.5]	Animal Neurophysiology	
BIOL 4309 [0.5]	Studies in Human Performance	
BIOL 4317 [0.5]	Neuroethology: The Neural Basis of Animal Behaviour	
BIOL 4318 [0.5]	Adaptations to Extreme Environments	
BIOL 4319 [0.5]	Studies in Exercise Physiology	
6. 1.0 credit in	BIOL at the 2000-level or higher	1.0
7. 0.5 credit in	BIOL or BIOC at the 3000-level or higher	0.5
8. 0.5 credit from:		0.5
BIOL 3901 [0.5]	Research Proposal	
BIOL 4901 [0.5]	Directed Special Studies	
	4000-level BIOL	
B. Credits not included in the Major CGPA (9.0 credits)		
9. 2.0 credits from:		2.0

CHEM 1001 [0.5] General Chemistry I & CHEM 1002 [0.5] General Chemistry II	
CHEM 2203 [0.5] Organic Chemistry I & CHEM 2204 [0.5] Organic Chemistry II (or)	
CHEM 2207 [0.5] Introduction to Organic Chemistry I & CHEM 2208 [0.5] Introduction to Organic Chemistry II	
See Note 2, below	
10. 1.0 credit in:	1.0
BIOL 1105 [0.5] Biological Methods, Analysis and Interpretation	
MATH 1007 [0.5] Elementary Calculus I	
11. 1.0 credit from:	1.0
PHYS 1007 [0.5] Elementary University Physics I or PHYS 1003 [0.5] Introductory Mechanics and Thermodynamics	
PHYS 1008 [0.5] Elementary University Physics II or PHYS 1004 [0.5] Introductory Electromagnetism and Wave Motion	
COMP 1005 [0.5] Introduction to Computer Science I	
COMP 1006 [0.5] Introduction to Computer Science II	
MATH 1107 [0.5] Linear Algebra I	
STAT 2507 [0.5] Introduction to Statistical Modeling I	
12. 1.0 credit in Science Faculty electives	1.0
13. 1.0 credit in Science Continuation courses (not in BIOL)	1.0
14. 2.0 credits in Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)	2.0
16. 1.0 credit in free electives.	1.0
Total Credits	20.0

Notes:

- Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
- For Item 9 above, CHEM 1001 and CHEM 1002 are strongly recommended for this program. Students may substitute CHEM 1001 and CHEM 1002 with CHEM 1005 and CHEM 1006, respectively. Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM. Students completing CHEM 1005 with a grade of B- or higher are encouraged to register for CHEM 1002.

Biology

B.Sc. Major (20.0 credits)

A. Credits included in the Major CGPA (9.0 credits)

1. 1.0 credit in:	1.0
BIOL 1103 [0.5] Foundations of Biology I	
BIOL 1104 [0.5] Foundations of Biology II	
2. 2.5 credits from:	2.5
BIOL 2001 [0.5] Animals: Form and Function	
BIOL 2002 [0.5] Plants: Form and Function	
BIOL 2104 [0.5] Introductory Genetics or BIOL 2107 [0.5] Fundamentals of Genetics	
BIOL 2200 [0.5] Cellular Biochemistry or BIOL 2201 [0.5] Cell Biology and Biochemistry	

BIOL 2303 [0.5] Microbiology	
BIOL 2600 [0.5] Introduction to Ecology	
3. 0.5 credit from:	0.5
BIOL 3205 [0.5] Plant Biochemistry and Physiology	
BIOL 3306 [0.5] Human Anatomy and Physiology	
4. 3.0 credits in BIOL at the 3000-level or higher	3.0
5. 2.0 credits in Advanced Science Faculty electives	2.0
B. Credits Not Included in the Major CGPA (11.0 credits)	
6. 1.0 credit from:	1.0
CHEM 1001 [0.5] General Chemistry I & CHEM 1002 [0.5] General Chemistry II	
CHEM 1005 [0.5] Elementary Chemistry I & CHEM 1006 [0.5] Elementary Chemistry II (See Note 2, below)	
7. 1.0 credit in:	1.0
BIOL 1105 [0.5] Biological Methods, Analysis and Interpretation	
MATH 1007 [0.5] Elementary Calculus I	
8. 1.0 credit from:	1.0
MATH 1107 [0.5] Linear Algebra I	
COMP 1005 [0.5] Introduction to Computer Science I	
COMP 1006 [0.5] Introduction to Computer Science II	
PHYS 1007 [0.5] Elementary University Physics I or PHYS 1003 [0.5] Introductory Mechanics and Thermodynamics	
PHYS 1008 [0.5] Elementary University Physics II or PHYS 1004 [0.5] Introductory Electromagnetism and Wave Motion	
STAT 2507 [0.5] Introduction to Statistical Modeling I	
9. 1.0 credit in Science Faculty Electives	1.0
10. 2.0 credits in Advanced Science Faculty Electives	2.0
11. 2.0 credits in Science Continuation courses (not in BIOL)	2.0
12. 2.0 credits in Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)	2.0
13. 1.0 credit in free electives.	1.0
Total Credits	20.0

Notes:

- Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
- For item 6 above, students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM.

Biology

B.Sc. General (15.0 credits)

Note: some advanced Biology courses with laboratory components will not be available to students enrolling in the B.Sc. General program.

A. Credits included in the Major CGPA (6.0 credits)

1. 1.0 credit in:	1.0
BIOL 1103 [0.5] Foundations of Biology I	
BIOL 1104 [0.5] Foundations of Biology II	
2. 2.0 credits from:	2.0

BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
BIOL 2107 [0.5]	Fundamentals of Genetics	
BIOL 2201 [0.5]	Cell Biology and Biochemistry	
BIOL 2303 [0.5]	Microbiology	
BIOL 2600 [0.5]	Introduction to Ecology	
3. 0.5 credit in:		0.5
BIOL 3306 [0.5]	Human Anatomy and Physiology	
4. 2.5 credits from BIOL at the 2000-level and 3000-level or higher		2.5
B. Credits Not Included in the Major CGPA (9.0 credits)		
5. 1.0 credit from:		1.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II	
CHEM 1005 [0.5]	Elementary Chemistry I	
& CHEM 1006 [0.5]	Elementary Chemistry II (See Note 2, below)	
6. 1.0 credit in:		1.0
BIOL 1105 [0.5]	Biological Methods, Analysis and Interpretation	
MATH 1007 [0.5]	Elementary Calculus I	
7. 1.0 credit from:		1.0
COMP 1005 [0.5]	Introduction to Computer Science I	
COMP 1006 [0.5]	Introduction to Computer Science II	
MATH 1107 [0.5]	Linear Algebra I	
PHYS 1007 [0.5]	Elementary University Physics I	
or PHYS 1003 [0.5]	Introductory Mechanics and Thermodynamics	
PHYS 1008 [0.5]	Elementary University Physics II	
or PHYS 1004 [0.5]	Introductory Electromagnetism and Wave Motion	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
8. 2.0 credits in Science Continuation (not in BIOL)		2.0
9. 1.0 credit in Science Faculty Electives		1.0
10. 2.0 credits in Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)		2.0
11. 1.0 credit free electives.		1.0
Total Credits		15.0

Notes:

1. Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
2. Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take advanced courses in BIOC and CHEM.

**Biology and Biotechnology
B.Sc. Honours (20.0 credits)**

A. Credits Included in the Major CGPA (12.5 credits)

1. 6.0 credits in:		6.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
BIOL 2104 [0.5]	Introductory Genetics	
BIOL 2200 [0.5]	Cellular Biochemistry	
BIOL 2301 [0.5]	Biotechnology I	

BIOL 2303 [0.5]	Microbiology	
BIOL 3104 [0.5]	Molecular Genetics	
BIOL 3201 [0.5]	Cell Biology	
BIOL 3301 [0.5]	Biotechnology II	
BIOL 4301 [0.5]	Current Topics in Biotechnology	
2. 1.0 credit in:		1.0
BIOC 3101 [0.5]	General Biochemistry I	
BIOC 3102 [0.5]	General Biochemistry II	
3. 4.5 credits from:		4.5
BIOC 2300 [0.5]	Physical Biochemistry	
or CHEM 2103 [0.5]	Physical Chemistry I	
BIOC 3008 [0.5]	Bioinformatics	
BIOC 3103 [0.5]	Practical Biochemistry I	
BIOC 3104 [0.5]	Practical Biochemistry II	
BIOC 3202 [0.5]	Biophysical Techniques and Applications	
BIOL 3004 [0.5]	Insect Diversity	
BIOL 3102 [0.5]	Mycology	
BIOL 3205 [0.5]	Plant Biochemistry and Physiology	
BIOL 3303 [0.5]	Experimental Microbiology	
BIOL 3305 [0.5]	Human and Comparative Physiology	
BIOL 3501 [0.5]	Biomechanics	
BIOL 3901 [0.5]	Research Proposal	
BUSI 2800 [0.5]	Entrepreneurship	
CHEM 3700 [0.5]	Industrial Applications of Chemistry	
CHEM 3800 [0.5]	The Chemistry of Environmental Pollutants	
FOOD 3005 [0.5]	Food Microbiology	
BIOC 4001 [0.5]	Methods in Biochemistry	
BIOC 4004 [0.5]	Industrial Biochemistry	
BIOC 4005 [0.5]	Biochemical Regulation	
BIOC 4007 [0.5]	Membrane Biochemistry	
BIOC 4008 [0.5]	Computational Systems Biology	
BIOC 4009 [0.5]	Biochemistry of Disease	
BIOC 4203 [0.5]	Advanced Metabolism	
BIOC 4204 [0.5]	Protein Biotechnology	
BIOC 4708 [0.5]	Principles of Toxicology	
BIOL 4106 [0.5]	Advances in Molecular Biology	
BIOL 4109 [0.5]	Laboratory Techniques in Molecular Genetics	
BIOL 4200 [0.5]	Immunology	
BIOL 4201 [0.5]	Advanced Cell Culture and Tissue Engineering	
BIOL 4202 [0.5]	Mutagenesis and DNA Repair	
BIOL 4206 [0.5]	Human Genetics	
BIOL 4901 [0.5]	Directed Special Studies	
TSES 4001 [0.5]	Technology and Society: Risk	
TSES 4002 [0.5]	Technology and Society: Forecasting	
4. 1.0 credit in:		1.0
BIOL 4905 [1.0]	Honours Workshop	
or BIOL 4907 [1.0]	(Honours Essay and Research Proposal	
or BIOL 4908 [1.0]	(Honours Research Thesis	
B. Credits Not Included in the Major CGPA (7.5 credits)		
5. 2.0 credits in:		2.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II	

CHEM 2203 [0.5]	Organic Chemistry I	
& CHEM 2204 [0.5]	Organic Chemistry II (See Note, below)	
6. 1.0 credit in:		1.0
BIOL 1105 [0.5]	Biological Methods, Analysis and Interpretation	
MATH 1007 [0.5]	Elementary Calculus I	
7. 1.5 credits from:		1.5
COMP 1005 [0.5]	Introduction to Computer Science I	
COMP 1006 [0.5]	Introduction to Computer Science II	
MATH 1107 [0.5]	Linear Algebra I	
PHYS 1007 [0.5]	Elementary University Physics I	
or PHYS 1003 [0.5]	Introductory Mechanics and Thermodynamics	
PHYS 1008 [0.5]	Elementary University Physics II	
or PHYS 1004 [0.5]	Introductory Electromagnetism and Wave Motion	
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
8. 2.0 credits in	Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)	2.0
19. 1.0 credit free elective.		1.0
Total Credits		20.0

Note: For Item 5 above, CHEM 1001 General Chemistry I and CHEM 1002 General Chemistry II are strongly recommended for this program. Students may substitute CHEM 1001 General Chemistry I and CHEM 1002 General Chemistry II with CHEM 1005 Elementary Chemistry I and CHEM 1006 Elementary Chemistry II, respectively. Students choosing CHEM 1005 Elementary Chemistry I and CHEM 1006 Elementary Chemistry II will be required to obtain a grade of B- or higher in CHEM 1006 Elementary Chemistry II to take BIOL 2200 Cellular Biochemistry and more advanced courses in BIOC and CHEM. Students completing CHEM 1005 Elementary Chemistry I with a grade of B- or higher are encouraged to register for CHEM 1002 General Chemistry II.

Biology and Earth Sciences

B.Sc. Combined Honours (20.0 credits)

A. Credits Included in the Major CGPA (12.0 credits)

1. 1.5 credits in:		1.5
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 2001 [0.5]	Animals: Form and Function	
2. 1.0 credit in:		1.0
ERTH 1006 [0.5]	Exploring Planet Earth	
ERTH 1009 [0.5]	The Earth System Through Time	
3. 0.5 credit from:		0.5
BIOL 2600 [0.5]	Introduction to Ecology	
BIOL 3605 [0.5]	Field Course I	
4. 3.5 credits in	BIOL or BIOC, with at least 1.0 credit at the 3000-level and 1.0 credit at the 4000-level	3.5
5. 3.0 credits in:		3.0
ERTH 2102 [0.5]	Mineralogy to Petrology	
ERTH 2312 [0.5]	Paleontology	
ERTH 2314 [0.5]	Sedimentation and Stratigraphy	
ERTH 3111 [0.5]	Vertebrate Evolution II	

ERTH 3112 [0.5]	Vertebrate Evolution I	
ERTH 3113 [0.5]	Geology of Human Origins	
6. 0.5 credit from:		0.5
ERTH 3203 [0.5]	Applied Sedimentology	
ERTH 3206 [0.5]	Oceanography: Its Modern and Geologic Records	
7. 1.0 credit in	ERTH at the 4000-level	1.0
8. 1.0 credit from:		1.0
BIOL 4905 [1.0]	Honours Workshop	
BIOL 4907 [1.0]	Honours Essay and Research Proposal	
BIOL 4908 [1.0]	Honours Research Thesis	
ERTH 4908 [1.0]	Honours Thesis	
ERTH 4909 [0.5]	Research in Earth Sciences (and 0.5 credit in EARTH at the 4000-level)	

B. Credits Not Included in the Major CGPA (8.0 credits)

9. 1.0 credit in:		1.0
MATH 1007 [0.5]	Elementary Calculus I	
MATH 1107 [0.5]	Linear Algebra I	
10. 1.0 credit from:		1.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II	
CHEM 1005 [0.5]	Elementary Chemistry I	
& CHEM 1006 [0.5]	Elementary Chemistry II	
11. 1.0 credit in:		1.0
PHYS 1007 [0.5]	Elementary University Physics I	
& PHYS 1008 [0.5]	Elementary University Physics II	
12. 0.5 credit in:		0.5
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
13. 0.5 credit in:		0.5
COMP 1005 [0.5]	Introduction to Computer Science I	
14. 1.0 credit in	Science Continuation courses	1.0
15. 2.0 credits in	Approved Courses Outside the Faculties of Science and Engineering and Design (may include NSCI 1000)	2.0
16. 1.0 credit in	free electives	1.0
Total Credits		20.0

Note: Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM.

Biology and Physics

B.Sc. Combined Honours (20.0 credits)

A. Credits Included in the Major CGPA (12.0 credits)

1. 1.0 credit from:		1.0
PHYS 1001 [0.5]	Foundations of Physics I	
& PHYS 1002 [0.5]	Foundations of Physics II (recommended)	
PHYS 1003 [0.5]	Introductory Mechanics and Thermodynamics	
& PHYS 1004 [0.5]	Introductory Electromagnetism and Wave Motion	
PHYS 1007 [0.5]	Elementary University Physics I	
& PHYS 1008 [0.5]	Elementary University Physics II (with an average grade of B- or higher)	
2. 2.0 credits in:		2.0
PHYS 2604 [0.5]	Modern Physics I	

PHYS 2202 [0.5]	Wave Motion and Optics	
PHYS 2305 [0.5]	Electricity and Magnetism	
PHYS 2401 [0.5]	Thermal Physics	
3. 2.0 credits in:		2.0
PHYS 3007 [0.5]	Third Year Physics Laboratory: Selected Experiments and Seminars	
PHYS 3207 [0.5]	Topics in Biophysics	
PHYS 3606 [0.5]	Modern Physics II	
PHYS 3701 [0.5]	Elements of Quantum Mechanics	
4. 1.0 credit from:		1.0
PHYS 3308 [0.5]	Electromagnetism	
PHYS 3802 [0.5]	Advanced Dynamics	
PHYS 3807 [0.5]	Mathematical Physics I	
PHYS 4008 [0.5]	Fourth-Year Physics Laboratory: Selected Experiments and Workshop	
PHYS 4203 [0.5]	Physical Applications of Fourier Analysis	
PHYS 4409 [0.5]	Thermodynamics and Statistical Physics	
PHYS 4608 [0.5]	Nuclear Physics	
PHYS 4707 [0.5]	Introduction to Quantum Mechanics I	
5. 4.0 credits in:		4.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 2200 [0.5]	Cellular Biochemistry	
BIOL 2104 [0.5]	Introductory Genetics	
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 3201 [0.5]	Cell Biology	
BIOL 3104 [0.5]	Molecular Genetics	
BIOL 3305 [0.5]	Human and Comparative Physiology	
6. 1.0 credit from:		1.0
BIOL 4106 [0.5]	Advances in Molecular Biology	
BIOL 4109 [0.5]	Laboratory Techniques in Molecular Genetics	
BIOL 4202 [0.5]	Mutagenesis and DNA Repair	
BIOL 4301 [0.5]	Current Topics in Biotechnology	
BIOL 4306 [0.5]	Animal Neurophysiology	
7. 1.0 credit from:		1.0
BIOL 4905 [1.0]	Honours Workshop	
BIOL 4907 [1.0]	Honours Essay and Research Proposal	
BIOL 4908 [1.0]	Honours Research Thesis	
PHYS 4909 [1.0]	Fourth-Year Project	
PHYS 4907 plus 0.5 credit 4000-level PHYS		
PHYS 4908 plus 0.5 credit 4000-level PHYS		
B. Credits Not Included in the Major CGPA (8.0 credits)		
8. 1.0 credit in:		1.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II (See Note, below)	
9. 1.5 credits in:		1.5
MATH 1004 [0.5]	Calculus for Engineering or Physics	
MATH 1005 [0.5]	Differential Equations and Infinite Series for Engineering or Physics	

MATH 1104 [0.5]	Linear Algebra for Engineering or Science	
10. 2.0 credits in:		2.0
STAT 2507 [0.5]	Introduction to Statistical Modeling I	
MATH 2004 [0.5]	Multivariable Calculus for Engineering or Physics	
MATH 3705 [0.5]	Mathematical Methods I	
MATH 3800 [0.5]	Mathematical Modeling and Computational Methods	
11. 0.5 credit in:		0.5
COMP 1005 [0.5]	Introduction to Computer Science I	
12. 2.0 credits in approved courses outside the faculties of Science and Engineering and Design (may include NSCI 1000)		2.0
13. 1.0 credit in free electives		1.0
Total Credits		20.0

Note: For **Item 8** above, CHEM 1001 and CHEM 1002 are strongly recommended for this program. Students may substitute CHEM 1001 and CHEM 1002 with CHEM 1005 and CHEM 1006, respectively. Students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM. Students completing CHEM 1005 with a grade of B- or higher are encouraged to register for CHEM 1002.

Neuroscience

B.Sc. Combined Honours (20.0 credits)

A. Credits Included in the Major CGPA (14.5 credits)

1. 5.5 credits in:		5.5
NEUR 1202 [0.5]	Neuroscience of Mental Health and Psychiatric Disease	
NEUR 1203 [0.5]	Neuroscience of Mental Health and Neurological Disease	
NEUR 2001 [0.5]	Introduction to Research Methods in Neuroscience	
NEUR 2002 [0.5]	Introduction to Statistics in Neuroscience	
NEUR 2201 [0.5]	Cellular and Molecular Neuroscience	
NEUR 2202 [0.5]	Neurodevelopment and Plasticity	
NEUR 3001 [0.5]	Data Analysis in Neuroscience I	
NEUR 3002 [0.5]	Data Analysis in Neuroscience II	
NEUR 3204 [0.5]	Neuropharmacology	
NEUR 3206 [0.5]	Sensory and Motor Neuroscience	
NEUR 3207 [0.5]	Integrative Neuroscience	
2. 3.0 credits in:		3.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2104 [0.5]	Introductory Genetics	
BIOL 2200 [0.5]	Cellular Biochemistry	
BIOL 3305 [0.5]	Human and Comparative Physiology	
3. 2.5 credits in BIOL or BIOC in 3000-level or above		2.5
4. 1.0 credit from:		1.0
NEUR 3301 [0.5]	Genetics of Mental Health	
NEUR 3303 [0.5]	The Neuroscience of Consciousness	

NEUR 3304 [0.5]	Hormones and Behaviour	
NEUR 3401 [0.5]	Environmental Toxins and Mental Health	
NEUR 3402 [0.5]	Impact of Lifestyle and Social Interactions on Mental Health	
NEUR 3403 [0.5]	Stress and Mental Health	
NEUR 3501 [0.5]	Neurodegeneration and Aging	
NEUR 3502 [0.5]	Neurodevelopmental Determinants of Mental Health	
NEUR 4301 [0.5]	Neurobiology of Energy Homeostasis	
NEUR 4302 [0.5]	Sex and the Brain	
NEUR 4303 [0.5]	Indigenous Health & Mental Health	
NEUR 4305 [0.5]	Immune-Brain Interactions	
NEUR 4306 [0.5]	The Neural Basis of Addiction	
NEUR 4600 [0.5]	Advanced Lab in Neuroanatomy	
5. 1.0 credit from:		1.0
BIOC 4007 [0.5]	Membrane Biochemistry	
BIOL 2600 [0.5]	Introduction to Ecology	
BIOL 3307 [0.5]	Advanced Human Anatomy and Physiology	
BIOL 3605 [0.5]	Field Course I	
BIOL 3609 [0.5]	Evolutionary Concepts	
BIOL 3802 [0.5]	Animal Behaviour	
BIOL 3804 [0.5]	Social Evolution	
BIOL 4306 [0.5]	Animal Neurophysiology	
BIOL 4317 [0.5]	Neuroethology: The Neural Basis of Animal Behaviour	
BIOL 4802 [0.5]	Advanced Animal Behaviour	
CHEM 2204 [0.5]	Organic Chemistry II	
6. 0.5 credit from:		0.5
NEUR 4200 [0.5]	Seminar on Current Advances in Neuroscience	
NEUR 4202 [0.5]	Seminar on Current Research in Neuroscience and Psychiatric Disease	
NEUR 4203 [0.5]	Seminar on Current Research in Neuroscience and Clinical Neurology	
7. 1.0 credit in neurophysiology, animal behaviour, neuropsychology or a related topic from:		1.0
NEUR 4905 [1.0]	Honours Workshop	
NEUR 4907 [1.0]	Honours Essay and Research Proposal	
NEUR 4908 [1.0]	Honours Research Thesis	
BIOL 4905 [1.0]	Honours Workshop	
BIOL 4907 [1.0]	Honours Essay and Research Proposal	
BIOL 4908 [1.0]	Honours Research Thesis	
B. Credits not included in the Major CGPA (5.5 credits)		
8. 1.0 credit in:		1.0
MATH 1007 [0.5]	Elementary Calculus I	
MATH 1107 [0.5]	Linear Algebra I	
9. 1.5 credits in:		1.5
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II	
CHEM 2203 [0.5]	Organic Chemistry I (See Note 2 below)	
10. 1.0 credit in:		1.0

PHYS 1007 [0.5]	Elementary University Physics I	
& PHYS 1008 [0.5]	Elementary University Physics II	
11. 2.0 credits in approved courses outside of the faculties of Science and Engineering and Design (may include NSCI 1000)		2.0
Total Credits		20.0

Biology

B.A. Honours (20.0 credits)

A. Credits included in the Major CGPA (8.0 credits)

1. 1.0 credit in:		1.0
BIOL 1103 [0.5]	Foundations of Biology I	
BIOL 1104 [0.5]	Foundations of Biology II	
2. 2.5 credits from:		2.5
BIOL 2001 [0.5]	Animals: Form and Function	
BIOL 2002 [0.5]	Plants: Form and Function	
BIOL 2104 [0.5]	Introductory Genetics	
or BIOL 2107 [0.5]	Fundamentals of Genetics	
BIOL 2200 [0.5]	Cellular Biochemistry	
or BIOL 2201 [0.5]	Cell Biology and Biochemistry	
BIOL 2303 [0.5]	Microbiology	
BIOL 2600 [0.5]	Introduction to Ecology	
3. 0.5 credit from:		0.5
BIOL 3205 [0.5]	Plant Biochemistry and Physiology	
BIOL 3303 [0.5]	Experimental Microbiology	
BIOL 3305 [0.5]	Human and Comparative Physiology	
BIOL 3306 [0.5]	Human Anatomy and Physiology	
4. 1.0 credit in BIOL at the 3000-level or higher		1.0
5. 2.0 credits in BIOL		2.0
6. 1.0 credit from:		1.0
BIOL 4905 [1.0]	Honours Workshop	
or BIOL 4907 [1.0]	Honours Essay and Research Proposal	
or BIOL 4908 [1.0]	Honours Research Thesis	

B. Credits not included in the Major CGPA (12.0 credits)

7. 1.0 credit from:		1.0
CHEM 1001 [0.5]	General Chemistry I	
& CHEM 1002 [0.5]	General Chemistry II	
CHEM 1005 [0.5]	Elementary Chemistry I	
& CHEM 1006 [0.5]	Elementary Chemistry II	
(see Note 2 below)		
8. 1.0 credit in Science Faculty Electives at the 2000-level or higher, not in BIOL		1.0
9. 1.0 credit in Science Faculty Electives not in BIOL		1.0
10. 2.0 credits in approved courses at the 2000 level outside of the faculties of Science and Engineering and Design		2.0
11. 4.0 credits in approved courses outside of the faculties of Science and Engineering and Design (may include NSCI 1000)		4.0
12. 1.0 credit at the 3000- or 4000-level		1.0
13. 2.0 credits in free electives.		2.0
Total Credits		20.0

Notes:

- Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology

2. For Item 7 above, students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM.

Biology

B.A. General (15.0 credits)

Note: some advanced Biology courses with laboratory components will not be available to students enrolling in the B.A. General program.

A. Credits included in the Major CGPA (6.0 credits)

1. 1.0 credit in:	1.0
BIOL 1103 [0.5] Foundations of Biology I	
BIOL 1104 [0.5] Foundations of Biology II	
2. 2.0 credits from:	2.0
BIOL 2001 [0.5] Animals: Form and Function	
BIOL 2002 [0.5] Plants: Form and Function	
BIOL 2107 [0.5] Fundamentals of Genetics	
BIOL 2201 [0.5] Cell Biology and Biochemistry	
BIOL 2303 [0.5] Microbiology	
BIOL 2600 [0.5] Introduction to Ecology	

3. 3.0 credits in BIOL	3.0
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B. Credits not included in the Major CGPA (9.0 credits)

4. 1.0 credit from:	1.0
CHEM 1001 [0.5] General Chemistry I & CHEM 1002 [0.5] General Chemistry II	
CHEM 1005 [0.5] Elementary Chemistry I & CHEM 1006 [0.5] Elementary Chemistry II (see Note 2, below)	
5. 1.0 credit in Science Faculty Electives, not in BIOL	1.0
6. 4.0 credits in approved courses outside of the faculties of Science and Engineering and Design (but may include NSCI 1000)	4.0
7. 1.0 credit at the 2000-level or higher	1.0
8. 2.0 credits in free electives.	2.0
Total Credits	15.0

Notes:

- Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
- For Item 4 above, students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take more advanced courses in BIOC and CHEM.

Biology

B.A. Combined Honours (20.0 credits)

A. Credits included in the Biology Major CGPA (6.0 credits)

1. 1.0 credit in:	1.0
BIOL 1103 [0.5] Foundations of Biology I	
BIOL 1104 [0.5] Foundations of Biology II	
2. 2.5 credits from:	2.5
BIOL 2001 [0.5] Animals: Form and Function	
BIOL 2002 [0.5] Plants: Form and Function	
BIOL 2104 [0.5] Introductory Genetics or BIOL 2107 [0.5] Fundamentals of Genetics	
BIOL 2200 [0.5] Cellular Biochemistry	

or BIOL 2201 [0.5] Cell Biology and Biochemistry	
BIOL 2303 [0.5] Microbiology	
BIOL 2600 [0.5] Introduction to Ecology	
3. 1.0 credit in BIOL at the 3000-level or higher	1.0
4. 1.5 credits from BIOL	1.5
B. Additional Requirements (14.0 credits)	
5. 1.0 credit from:	1.0
CHEM 1001 [0.5] General Chemistry I & CHEM 1002 [0.5] General Chemistry II	
CHEM 1005 [0.5] Elementary Chemistry I & CHEM 1006 [0.5] Elementary Chemistry II (see Note 2, below)	
6. 1.0 credit from:	1.0
BIOL 4905 [1.0] Honours Workshop or BIOL 4907 [1.0] Honours Essay and Research Proposal or BIOL 4908 [1.0] Honours Research Thesis or equivalent from the other Honours department	
7. 1.0 credit in Science Faculty Electives, not in BIOL, at the 2000-level or higher	1.0
8. 1.0 credit in Science Faculty Electives, not in BIOL	1.0
9. 7.0 credits in approved courses outside of the faculties of Science and Engineering and Design (may include NSCI 1000), to include the requirements for the other discipline	7.0
10. 3.0 credits in free electives.	3.0
Total Credits	20.0

Notes:

- Students should choose their second year courses carefully to ensure that they have the necessary prerequisites for upper year courses in Biology.
- For item 5 above, students choosing CHEM 1005 and CHEM 1006 will be required to obtain a grade of B- or higher in CHEM 1006 to take BIOL 2200 and more advanced courses in BIOC and CHEM.

Minor in Biology (4.0 credits)

The Minor in Biology is available to students registered in degree programs other than those offered by the Department of Biology.

Requirements (4.0 credits)

1. 1.0 credit in:	1.0
BIOL 1103 [0.5] Foundations of Biology I	
BIOL 1104 [0.5] Foundations of Biology II	
2. 1.0 credit from:	1.0
BIOL 1105 [0.5] Biological Methods, Analysis and Interpretation	
BIOL 1010 [0.5] Biotechnology and Society	
BIOL 1902 [0.5] Natural History	
BIOL 2001 [0.5] Animals: Form and Function	
BIOL 2002 [0.5] Plants: Form and Function	
BIOL 2005 [0.5] Human Physiology	
BIOL 2107 [0.5] Fundamentals of Genetics	
BIOL 2201 [0.5] Cell Biology and Biochemistry	
BIOL 2303 [0.5] Microbiology	
BIOL 2903 [0.5] Natural History and Ecology of Ontario	
3. 1.0 credit in BIOL at the 2000-level or higher	1.0

4. 1.0 credit in BIOL at the 3000-level or higher	1.0
Total Credits	4.0

Note: At least 2.0 of these credits must be taken at Carleton University.

Co-operative Education

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

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

Undergraduate Co-operative Education Policy Admission Requirements

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

If a student is admitted to co-op from high school, their grades will be reviewed two terms to one year prior to their first work term to ensure they continue to meet the academic requirements after their 1st or 2nd year of study. The time at which evaluation takes place depends on the program of study. Students will automatically be notified via their Carleton email account if they are permitted to continue.

Students not admitted to Carleton University with the co-op option on their degree can apply for admission via the co-operative education program website. To view application deadlines, visit carleton.ca/co-op.

Admission to the co-op option is based on the completion of 5.0 or more credits at Carleton University, the CGPA requirement for the students' academic program as well as any course prerequisites. The articulated CGPA for each program is the normal standard for assessment. Please see the specific degree program sections for the unique admission and continuation requirements for each academic program.

English Language Proficiency

Students admitted to Carleton based on CAEL, IELTS or TOEFL assessments and who are required to take an ESL course must take and pass the Oral Proficiency in Communicative Settings (OPECS) Test. The test must be taken before being permitted to register in COOP 1000. Admission to the co-op program can be confirmed with a minimum score of 4+.

Participation Requirements

COOP 1000

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

Communication with the Co-op Office

Students must maintain contact with the co-op office during their job search and while on a work term. All

email communication will be conducted via the students' Carleton email account.

Employment

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

Registering in Co-op Courses

Students will be registered in a Co-op Work Term course while at work. The number of Co-op Work Term courses that a student is registered in is dependent upon the number of four-month work terms that a student accepts.

While on a co-op work term students may take a maximum of 0.5 credit throughout each four-month co-op work term. Courses must be scheduled outside of regular working hours.

Students must be registered as full-time before they begin their co-op job search (2.0 credits). All co-op work terms must be completed before the beginning of the final academic term. Students may not finish their degree on a co-op work term.

Work Term Assessment and Evaluation

To obtain a Satisfactory grade for the co-op work term students must have:

1. A satisfactory work term evaluation by the co-op employer;
2. A satisfactory grade on the work term report.

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

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

Graduation with the Co-op Designation

In order to graduate with the co-op designation, students must satisfy all requirements for their degree program in addition to the requirements according to each co-op

program (i.e. successful completion of three or four work terms).

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

Voluntary Withdrawal from the Co-op Option

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

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

Involuntary or Required Withdrawal from the Co-op Option

Students may be required to withdraw from the co-op option of their degree program for one or any of the following reasons:

1. Failure to achieve a grade of SAT in COOP 1000
2. Failure to pay all co-op related fees
3. Failure to actively participate in the job search process
4. Failure to attend all interviews for positions to which the student has applied
5. Declining more than one job offer during the job search process
6. Continuing a job search after accepting a co-op position
7. Dismissal from a work term by the co-op employer
8. Leaving a work term without approval by the Co-op manager
9. Receipt of an unsatisfactory work term evaluation
10. Submission of an unsatisfactory work term report

Standing and Appeals

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

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

International Students

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

discuss the application process and requirements with the International Student Services Office.

B.Sc. Honours Biology, Bioinformatics: Co-op Admission and Continuation Requirements

- Maintain full-time status in each study term (2.0 credits);
- Be eligible to work in Canada (for off-campus work)
- Have successfully completed COOP 1000 [0.0]

In addition to the following:

1. Completion of 5.0 or more credits at Carleton University;
2. Registered as a full-time student in the Bachelor of Science Honours degree program;
3. Obtained and maintained a major CGPA of 8.0 or higher and an overall CGPA of 6.50 or higher

B.Sc. Honours Biology and Bioinformatics students must successfully complete three (3) work terms to obtain the Co-op designation.

Work Term Course: BIOL 3999

Work/Study Pattern:

Year 1		Year 2		Year 3		Year 4		Year 5	
Term	Pattern	Term	Pattern	Term	Pattern	Term	Pattern	Term	Pattern
Fall	S	Fall	S	Fall	S	Fall	*W/S	Fall	S
Winter	S	Winter	S	Winter	S	Winter	*W/S	Winter	S
Summer	**O/W	Summer	*W	Summer	O/W	Summer	O/W		

Legend

S: Study

W: Work

O: Optional

* indicates recommended work study pattern

** student finds own employer for this work-term.

B.Sc. Regulations

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

Breadth Requirement for the B.Sc.

Students in Bachelor of Science Honours, Major, or General programs must present the following credits at graduation:

1. 2.0 credits in Science Continuation courses not in the major discipline; **students completing a double major are considered to have completed this requirement providing they have 2.0 credits in science continuation courses in each of the two majors**
2. 2.0 credits in courses outside of the faculties of Science and Engineering and Design (but may include NSCI 1000)

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

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

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

Declared and Undeclared Students

Students who are registered in a program within the degree are called Declared students. Most students designate a program of study when they first apply for admission and so begin their studies as Declared students. Students may also choose to begin their studies within the B.Sc. degree without being registered in a program. These students are referred to as Undeclared students. The recommended course pattern for Undeclared students is provided in the Undeclared entry of the Programs section of this Calendar. Undeclared students normally must apply to enter a program before beginning their second year of study. The Science Student Success Centre (SSSC) provides Undeclared students guidance to the appropriate support services in making this decision.

Change of Program within the B.Sc. Degree

Students may transfer to a program within the B.Sc. degree if upon entry to the new program they would be in good academic standing.

Other applications for change of program will be considered on their merits; students may be accepted in the new program in *Good Standing* or on *Academic Warning*.

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

Minors, Concentrations and Specializations

Students may add a minor, concentration or specialization by completing a Change of Program Elements (COPE) application form online through Carleton Central. Acceptance into a minor, concentration or specialization requires that the student be in *Good Standing* and is subject to any specific requirements of the intended Minor, Concentration or Specialization as published in the relevant Calendar entry.

Experimental Science Requirement

Students in B.Sc. Honours, Major, or General degree programs must present at graduation at least two full credits of experimental science chosen from two different departments or institutes from the list below:

Approved Experimental Science Courses

Biochemistry	
BIOC 2200 [0.5]	Cellular Biochemistry
BIOC 4001 [0.5]	Methods in Biochemistry
BIOC 4201 [0.5]	Advanced Cell Culture and Tissue Engineering
Biology	
BIOL 1103 [0.5]	Foundations of Biology I
BIOL 1104 [0.5]	Foundations of Biology II
BIOL 2001 [0.5]	Animals: Form and Function
BIOL 2002 [0.5]	Plants: Form and Function
BIOL 2104 [0.5]	Introductory Genetics
BIOL 2200 [0.5]	Cellular Biochemistry
BIOL 2600 [0.5]	Introduction to Ecology
Chemistry	
CHEM 1001 [0.5]	General Chemistry I
CHEM 1002 [0.5]	General Chemistry II
CHEM 1005 [0.5]	Elementary Chemistry I
CHEM 1006 [0.5]	Elementary Chemistry II
CHEM 2103 [0.5]	Physical Chemistry I
CHEM 2203 [0.5]	Organic Chemistry I
CHEM 2204 [0.5]	Organic Chemistry II
CHEM 2206 [0.5]	Organic Chemistry IV
CHEM 2302 [0.5]	Analytical Chemistry I
CHEM 2303 [0.5]	Analytical Chemistry II
CHEM 2800 [0.5]	Foundations for Environmental Chemistry
Earth Sciences	
ERTH 1006 [0.5]	Exploring Planet Earth
ERTH 1009 [0.5]	The Earth System Through Time
ERTH 2102 [0.5]	Mineralogy to Petrology
ERTH 2404 [0.5]	Engineering Geoscience
ERTH 2802 [0.5]	Field Geology I
ERTH 3111 [0.5]	Vertebrate Evolution II
ERTH 3112 [0.5]	Vertebrate Evolution I
ERTH 3204 [0.5]	Mineral Deposits
ERTH 3205 [0.5]	Physical Hydrogeology
ERTH 3806 [0.5]	Structural Geology
Food Sciences	
FOOD 3001 [0.5]	Food Chemistry
FOOD 3002 [0.5]	Food Analysis
FOOD 3005 [0.5]	Food Microbiology
Geography	
GEOG 1010 [0.5]	Global Environmental Systems
GEOG 3108 [0.5]	Soil Properties
Neuroscience	
NEUR 3206 [0.5]	Sensory and Motor Neuroscience
NEUR 3207 [0.5]	Integrative Neuroscience
NEUR 4600 [0.5]	Advanced Lab in Neuroanatomy
Physics	
PHYS 1001 [0.5]	Foundations of Physics I
PHYS 1002 [0.5]	Foundations of Physics II
PHYS 1003 [0.5]	Introductory Mechanics and Thermodynamics
PHYS 1004 [0.5]	Introductory Electromagnetism and Wave Motion
PHYS 1007 [0.5]	Elementary University Physics I

PHYS 1008 [0.5]	Elementary University Physics II
PHYS 2202 [0.5]	Wave Motion and Optics
PHYS 2604 [0.5]	Modern Physics I
PHYS 3007 [0.5]	Third Year Physics Laboratory: Selected Experiments and Seminars
PHYS 3606 [0.5]	Modern Physics II
PHYS 3608 [0.5]	Modern Applied Physics

Course Categories for B.Sc. Programs

Science Geography Courses

GEOG 1010 [0.5]	Global Environmental Systems
GEOG 2006 [0.5]	Introduction to Quantitative Research
GEOG 2013 [0.5]	Weather and Water
GEOG 2014 [0.5]	The Earth's Surface
GEOG 3003 [0.5]	Quantitative Geography
GEOG 3010 [0.5]	Field Methods in Physical Geography
GEOG 3102 [0.5]	Geomorphology
GEOG 3103 [0.5]	Watershed Hydrology
GEOG 3104 [0.5]	Principles of Biogeography
GEOG 3105 [0.5]	Climate and Atmospheric Change
GEOG 3106 [0.5]	Aquatic Science and Management
GEOG 3108 [0.5]	Soil Properties
GEOG 4000 [0.5]	Field Studies
GEOG 4005 [0.5]	Directed Studies in Geography
GEOG 4013 [0.5]	Cold Region Hydrology
GEOG 4017 [0.5]	Global Biogeochemical Cycles
GEOG 4101 [0.5]	Two Million Years of Environmental Change
GEOG 4103 [0.5]	Water Resources Engineering
GEOG 4104 [0.5]	Microclimatology
GEOG 4108 [0.5]	Permafrost

Science Psychology Courses

PSYC 2001 [0.5]	Introduction to Research Methods in Psychology
PSYC 2002 [0.5]	Introduction to Statistics in Psychology
PSYC 2700 [0.5]	Introduction to Cognitive Psychology
PSYC 3000 [1.0]	Design and Analysis in Psychological Research
PSYC 3506 [0.5]	Cognitive Development
PSYC 3700 [1.0]	Cognition (Honours Seminar)
PSYC 3702 [0.5]	Perception
PSYC 2307 [0.5]	Human Neuropsychology I
PSYC 3307 [0.5]	Human Neuropsychology II

Science Continuation Courses

A course at the 2000 level or above may be used as a Science Continuation credit in a B.Sc. program if it is not in the student's major discipline, and is chosen from the following:

BIOC (Biochemistry)
BIOL (Biology)
CHEM (Chemistry)

COMP (Computer Science) A maximum of two half-credits at the 1000-level in COMP, excluding COMP 1001 may be used as Science Continuation credits.

ERTH (Earth Sciences), except EARTH 2415 which may be used only as a free elective for any B.Sc. program. Students in Earth Sciences programs may use EARTH 2401, EARTH 2402, and EARTH 2403 only as free electives.

Engineering. Students wishing to register in Engineering courses must obtain the permission of the Faculty of Engineering and Design.

ENSC (Environmental Science)

FOOD (Food Science and Nutrition)

GEOM (Geomatics)

HLTH (Health Sciences)

MATH (Mathematics)

NEUR (Neuroscience)

PHYS (Physics), except PHYS 2903

Science Geography Courses (see list above)

Science Psychology Courses (see list above)

STAT (Statistics)

TSES (Technology, Society, Environment) except TSES 2305. Biology General, Major, and Honours students may use these courses only as free electives. Integrated Science and Environmental Science students may include these courses in their programs but may not count them as part of the Science Sequence.

Science Faculty Electives

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

BIOC (Biochemistry)

BIOL (Biology) Biology & Biochemistry students may use BIOL 1010 and BIOL 2005 only as free electives

CHEM (Chemistry) except CHEM 1003, CHEM 1004 and CHEM 1007

COMP (Computer Science) except COMP 1001

ERTH (Earth Sciences) except EARTH 1010, EARTH 1011 and EARTH 2415. Earth Sciences students may use EARTH 2401, EARTH 2402, and EARTH 2403 only as free electives.

Engineering

ENSC 2001

FOOD (Food Science and Nutrition)

GEOM (Geomatics)

HLTH (Health Science)

MATH (Mathematics)

NEUR (Neuroscience)

PHYS (Physics) except PHYS 1901, PHYS 1902, PHYS 1905, PHYS 2903

Science Geography (see list above)

Science Psychology (see list above)

STAT (Statistics)

TSES (Technology, Society, Environment) Biology General, Major and Honours students may use these courses only as free electives.

Advanced Science Faculty Electives

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

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

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

Free Electives

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

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

CHEM 1003 [0.5]	The Chemistry of Food, Health and Drugs
CHEM 1004 [0.5]	Drugs and the Human Body
CHEM 1007 [0.5]	Chemistry of Art and Artifacts
ERTH 1010 [0.5]	Our Dynamic Planet Earth
ERTH 1011 [0.5]	Evolution of the Earth
ERTH 2415 [0.5]	Natural Disasters
ISCI 1001 [0.5]	Introduction to the Environment
ISCI 2000 [0.5]	Natural Laws
ISCI 2002 [0.5]	Human Impacts on the Environment
MATH 0107 [0.5]	Algebra and Geometry
PHYS 1901 [0.5]	Planetary Astronomy
PHYS 1902 [0.5]	From our Star to the Cosmos
PHYS 1905 [0.5]	How Things Work: Physics in Everyday Life
PHYS 2903 [0.5]	Physics and the Imagination

Prohibited Courses

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

COMP 1001 [0.5]	Introduction to Computational Thinking for Arts and Social Science Students
MATH 0005 [0.5]	Precalculus: Functions and Graphs
MATH 0006 [0.5]	Precalculus: Trigonometric Functions and Complex Numbers
MATH 1009 [0.5]	Calculus: with Applications to Business
MATH 1119 [0.5]	Linear Algebra: with Applications to Business
MATH 1401 [0.5]	Elementary Mathematics for Economics I
MATH 1402 [0.5]	Elementary Mathematics for Economics II

B.A. Regulations

The regulations presented below apply to all Bachelor of Arts programs. In addition to the requirements presented here, students must satisfy the University regulations common to all undergraduate students including the

process of Academic Performance Evaluation (consult the Academic Regulations of the University section of this Calendar).

First-Year Seminars

B.A. degree students are strongly encouraged to include a First-Year Seminar (FYSM) during their first 4.0 credits of registration. Students are limited to 1.0 credit in FYSM and can only register in a FYSM while they have first-year standing in their B.A. program. Students who have completed the Enriched Support Program (ESP) or who are required to take a minimum of one English as a Second Language (ESLA) credit are not permitted to register in a FYSM.

Breadth Requirement

Among the credits presented at graduation, students in both the B.A. General and the B.A. Honours degrees and B.Co.M.S. are required to include 3.0 breadth credits, including 1.0 credit from each of three of the four Breadth Areas identified below. Credits that fulfil requirements in the Major, Minor, Concentration or Specialization may be used to fulfil the Breadth Requirement.

Students admitted with a completed university degree are exempt from breadth requirements.

Students in the following interdisciplinary programs are exempt from the B.A. breadth requirement.

- African Studies
- Criminology and Criminal Justice
- Environmental Studies
- Human Rights
- Human Rights and Social Justice

Breadth Area 1: Culture and Communication

American Sign Language, Art History, Art and Culture, Communication and Media Studies, Comparative Literary Studies, Digital Humanities, English, Film Studies, French, Journalism, Media Production and Design, Music, and Languages (Arabic, English as a Second Language, German, Greek, Hebrew, Indigenous Languages, Italian, Japanese, Korean, Latin, Mandarin, Portuguese, Russian, Spanish)

Subject codes: ARAB, ARTH, ASLA, CHIN, CLST, COMS, DIGH, ENGL, ESLA, FILM, FINS, FREN, GERM, GREK, HEBR, ITAL, JAPA, JOUR, KORE, LANG, LATN, MPAD, MUSI, PORT, RUSS, SPAN

Breadth Area 2: Humanities

African Studies, Applied Linguistics and Discourse Studies, Canadian Studies, Child Studies, Classical Civilization, Directed Interdisciplinary Studies, Disability Studies, European and Russian Studies, History, Human Rights, Humanities, Indigenous Studies, Latin American and Caribbean Studies, Linguistics, Medieval and Early Modern Studies, Philosophy, Religion, Sexuality Studies, South Asian Studies, and Women's and Gender Studies.

Subject codes: AFRI, ALDS, CDNS, CHST, CLCV, DBST, DIST, EURR, HIST, HUMR, HUMS, INDG, LACS, LING, MEMS, PHIL, RELI, SAST, SXST, WGST

Breadth Area 3: Science, Engineering, and Design

Architecture, Biology, Chemistry, Computer Science, Earth Sciences, Engineering, Environmental Science, Food Science and Nutrition, Health Sciences, Industrial Design, Information Technology (ITEC), Mathematics, Neuroscience, Statistics, Physics, and Technology, Society, Environment.

Subject codes: AERO, ARCC, ARCH, ARCN, ARCS, ARCU, BIOC, BIOL, CHEM, CIVE, CMPS, COMP, ECOR, ELEC, ENSC, ENVE, EARTH, FOOD, HLTH, IDES, ISCI, ISCS, ISYS, ITEC, MAAE, MATH, MECH, NEUR, NSCI, PHYS, SREE, STAT, SYSC, TSES

Breadth Area 4: Social Sciences

Anthropology, Business, Cognitive Science, Criminology and Criminal Justice, Economics, Environmental Studies, Geography, Geomatics, Global and International Studies, Global Politics, Interdisciplinary Public Affairs, International Affairs, Law, Migration and Diaspora Studies, Political Management, Political Science, Psychology, Public Administration, Public Affairs and Policy Management, Social Work, Sociology/Anthropology, Sociology

Subject codes: ANTH, BUSI, CGSC, CRCJ, ECON, ENST, GEOG, GEOM, GINS, GPOL, INAF, IPAF, LAWS, MGDS, PADM, PADM, POLM, PSCI, PSYC, SOCI, SOWK

Declared and Undeclared Students

Students who are registered in a program within the degree are called Declared students. Most students designate a program of study when they first apply for admission and so begin their studies as Declared students. Students may also choose to begin their studies within the B.A. degree without being registered in a program. These students are referred to as Undeclared. The recommended course pattern for Undeclared students is outlined under *Undeclared* in the Programs section of this Calendar. Undeclared students must apply to enter a program before beginning their second year of study. The Student Academic Success Centre offers support to Undeclared students in making this decision.

Change of Program Within the B.A. Degree

Students may transfer to a program within the B.A. degree, if upon entry to the new program they would be in *Good Standing*. Other applications for change of program will be considered on their merits; students may be admitted to the new program in *Good Standing* or on Academic Warning. Students may apply to declare or change their program within the B.A. Degree at the Registrar's Office according to the published deadlines. Acceptance into a program or into a program element or option is subject to any enrollment limitations, specific program, program element or option requirements, as published in the relevant Calendar entry.

Minors, Concentrations and Specializations

Students may apply to the Registrar's Office to be admitted to a minor, concentration or specialization during their first or subsequent years of study. Acceptance into a minor, concentration or specialization is subject to any specific requirements of the intended Minor, Concentration or Specialization as published in the relevant Calendar

entry. Acceptance into a Concentration or Specialization requires that the student be in Good Standing.

Mention : Français

Students registered in certain B.A. programs may earn the notation *Mention : Français* by completing part of their requirements in French and by demonstrating a knowledge of the history and culture of French Canada. The general requirements are listed below. For more specific details consult the departmental program entries.

Students in a B.A. Honours program must present:

1. 1.0 credit in French language;
2. 1.0 credit devoted to the history and culture of French Canada;
3. 1.0 credit at the 2000- or 3000-level and 1.0 credit at the 4000-level in the Honours discipline taken in French.

Students in a B.A. General program must present:

1. 1.0 credit in advanced French;
2. 1.0 credit devoted to the history and culture of French Canada;
3. 1.0 credit at the 2000- or 3000-level in the Major discipline taken in French.

Students in Combined Honours programs must fulfil the *Mention : Français* requirement in both disciplines.

Courses taught in French (Item 3, above) may be taken at Carleton, at the University of Ottawa on the Exchange Agreement, or at a francophone university on a Letter of Permission. Students planning to take courses on exchange or on a Letter of Permission should take careful note of the residence requirement for a minimum number of Carleton courses in their programs. Consult the *Academic Regulations of the University* section of this Calendar for information regarding study on Exchange or Letter of Permission.

Degrees

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

Admission Requirements

Honours Program

First Year

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

Specific Honours Admission Requirements

For the Honours programs in Environmental Science, Geography, Geomatics and Earth Sciences, Calculus and Vectors may be substituted for Advanced Functions.

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

For the Combined Honours program in Chemistry and Computer Science, 4U Chemistry and Calculus and Vectors are strongly recommended.

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

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

Advanced Standing

For entry to an Honours program after the completion of 5.0 included credits, a student must have a major CGPA of 5.50 or higher, an overall CGPA of 4.50 or higher and the recommendation of the Honours department or committee. A student beginning the final 10.0 credits towards an Honours degree must present a major CGPA of 6.00 or higher, an overall CGPA of 5.00 or higher and the recommendation of the Honours department or committee. A student beginning the final 5.0 credits towards an Honours degree must present a major CGPA of 6.50 or higher and an overall CGPA of 5.00 or higher, as calculated for graduation. Advanced standing will be granted for studies undertaken elsewhere when these are recognized as the equivalent of subjects offered at Carleton University.

Major Program

General Program

First Year

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

Advanced Standing

For entry to a General or Major program after the completion of 5.0 included credits, a student must have a major and core CGPA of 3.50 or higher and an overall CGPA of 3.50 or higher. A student beginning the final 5.0 credits towards a General or Major degree must present a major and core CGPA of 4.00 or higher and an overall CGPA of 4.00 or higher, as calculated for graduation. Advanced standing will be granted for studies undertaken elsewhere when these are recognized as the equivalent of subjects offered at Carleton University.

Co-op Option

Direct Admission to the First Year of the Co-op Option

Applicants must:

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

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

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

Admission Requirements

Degrees

- Bachelor of Arts (B.A.)(Honours)
- Bachelor of Arts (B.A.)(General)

First Year

For B.A. (General) and B.A. (Honours)

The Ontario Secondary School Diploma (OSSD) or equivalent including a minimum of six 4U or M courses. The six 4U or M courses must include a 4U course in English (or *anglais*). For applicants whose first language is not English, the requirement of English can also be met under the conditions outlined in the section "English Language Requirements" in the Admissions Requirements and Procedures section of this Calendar.

The cut-off average for admission will be set annually and will normally be above the minimum requirement. Applicants falling slightly below the cut-off average will be considered on an individual basis to determine whether there are special circumstances that would permit their admission. Students who feel that their high school grade average does not reflect their potential may apply to the Enriched Support Program (see the Enriched Support Program section of this Calendar).

Biology

For the major in Biology in the B.A. program, in addition to the 4U English, a 4U course in Chemistry is required. Advanced Functions and Calculus and Vectors are recommended.

Advanced Standing

B.A. (General and Honours) Program

Applications for admission to the second or subsequent years will be assessed on their merits. Advanced standing will be granted only for those courses that are determined to be appropriate.

Direct Admission to the First Year of the Co-op Option

Anthropology and Sociology, Communication and Media Studies, English, European and Russian Studies, French, History, Law, Political Science, Psychology

Applicants must:

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

Meeting the above requirements only establishes eligibility for admission to the program. The prevailing job market may limit enrolment in the co-op option. Students should also note that hiring priority is given to Canadian citizens for co-op positions in the Public Service Commission.

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

Biology (BIOL) Courses

BIOL 1010 [0.5 credit]

Biotechnology and Society

A course for students interested in the science behind recent advances in biotechnology. The different ways in which biotechnology is being applied in agriculture, health care, and the environment will be examined. Prerequisite: credit will not be given if taken concurrently with, or after BIOL 2200 or BIOC 2200 or BIOL 2201. Students in Biology and Biochemistry programs may only take this course as a free elective.

Lectures three hours a week.

BIOL 1103 [0.5 credit]

Foundations of Biology I

A research-oriented course focusing on the scientific process of biological exploration at the cellular level. Topics include cell organization, metabolism, genetics, and reproduction.

Precludes additional credit for BIOL 1003 (no longer offered).

Prerequisite(s): Ontario 4U/M in Biology (or equivalent), or Ontario 4U/M in Chemistry (or equivalent).

Lectures three hours a week, laboratory or tutorial three hours a week.

BIOL 1104 [0.5 credit]

Foundations of Biology II

A research-oriented course focusing on the scientific process of biological exploration at the macroscale. Topics include evolution, diversity of life, and ecological relationships.

Precludes additional credit for BIOL 1004 (no longer offered).

Prerequisite(s): Ontario 4U/M in Biology (or equivalent) or BIOL 1103.

Lectures three hours a week, laboratory or tutorial three hours a week.

BIOL 1105 [0.5 credit]

Biological Methods, Analysis and Interpretation

Formulation of biological research questions, development of hypotheses and predictions, design of experiments, collection and analysis of data, interpretation and presentation of results.

Lectures three hours a week.

BIOL 1902 [0.5 credit]

Natural History

A course designed primarily for students in non-biology programs to investigate the natural history of plants and animals, and the communities in which they occur.

Particular attention is paid to the Ottawa region, but appropriate examples from other locales are also included.

Lectures three hours a week.

BIOL 2001 [0.5 credit]

Animals: Form and Function

An introduction to the diverse structures of animals (both invertebrates and vertebrates) in relationship to their functions, discussed within an evolutionary framework.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the Department.

Lectures three hours a week, laboratory or tutorial three hours a week.

BIOL 2002 [0.5 credit]

Plants: Form and Function

An introduction to the structure and development of higher plants (at cellular, morphological and organism levels) discussed in relation to their function.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the Department.

Lectures three hours a week, laboratory or tutorial three hours a week.

BIOL 2005 [0.5 credit]**Human Physiology**

Topics may include: neurophysiology, sensory reception, the skeletal system, muscular contraction, the cardiovascular system, the respiratory system, and the gastrointestinal system. Preclusion: credit will not be given if taken concurrently with, or after BIOL 3305 or BIOL 3306. Students in Biology and Biochemistry programs may only take this course as a free elective. Prerequisite(s): BIOL 1003 or BIOL 1103 and (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006) or permission of the Department. Lectures three hours a week.

BIOL 2104 [0.5 credit]**Introductory Genetics**

A lecture and laboratory course on the mechanisms of inheritance and the nature of gene structure, composition and function, introducing both classical Mendelian genetics and modern molecular genetics. It is strongly recommended that this course be taken by Biology majors in their second year of study. Precludes additional credit for BIOL 2106 (no longer offered) and BIOL 2107. Credit for BIOL 2106 will only be given if taken before BIOL 2104. Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the Department. Lectures three hours a week, laboratory or tutorial three hours a week.

BIOL 2107 [0.5 credit]**Fundamentals of Genetics**

Mechanisms of inheritance and the nature of gene structure, composition and function, introducing both classical Mendelian genetics and modern molecular genetics. Precludes additional credit for BIOL 2104 and BIOL 2106 (no longer offered). Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the Department. Lectures three hours a week.

BIOL 2200 [0.5 credit]**Cellular Biochemistry**

Cellular functions and their interrelationships. Introduction to thermodynamics, membrane structure and function, transport mechanisms, basic metabolic pathways, energy production and utilization, communications between cells. It is strongly recommended that Biology Majors and Honours students take this course in their second year of study. Also listed as BIOC 2200. Precludes additional credit for BIOL 2201. Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104), (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006), or permission of the Department. Lectures three hours a week, laboratory or tutorial four hours a week.

BIOL 2201 [0.5 credit]**Cell Biology and Biochemistry**

A study of the molecular, metabolic and structural organization of cells in relation to function. This course is recommended for students not taking upper year Biology laboratory courses for which BIOL/BIOC laboratories are prerequisites. Precludes additional credit for BIOL 2200, BIOC 2200. Prerequisite(s): (BIOL 1003 or BIOL 1103) and (CHEM 1002 or CHEM 1006), or permission of the Department. Lectures three hours a week.

BIOL 2301 [0.5 credit]**Biotechnology I**

An introductory course on the science, technology, entrepreneurial skills and business considerations related to biotechnology. The course will survey broadly across the disciplines of Biology, including applications in agriculture, health, environment and industry. Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104) or permission of the department. Lectures and workshops three hours a week

BIOL 2303 [0.5 credit]**Microbiology**

The biology of the bacteria, Archaea, Viruses and Protozoans, from the fundamentals of cell chemistry, molecular biology, structure and function, to their involvement in ecological and industrial processes and human disease. Also listed as ENVE 2002. Prerequisite(s): BIOL 1003 or BIOL 1103. Lectures three hours a week.

BIOL 2600 [0.5 credit]**Introduction to Ecology**

The scientific study of interactions of living organisms and their environment, and how these affect the distribution and abundance of life. Topics include energy transformation and flow, nutrient cycling, population and community dynamics, human impacts on ecosystems, conservation issues. Laboratory includes field and computer exercises. Prerequisite(s): (BIOL 1003 and BIOL 1004), or (BIOL 1103 and BIOL 1104) or permission of the Department. Lectures three hours a week, laboratory or tutorial four hours a week.

BIOL 2903 [0.5 credit]**Natural History and Ecology of Ontario**

Introduction to the remarkable diversity and ecological relationships of Ontario's flora and fauna, which are explored in a habitat context. Precludes additional credit for BIOL 1903 (no longer offered). Prerequisite(s): BIOL 1004 or BIOL 1104 or BIOL 1902. Lectures three hours a week.

BIOL 3004 [0.5 credit]**Insect Diversity**

Introductory course dealing with the taxonomic diversity, anatomy, behavior and physiology of insects, as well as their impacts on ecosystems, agriculture and animal and human health.

Precludes additional credit for BIOL 4601.

Prerequisite(s): BIOL 2001.

Lectures three hours a week.

BIOL 3008 [0.5 credit]**Bioinformatics**

A practical exploration in the application of information technology to biochemistry and molecular biology. Insight into biological knowledge discovery via molecular structure and function prediction, comparative genomics and biological information management.

Also listed as BIOC 3008, COMP 3308.

Prerequisite(s): BIOC 2200 or BIOL 2200, or permission of the Department.

Lectures two hours a week, computer workshop three hours a week.

BIOL 3102 [0.5 credit]**Mycology**

This introductory course will cover the morphology, physiology, life cycles, evolution, ecology and biotechnology of the fungi.

Prerequisite(s): BIOL 2104 or BIOL 2107.

Lectures three hours a week.

BIOL 3104 [0.5 credit]**Molecular Genetics**

A lecture course dealing with modern advances in molecular genetics.

Prerequisite(s): BIOL 2104 or BIOL 2107 or permission of the Department.

Lectures three hours a week.

BIOL 3201 [0.5 credit]**Cell Biology**

A lecture and laboratory course on the structure, composition, and function of eukaryotic cells.

Prerequisite(s): BIOL 2104 and BIOL 2200/BIOC 2200, or permission of the Department.

Lectures three hours a week, laboratory four hours a week.

BIOL 3202 [0.5 credit]**Principles of Developmental Biology**

Introduction to the underlying principles and mechanisms governing development in multicellular animals and plants. Differentiation, growth, morphogenesis, and patterning will be examined at the organismal, cellular, and molecular levels to provide a balanced view of developmental phenomena in key model organisms.

Prerequisite(s): BIOL 2104 or BIOL 2107 and one of BIOL 2001 or BIOL 2002, or permission of the Department.

Lectures three hours a week.

BIOL 3205 [0.5 credit]**Plant Biochemistry and Physiology**

A lecture and laboratory course consisting of selected topics in metabolism and physiology of plants, including photosynthesis, nutrient uptake and transport, intermediary and secondary metabolism, germination, growth and development.

Prerequisite(s): BIOL 2002 and BIOL 2200/BIOC 2200, or permission of the Department.

Lectures three hours a week, laboratory four hours a week.

BIOL 3301 [0.5 credit]**Biotechnology II**

An interdisciplinary course on interactions between science, invention and innovation in biotechnology. Case studies related to regional biotechnology opportunities; social and ethical issues impacting biotechnology.

Prerequisite(s): BIOL 2301 or (BIOL 2104 and BIOL 2200/BIOC 2200) or permission of the department.

Lectures and laboratory/workshops three hours a week

BIOL 3303 [0.5 credit]**Experimental Microbiology**

Intensive training in laboratory techniques in microbiology, using bacteria and other microorganisms to demonstrate processes of cell growth, metabolism, gene expression, rapid evolution, gene transfer, microbial community dynamics and interactions with other organisms.

Prerequisite(s): BIOL 2104, BIOL 2200/BIOC 2200 and BIOL 2303, or permission of the Department.

Lecture/tutorial one and a half hours a week, laboratory four hours a week.

BIOL 3305 [0.5 credit]**Human and Comparative Physiology**

The properties of physiological systems and components of humans and other animals with an emphasis on physical and chemical bases.

Precludes additional credit for BIOL 3306.

Prerequisite(s): BIOL 2200/BIOC 2200 and BIOL 2001. A credit in PHYS at the 1000-level is strongly recommended.

Lectures three hours a week, laboratory four hours a week.

BIOL 3306 [0.5 credit]**Human Anatomy and Physiology**

The anatomy and physiology of the neuromuscular, cardiovascular, respiratory, and excretory systems of humans with comparison to other animals.

Precludes additional credit for BIOL 3305.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104), and (CHEM 1001 and CHEM 1002) or (CHEM 1005 and CHEM 1006).

Lectures three hours per week.

BIOL 3307 [0.5 credit]**Advanced Human Anatomy and Physiology**

The anatomy and physiology of the endocrine, skeletal, digestive, immunological, and reproductive systems, with additional emphasis on the embryological origins of the major physiological systems.

Prerequisite(s): BIOL 3305 or BIOL 3306.

Lectures three hours per week, workshop or laboratory four hours per week.

BIOL 3501 [0.5 credit]**Biomechanics**

Properties of muscles, tendons, bones, joints and the co-ordinated use of these structures. Human and other animal locomotion and fitness, bird flight, especially the soaring of the vulture and the albatross, and animal migration are covered in detail.

Prerequisite(s): (BIOL 1003 and BIOL 1004) or (BIOL 1103 and BIOL 1104).

Lectures three hours a week, workshop two hours a week.

BIOL 3601 [0.5 credit]**Ecosystems and Environmental Change**

Exploration of the unique contribution of the ecosystem approach to ecology, and of early key literature in ecosystem ecology through to current work on global environmental change.

Prerequisite(s): BIOL 2600.

Lectures three hours a week, laboratory four hours a week in six sessions.

BIOL 3602 [0.5 credit]**Conservation Biology**

The science of biology as applied to the problem of maintaining species diversity. Topics include: history of conservation biology, valuation of species, indices of biodiversity, extinction, conservation genetics, conservation planning in parks and reserves, landscape ecology and case studies of conservation problems.

Prerequisite(s): BIOL 2600 or permission of the Department.

Lectures three hours a week and laboratory/workshop three hours a week.

BIOL 3604 [0.5 credit]**Analysis of Ecological Relationships**

Introduction to the analysis of ecological data. Students analyze real ecological data sets in weekly laboratory sessions. Methods introduced include simple linear, polynomial, and multiple regression analysis, analysis of variance, nonparametric tests, tests of independence and logistic regression analysis.

Prerequisite(s): BIOL 2600 and STAT 2507.

Lectures one and one-half hours and laboratory two and one-half hours a week.

BIOL 3605 [0.5 credit]**Field Course I**

An intensive study of living organisms under natural conditions. Credit is based on two weeks of full-time fieldwork with attendant assignments. A wide range of modules is available. Transportation and room and board costs are borne by the student. Students may take both BIOL 3605 and BIOL 3606 for credit, but neither may be used to repeat a particular module.

Also listed as NEUR 3203, for animal behaviour modules only.

Prerequisite(s): at least one course in BIOL beyond the 1000-level and written permission of the Department.

All day, approximately six days a week.

BIOL 3606 [0.5 credit]**Field Course II**

An intensive study of living organisms under natural conditions. Credit is based on two weeks of full-time fieldwork with attendant assignments. A wide range of modules is available. Transportation and room and board costs are borne by the student. Students may take both BIOL 3605 and BIOL 3606 for credit, but neither can be used to repeat a particular module.

Prerequisite(s): at least one course in BIOL beyond the 1000-level and written permission of the Department.

All day, approximately six days a week.

BIOL 3608 [0.5 credit]**Principles of Biogeography**

Contemporary and past controls on distribution of plants and animals at global, regional and local scales; significance of these distributions.

Also listed as GEOG 3104.

Prerequisite(s): BIOL 2600 or GEOG 1010 or permission of the Department.

Lectures, laboratory, and fieldwork five hours a week.

BIOL 3609 [0.5 credit]**Evolutionary Concepts**

Evolution is the change in population properties across generations. Genetic variation, mutation, selection, drift, gene flow, genome evolution, speciation, development, biodiversity, fossils, and macro-evolution.

Prerequisite(s): BIOL 2104 or BIOL 2107 or permission of the instructor.

Lectures three hours a week.

BIOL 3611 [0.5 credit]**Evolutionary Ecology**

The term "adaptation" is meaningful only with respect to an ecological context. Ecological contexts lead to evolutionary outcomes such as diverse mating systems, ageing, sexual reproduction, sexual dimorphism, geographic variation, phenotypic plasticity, and diverse life histories.

Precludes additional credit for BIOL 4608.

Prerequisite(s): BIOL 2600.

Lectures three hours a week; one field trip.

BIOL 3612 [0.5 credit]**Computational Methods in Ecology and Evolution**

Introduction to the development and use of computer programs to address biological problems. Topics include the development of programs to analyse ecological data, models of population dynamics, deterministic chaos, cellular automata, simulations of foraging behaviour and evolutionary computation.

Prerequisite(s): BIOL 2600 or permission of the Department.

Lectures two hours per week, workshop three hours per week.

BIOL 3801 [0.5 credit]**Plants and Herbivores**

Exploration of the chemical, physiological, ecological and evolutionary interactions that underlie the relationship between plants and their insect herbivores.

Prerequisite(s): BIOL 2001 and BIOL 2002.

Lectures/seminars three hours a week.

BIOL 3802 [0.5 credit]**Animal Behaviour**

Advanced study of animal behaviour including the environmental, genetic, and neural influences on behaviour. Topics such as predator-prey interactions, mating behaviour, migration, parental care and social interactions are interpreted in an evolutionary context.

Prerequisite(s): BIOL 2001 or BIOL 2600 or permission of the Department.

Lectures and workshop/tutorials three hours a week.

BIOL 3804 [0.5 credit]**Social Evolution**

Diversity in social behaviour from evolutionary and ecological perspectives. Topics include ecological determinants of social living, social networks, social foraging, inclusive fitness, kin selection, altruism, cooperation, and mating systems and strategies.

Prerequisite(s): BIOL 2001 and BIOL 2600, or permission of the Department.

Lectures three hours a week.

BIOL 3901 [0.5 credit]**Research Proposal**

The development of a competitive research proposal in consultation with an advisor.

Prerequisite(s): third year standing in an Honours Biology program and permission of the Department.

BIOL 3902 [0.5 credit]**Topics in Biology I**

Specific topics of current interest. Topics may vary from year to year.

Prerequisite(s): third-year standing in a Biology program or permission of the Department.

Lecture, seminars, or workshops three hours per week.

BIOL 3999 [0.0 credit]**Co-operative Work Term Report**

Practical experience for students enrolled in the Co-operative Option. Students must receive satisfactory evaluations from their work term employer. Written reports describing the work term project will be required. Graded Sat or Uns.

Prerequisite(s): registration in the Biology Co-operative Option and permission of the Department.

BIOL 4008 [0.5 credit]**Molecular Plant Development**

Recent advances in plant development including molecular, biochemical, genomics, and proteomics studies.

Prerequisite(s): BIOL 2002 or permission of the Department.

Lectures three hours a week.

BIOL 4102 [0.5 credit]**Molecular Ecology**

The interface of molecular biology, ecology and population biology. Topics include experimental design and a survey and critique of molecular genetic methods to study ecology.

Prerequisite(s): BIOL 2104 or BIOL 2107 and BIOL 2600; BIOL 3104 or one of BIOL 3601, BIOL 3602 (may be taken concurrently), or permission of the Department.

Lectures three hours a week.

BIOL 4103 [0.5 credit]**Population Genetics**

Evolution of gene frequencies, including selection, mutation, genetic drift, inbreeding, gene flow, and population structure.

Prerequisite(s): BIOL 2104 or BIOL 2107 or permission of the Department. A course in statistics is highly recommended.

Lectures and seminars three hours a week.

BIOL 4104 [0.5 credit]**Evolutionary Genetics**

An overview of the molecular evidence of evolution, speciation as well as the phylogenetic analysis of biological sequence data and biometrical traits.

Prerequisite(s): (BIOL 2001 or BIOL 2002) and (BIOL 2104 or BIOL 2107) or permission of the Department. A course in statistics is recommended.

Lectures and computer lab three hours a week.

BIOL 4106 [0.5 credit]**Advances in Molecular Biology**

Review of the application of high throughput approaches to research in molecular and cellular biology and biochemistry with an emphasis on gene function and human disease progression.

Prerequisite(s): BIOL 2303 and (BIOL 3104 or BIOL 3201). Lectures and seminars three hours a week.

BIOL 4109 [0.5 credit]**Laboratory Techniques in Molecular Genetics**

This laboratory course provides practical familiarity with commonly used techniques in molecular genetics. The laboratory is suitable for students with a developing interest in problems of molecular and cellular biology and biochemistry.

Prerequisite(s): BIOL 2200/BIOC 2200 and BIOL 2303 and BIOL 3104 or permission of the Department.

Lecture/laboratory six hours a week in two sessions.

BIOL 4200 [0.5 credit]**Immunology**

The organization and function of the immune system, including the anatomy of the immune system, the properties and behaviour of cells of the immune system, and the molecular and genetic bases of the immune response.

Also listed as BIOC 4200.

Prerequisite(s): BIOL 3201 or permission of the Department.

Lectures three hours a week.

BIOL 4201 [0.5 credit]**Advanced Cell Culture and Tissue Engineering**

Theory and application of current techniques and developments in cell culture as applied to research questions in the field of stem cells and tissue engineering.

Also listed as BIOC 4201.

Prerequisite(s): BIOL 3201 or permission of the Department.

Laboratory four hours per week, tutorial one hour a week. Labs require regular participation outside of the scheduled lab time to maintain cell cultures and set up or complete experiments.

BIOL 4202 [0.5 credit]**Mutagenesis and DNA Repair**

A mechanistic study of mutagenesis and DNA repair. Topics include DNA structure perturbations, spontaneous and induced mutagenesis, the genetics and biochemistry of DNA repair and recombination, and the role of mutations in the development of genetic disease and cancer.

Also listed as BIOC 4202.

Prerequisite(s): BIOL 3104 and BIOL 2200/BIOC 2200 or permission of the Department.

Lectures and tutorial three hours a week.

BIOL 4203 [0.5 credit]**Evolution of Sex**

The evolution of sex, including meiosis, syngamy, sex determination, sex chromosomes, and gender from organismal, genetic, and developmental perspectives; the origin, maintenance, function, and ubiquity of sex.

Prerequisite(s): BIOL 2104 or BIOL 2107.

Lectures three hours a week.

BIOL 4206 [0.5 credit]**Human Genetics**

A survey of human genetic variation and mutation in a molecular genetics context. Topics may include molecular basis of diseases, chromosomal abnormalities, genomic imprinting, cancer genetics, genomics, gene mapping and gene therapy.

Prerequisite(s): BIOL 3104 or permission of the Department.

Lectures three hours a week.

BIOL 4207 [0.5 credit]**Advanced Embryology & Developmental Biology**

A laboratory-based exploration of techniques and recent developments in the use of model embryological systems as applied to questions of development and human health.

Prerequisite(s): BIOL 3201 or BIOL 3202 or permission of the Department.

Laboratory four hours per week, tutorial one hour a week. Labs require regular participation outside of the scheduled lab time to set up or complete experiments.

BIOL 4209 [0.5 credit]**Advanced Plant Physiology**

An advanced course dealing with recent developments in selected topics of plant physiology.

Prerequisite(s): BIOL 3205 and CHEM 2203, CHEM 2204 or permission of the Department.

Lectures/discussion three hours a week.

BIOL 4300 [0.5 credit]**Applied Microbiology**

Studies of the application of microorganisms. Topics may include: microbial communities, and agricultural, pharmaceutical, industrial and health sciences.

Prerequisite(s): (BIOL 2200/BIOC 2200 or BIOL 2201), BIOL 2303 and (BIOL 3104 or BIOL 3303) or permission of the Department.

Lectures and tutorial three hours a week.

BIOL 4301 [0.5 credit]**Current Topics in Biotechnology**

Explorations of developing biotechnologies in areas such as microbial products, protein engineering, plant genetic engineering, environmental remediation, pharmaceuticals production and medical diagnostics and therapy.

Prerequisite(s): BIOL 3301 or (BIOL 2104 or BIOL 2107) and (BIOL 2200/BIOC 2200 or BIOL 2201,) or permission of the department.

Lectures and tutorials three hours a week.

BIOL 4303 [0.5 credit]**Advances in Microbiology**

Exploration of current microbiology including the biology of infectious agents, microbial and functional genomics and proteomics. Special attention will be paid to the "big questions" in the field. Students will be exposed to proposing research to answer a specific question in microbiology.

Prerequisite(s): BIOL 2303 and (BIOL 3104 or BIOL 3303 or BIOC 3102) or permission of the Department.

Lectures three hours per week.

BIOL 4306 [0.5 credit]**Animal Neurophysiology**

A course dealing with recent advances made in particular areas of animal neurophysiology.

Precludes additional credit for BIOL 4305.

Prerequisite(s): BIOL 3305 or BIOL 3306, or permission of the Department.

Lectures two hours a week, workshops or laboratory four hours a week.

BIOL 4309 [0.5 credit]**Studies in Human Performance**

Biomechanical underpinnings of human performance including the quantitative analysis of human motion in normal activities and in athletic performance. Students will learn modern motion capture methods. This course will require students to design and execute an independent project.

Prerequisite(s): BIOL 3307 and fourth-year standing, or permission of the department.

Lecture three hours per week, workshop/labs three hours per week.

BIOL 4317 [0.5 credit]**Neuroethology: The Neural Basis of Animal Behaviour**

The proximate mechanisms underlying animal behaviour are examined focusing on how nervous systems evolve in response to environmental selection pressures.

Topics include genetic and hormonal influences on behaviour (e.g. maternal care), unique sensory worlds (e.g. magnetic), and various levels of neural integration, from simple reflexes to complex social behaviour.

Prerequisite(s): BIOL 3305 or BIOL 3306, or permission of the Department.

Lectures three hours a week.

BIOL 4318 [0.5 credit]**Adaptations to Extreme Environments**

Lectures, discussions and student presentations will be used to examine adaptations of animals to extreme environments (e.g. desert) or lifestyles (e.g. diving), at the physiological, biochemical and molecular levels. Emphasis on becoming familiar with the current primary literature.

Prerequisite(s): BIOL 3305, or permission of the Department.

Lectures three hours a week, workshop two hours a week.

BIOL 4319 [0.5 credit]**Studies in Exercise Physiology**

Physiological mechanisms underlying human athletic performance. Exercise physiology and cardio-respiratory activity, metabolic regulation and musculoskeletal function. Practical experience will be gained in the workshop/laboratory based experimental sessions.

Prerequisite(s): BIOL 3307 and fourth-year standing, or permission of the department.

Lectures two hours per week, workshop/labs three hours per week.

BIOL 4500 [0.5 credit]**Ornithology I**

Introduction to ornithology, the study of birds; the evolution of birds, migration, geographic variation, adaptations for flight, feeding, reproduction; extinction and preservation.

Prerequisite(s): BIOL 2001.

Lectures three hours per week.

BIOL 4501 [0.5 credit]**Ornithology II**

The taxonomy of birds and species identification are learned through the use of study skins in the lab. Field excursions allow first-hand study of wintering species. Participants must acquire a pair of binoculars and one of the recommended field guides.

Prerequisite(s): BIOL 4500.

Laboratory/field excursions four hours per week.

BIOL 4502 [0.5 credit]**Herpetology**

Herpetology is the study of amphibians and reptiles. The behaviours, physiological ecology, conservation and identification of amphibians and reptiles will be examined through lectures, seminars and hands-on activities.

Prerequisite(s): BIOL 2001.

Lectures or seminars three hours per week.

BIOL 4503 [0.5 credit]**Fish Ecology, Conservation and Management**

Introduction to the diversity and environmental biology of the world's fishes. Applied issues in fisheries management, conservation, and aquaculture. Workshops expose students to techniques in fisheries science through hands-on demonstrations and field excursions.

Prerequisite(s): BIOL 2600 or permission of the Department.

Lectures/seminars two hours a week, plus labs/workshops two hours a week.

BIOL 4504 [0.5 credit]**Ecology of Freshwater Invertebrates**

Overview of the diversity and ecology of freshwater invertebrates. Aquatic invertebrates from local bodies of water will be sampled and identified in the lab. Experiments on the ecology and behaviour of model species of freshwater invertebrates will also be conducted in the lab.

Prerequisite(s): BIOL 2001 and BIOL 2600.

Seminar and lab four hours a week.

BIOL 4602 [0.5 credit]**Evolutionary Applications across Disciplines: From Medicine to Conservation**

Evolutionary principles contributing to advancements across fields including medicine, agriculture, conservation, climate change, and engineering. Topics include evolution of virulence, causes of variation in human health, evolution of resistance to pesticides, interventions for recovery of species at risk, and biomimetic modeling in engineering and architecture.

Prerequisite(s): BIOL 1104 and third-year standing.

Lectures/workshops three hours per week.

BIOL 4603 [0.5 credit]**Insect Evolution and Biology**

Major questions on the origin, evolution and adaptation of structures and physiology of terrestrial arthropods, especially insects.

Prerequisite(s): BIOL 3004, or permission of the Department.

Lectures two hours a week, laboratory four hours a week.

BIOL 4604 [0.5 credit]**Landscape Ecology**

Landscape ecology is the study of how landscape structure affects the abundance and distribution of organisms. The focus of this course is on research methods and results in landscape ecology. Applications in forestry, agriculture, and species conservation.

Prerequisite(s): BIOL 2600 or equivalent, BIOL 3601 or BIOL 3602 or BIOL 3608 or equivalent, and honours standing in Biology, Geography, or Environmental Sciences.

Lecture three hours a week.

BIOL 4802 [0.5 credit]**Advanced Animal Behaviour**

Contemporary issues in behavioural ecology. Topics may include the relevance of behavioural ecology to conservation biology, to new insights into human social behaviour, and will be selected through consultation between professor and students.

Prerequisite(s): BIOL 3802 or BIOL 3804, or permission of the Department.

Lectures two hours a week, laboratory four hours a week.

BIOL 4900 [1.0 credit]**Directed Special Studies and Seminar**

Prerequisite(s): permission of the Department.

BIOL 4901 [0.5 credit]**Directed Special Studies**

Independent or group study, open to third- and fourth-year students to explore a particular topic, in consultation with a Faculty supervisor. May include directed reading, written assignments, tutorials, laboratory or field work.

Prerequisite(s): permission of the Department. Students normally may not offer more than 1.0 credit of Directed Special Studies in their program.

BIOL 4902 [0.5 credit]**Topics in Biology II**

Specific topics of current interest. Topics may vary from year to year.

Prerequisite(s): fourth-year standing in a Biology program or permission of the Department.

Lecture, seminars, or workshops three hours per week.

BIOL 4905 [1.0 credit]**Honours Workshop**

Within the context of an active learning environment, students participate in a variety of activities which may include literature reviews and critiques, media releases and response papers, oral presentations, and posters. Projects are focused on an area of biological research of interest to the student.

Precludes additional credit for BIOL 4907 and BIOL 4908. Prerequisite(s): fourth-year standing in an Honours biology program and permission of the Department. Workshops three hours per week.

BIOL 4907 [1.0 credit]**Honours Essay and Research Proposal**

An independent critical review and research proposal, using library resources, under the direct supervision of a Faculty advisor. Evaluation is based on a written report and a poster presentation.

Precludes additional credit for BIOL 4905 and BIOL 4908. Prerequisite(s): fourth-year standing in an Honours Biology program and permission of the Department.

BIOL 4908 [1.0 credit]**Honours Research Thesis**

An independent research project undertaken in the field and/or the laboratory, under the direct supervision of a faculty adviser. Evaluation is based on a written thesis and a poster presentation.

Precludes additional credit for BIOL 4905 and BIOL 4907. Prerequisite(s): fourth-year standing in an Honours biology program with a minimum CGPA of 8.0 in the major or permission of the Department.

Summer session: some of the courses listed in this Calendar are offered during the summer. Hours and scheduling for summer session courses will differ significantly from those reported in the fall/winter Calendar. To determine the scheduling and hours for summer session classes, consult the class schedule at central.carleton.ca

Not all courses listed are offered in a given year. For an up-to-date statement of course offerings for the current session and to determine the term of offering, consult the class schedule at central.carleton.ca