

BIOLOGICAL SCIENCES, B.SC. MAJOR

Degree Requirements

Four Year Major: Cell, Molecular and Developmental Biology Theme (Including Co-operative Option)

Important Note¹

Course	Title	Hours
Year 1		
BIOL 1020	Biology 1: Principles and Themes	3
BIOL 1030	Biology 2: Biological Diversity, Function and Interactions (C+)	3
CHEM 1100	Introductory Chemistry 1: Atomic and Molecular Structure and Energetics	3
CHEM 1110	Introductory Chemistry 2: Interaction, Reactivity, and Chemical Properties	3
CHEM 1120	Introduction to Chemistry Techniques ²	3
STAT 1150 or STAT 1000	Introduction to Statistics and Computing ³ or Basic Statistical Analysis 1	3
Hours		18

Years 1-2

In Year 1 or Year 2 the following must be completed:		
3 credit hours of Mathematics or Physics chosen from:		3
MATH 1240	Elementary Discrete Mathematics ⁴	
MATH 1300	Vector Geometry and Linear Algebra ⁴	
MATH 1500	Introduction to Calculus ⁴	
PHYS 1020 or PHYS 1050	General Physics 1 or Physics 1: Mechanics	
6 credit hours from the Faculty of Arts, including a required "W" course		6
6 credit hours of electives		6
Hours		15

Year 2

BIOL 2300	Principles of Ecology	3
BIOL 2500	Genetics 1	3
BIOL 2520	Cell Biology	3
Select A or B:		9
A: ⁵		
CHEM/MBIO 2700	Biochemistry 1: Biomolecules and an Introduction to Metabolic Energy	
CHEM/MBIO 2710	Biochemistry 2: Catabolism, Synthesis, and Information Pathways	
CHEM 2720	Principles and Practices of the Modern Biochemistry Laboratory	
B: ⁵		
CHEM/MBIO 2730	Elements of Biochemistry 1	
CHEM/MBIO 2750	Elements of Biochemistry 2	
CHEM 2740	Introduction to the Biochemistry Laboratory	
BIOL 2200 or BIOL 2210	The Invertebrates or The Chordates	3

One of:		3
BIOL 2240	The Non-Flowering Plants	
BIOL 2242	The Flowering Plants	
BIOL 2260	Biology of Fungi and Lichens	
BIOL 2262	Biology of Algae	
One additional course from:		3
BIOL 2200	The Invertebrates	
BIOL 2210	The Chordates	
BIOL 2240	The Non-Flowering Plants	
BIOL 2242	The Flowering Plants	
BIOL 2260	Biology of Fungi and Lichens	
BIOL 2262	Biology of Algae	
BIOL 2420	Human Physiology 2	
BIOL 2600	Introduction to Computational Biology	
CHEM 2100	Organic Chemistry 1: Foundations of Organic Chemistry ⁵	
Hours		27

Year 3

Co-op Requirements (if selected):

SCI 3980	Co-operative Education Work Term 1	0
SCI 3990	Co-operative Education Work Term 2	0
Hours		0

Years 3-4

BIOL 3300	Evolutionary Biology	3
BIOL 3542	Developmental Biology ⁶	3
One of:		3
BIOL 3400	Plant Physiology	
BIOL 3470	Environmental Physiology of Animals 1	
BIOL 3472	Environmental Physiology of Animals 2	
30 credit hours of 3000 or 4000 level Biology courses ⁷		30
21 credit hours of electives		21
Hours		60

Year 4

Co-op Requirements (if selected):

SCI 4980	Co-operative Education Work Term 3	0
SCI 4990	Co-operative Education Work Term 4 (if a 4th work term is selected)	0
Hours		0
Total Hours		120

¹ The program need not be completed in the manner prescribed in the grid above. The grid indicates one possible arrangement of the 120 credit hours that makes up the degree and are meant to be a guide around which students can plan their program with a view to satisfying the prerequisites of the required courses. These 120 credit hours are a combination of the courses outlined in the grid above and elective courses chosen by the student in consultation with the program advisors.

² The former courses CHEM 1300 and CHEM 1310 may be used in place of CHEM 1100, CHEM 1110, and CHEM 1120. CHEM 1122 and CHEM 1126 may be used in lieu of CHEM 1120.

³ STAT 1150 is recommended over STAT 1000.

- 4 • MATH 1230, MATH 1510, MATH 1520, or MATH 1690 may be taken in place of MATH 1500;
• MATH 1220 or MATH 1310 may be taken in place of MATH 1300;
• MATH 1200 may be used in place of MATH 1240.
- 5 Students are strongly recommended to complete their biochemistry requirements in their second year. The former courses CHEM 2360 (MBIO 2360) and CHEM 2370 (MBIO 2370) may be used in place of CHEM 2700 (MBIO 2700), CHEM 2710 (MBIO 2710), and CHEM 2720. The former courses CHEM 2770 (MBIO 2770) and CHEM 2780 (MBIO 2780) may be used in place of CHEM 2730 (MBIO 2730), CHEM 2740, and CHEM 2750 (MBIO 2750). If the choice of Biochemistry courses includes the requirement of CHEM 2100, CHEM 2100 can be used as the additional course listed above. The former CHEM 2210 may be used in place of CHEM 2100.
- 6 The former BIOL 2540 may be used in place of BIOL 3542.
- 7 Courses from other departments or faculties may be acceptable for use towards the 30 credit hours of 3000/4000 level Biological Sciences courses required in the Major Degree program. Please consult with the theme advisor for permission to use alternate courses.

(Letters in brackets indicate minimum prerequisite standing for further study.)

Four Year Major: Ecology and Environmental Biology Theme (Including Co-operative Option)

Important Note¹

Course	Title	Hours
Year 1		
BIOL 1020	Biology 1: Principles and Themes	3
BIOL 1030	Biology 2: Biological Diversity, Function and Interactions (C+)	3
CHEM 1100	Introductory Chemistry 1: Atomic and Molecular Structure and Energetics	3
CHEM 1120	Introduction to Chemistry Techniques ²	3
STAT 1150 or STAT 1000	Introduction to Statistics and Computing ³ or Basic Statistical Analysis 1	3
Hours		15
Years 1-2		
In Year 1 or Year 2 the following must be completed:		
3 credit hours of Mathematics or Physics chosen from:		3
MATH 1240	Elementary Discrete Mathematics ⁴	
MATH 1300	Vector Geometry and Linear Algebra ⁴	
MATH 1500	Introduction to Calculus ⁴	
PHYS 1020 or PHYS 1050	General Physics 1 or Physics 1: Mechanics	
6 credit hours from the Faculty of Arts, including a required "W" course		6
15 credit hours of electives		15
Hours		24
Year 2		
BIOL 2300	Principles of Ecology	3
BIOL 2500	Genetics 1	3
BIOL 2520	Cell Biology	3
BIOL 2200 or BIOL 2210	The Invertebrates or The Chordates	3

One of:		3
BIOL 2240	The Non-Flowering Plants	
BIOL 2242	The Flowering Plants	
BIOL 2260	Biology of Fungi and Lichens	
BIOL 2262	Biology of Algae	
One additional course from:		3
BIOL 2200	The Invertebrates	
BIOL 2210	The Chordates	
BIOL 2240	The Non-Flowering Plants	
BIOL 2242	The Flowering Plants	
BIOL 2260	Biology of Fungi and Lichens	
BIOL 2262	Biology of Algae	
BIOL 2600	Introduction to Computational Biology	
STAT 2150 or STAT 2000	Statistics and Computing ^{3,4} or Basic Statistical Analysis 2	3
Hours		21

Year 3

Co-op Requirements (if selected):

SCI 3980	Co-operative Education Work Term 1	0
SCI 3990	Co-operative Education Work Term 2	0
Hours		0

Years 3-4

BIOL 3300	Evolutionary Biology	3
BIOL 3310	Foundations of Population Ecology	3
BIOL 3312	Community Ecology	3
BIOL 3314	Field Ecology ⁵	3
One of:		3
BIOL 3400	Plant Physiology	
BIOL 3470	Environmental Physiology of Animals 1	
BIOL 3472	Environmental Physiology of Animals 2	
21 credit hours of 3000 or 4000 level Biology courses ⁶		21
24 credit hours of electives		24
Hours		60

Year 4

Co-op Requirements (if selected):

SCI 4980	Co-operative Education Work Term 3	0
SCI 4990	Co-operative Education Work Term 4 (if a 4th work term is selected)	0
Hours		0

Total Hours **120**

¹ The program need not be completed in the manner prescribed in the grid above. The grid indicates one possible arrangement of the 120 credit hours that makes up the degree and is meant to be a guide around which students can plan their program with a view to satisfying the prerequisites of the required courses. These 120 credit hours are a combination of the courses outlined in the grid above and elective courses chosen by the student in consultation with the program advisors.

² The former courses CHEM 1300 and CHEM 1310 may be used in place of CHEM 1100 and CHEM 1120. CHEM 1122 and CHEM 1126 may be used in lieu of CHEM 1120.

³ STAT 1150 is strongly recommended over STAT 1000; and STAT 2150 is strongly recommended over STAT 2000.

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- MATH 1230, MATH 1510, MATH 1520, or MATH 1690 may be taken in place of MATH 1500;
 - MATH 1220 or MATH 1310 may be taken in place of MATH 1300;
 - MATH 1200 may be used in place of MATH 1240.

Note that STAT 2150 has a prerequisite which requires one of MATH 1230, MATH 1500, MATH 1510, or MATH 1690.

- ⁵ With departmental approval, other Field Ecology courses may be used in place of BIOL 3314. A list of possible courses can be found on the Departmental Website (<http://sci.umanitoba.ca/biological-sciences/>).

- ⁶ Courses from other departments or faculties may be acceptable for use towards the 21 credit hours of 3000/4000 level Biological Sciences courses required in the Major Degree program. Please consult with the theme advisor for permission to use alternate courses.

(Letters in brackets indicate minimum prerequisite standing for further study.)

Four Year Major: Environmental and Integrative Physiology Theme (Including Co-operative Option)

Important Note¹

Course	Title	Hours
Year 1		
BIOL 1020	Biology 1: Principles and Themes	3
BIOL 1030	Biology 2: Biological Diversity, Function and Interactions (C+)	3
CHEM 1100	Introductory Chemistry 1: Atomic and Molecular Structure and Energetics	3
CHEM 1110	Introductory Chemistry 2: Interaction, Reactivity, and Chemical Properties	3
CHEM 1120	Introduction to Chemistry Techniques ²	3
STAT 1150 or STAT 1000	Introduction to Statistics and Computing ³ or Basic Statistical Analysis 1	3
Hours		18
Years 1-2		
In Year 1 or Year 2 the following must be completed:		
3 credit hours of Mathematics or Physics chosen from:		3
MATH 1240	Elementary Discrete Mathematics ⁴	
MATH 1300	Vector Geometry and Linear Algebra ⁴	
MATH 1500	Introduction to Calculus ⁴	
PHYS 1020 or PHYS 1050	General Physics 1 or Physics 1: Mechanics	
6 credit hours from the Faculty of Arts, including a required "W" course		6
3-6 credit hour of electives ⁵		3-6
Hours		15
Year 2		
BIOL 2300	Principles of Ecology	3
BIOL 2500	Genetics 1	3
BIOL 2520	Cell Biology	3
BIOL 2200 or BIOL 2210	The Invertebrates or The Chordates	3
One of:		3
BIOL 2240	The Non-Flowering Plants	

BIOL 2242	The Flowering Plants	
BIOL 2260	Biology of Fungi and Lichens	
BIOL 2262	Biology of Algae	
One additional course from:		3
BIOL 2200	The Invertebrates	
BIOL 2210	The Chordates	
BIOL 2240	The Non-Flowering Plants	
BIOL 2242	The Flowering Plants	
BIOL 2260	Biology of Fungi and Lichens	
BIOL 2262	Biology of Algae	
BIOL 2420	Human Physiology 2	
BIOL 2600	Introduction to Computational Biology	
Select A or B:		9
A: ⁵		
CHEM/MBIO 2700	Biochemistry 1: Biomolecules and an Introduction to Metabolic Energy	
CHEM/MBIO 2710	Biochemistry 2: Catabolism, Synthesis, and Information Pathways	
CHEM 2720	Principles and Practices of the Modern Biochemistry Laboratory	
B: ⁵		
CHEM/MBIO 2730	Elements of Biochemistry 1	
CHEM/MBIO 2750	Elements of Biochemistry 2	
CHEM 2740	Introduction to the Biochemistry Laboratory	
Hours		27
Year 3		
Co-op Requirements (if selected):		
SCI 3980	Co-operative Education Work Term 1	0
SCI 3990	Co-operative Education Work Term 2	0
Hours		0
Years 3-4		
BIOL 3300	Evolutionary Biology	3
Three of:		9
BIOL 3400	Plant Physiology	
BIOL 3452	Environmental Plant Physiology	
BIOL 3470	Environmental Physiology of Animals 1	
BIOL 3472	Environmental Physiology of Animals 2	
24 credit hours of 3000 or 4000 level Biology courses ⁶		24
24 credit hours of electives		24
Hours		60
Year 4		
Co-op Requirements (if selected):		
SCI 4980	Co-operative Education Work Term 3	0
SCI 4990	Co-operative Education Work Term 4 (if a 4th work term is selected)	0
Hours		0
Total Hours		120

¹ The program need not be completed in the manner prescribed in the grid above. The grid indicates one possible arrangement of the 120 credit hours that make up the degree and is meant to be a guide around which students can plan their program with a view to satisfying the prerequisites of the required courses. These 120 credit hours are a combination of the courses outlined in the grid above and elective courses chosen by the student in consultation with the program advisors.

² The former courses CHEM 1300 and CHEM 1310 may be used in place of CHEM 1100, CHEM 1110, and CHEM 1120. CHEM 1122 and CHEM 1126 may be used in lieu of CHEM 1120.

³ STAT 1150 is recommended over STAT 1000.

⁴ • MATH 1230, MATH 1510, MATH 1520, or MATH 1690 may be taken in place of MATH 1500;
• MATH 1220 or MATH 1310 may be taken in place of MATH 1300;
• MATH 1200 may be used in place of MATH 1240.

⁵ The former courses CHEM 2360 (MBIO 2360) and CHEM 2370 (MBIO 2370) may be used in place of CHEM 2700 (MBIO 2700), CHEM 2710 (MBIO 2710), and CHEM 2720. The former courses CHEM 2770 (MBIO 2770) and CHEM 2780 (MBIO 2780) may be used in place of CHEM 2730 (MBIO 2730), CHEM 2740, and CHEM 2750 (MBIO 2750). Number of credit hours of electives depends on the choice of Biochemistry courses and the inclusion of CHEM 2100 (or the former CHEM 2210).

⁶ Courses from other departments or faculties may be acceptable for use towards the 24 credit hours of 3000/4000 level Biological Sciences courses required in the Major Degree program. Please consult with the theme advisor for permission to use alternate courses.

(Letters in brackets indicate minimum prerequisite standing for further study.)

Four Year Major: Evolution and Biodiversity Theme (Including Co-operative Option)

Important Note¹

Course	Title	Hours
Year 1		
BIOL 1020	Biology 1: Principles and Themes	3
BIOL 1030	Biology 2: Biological Diversity, Function and Interactions (C+)	3
CHEM 1100	Introductory Chemistry 1: Atomic and Molecular Structure and Energetics	3
CHEM 1120	Introduction to Chemistry Techniques ²	3
STAT 1150 or STAT 1000	Introduction to Statistics and Computing ³ or Basic Statistical Analysis 1	3
Hours		15

Years 1-2

In Year 1 or Year 2 the following must be completed:

3 credit hours of Mathematics or Physics chosen from:		3
MATH 1240	Elementary Discrete Mathematics ⁴	
MATH 1300	Vector Geometry and Linear Algebra ⁴	
MATH 1500	Introduction to Calculus ⁴	
PHYS 1020 or PHYS 1050	General Physics 1 or Physics 1: Mechanics	

6 credit hours from the Faculty of Arts, including a required "W" course 6

15 credit hours of electives	15
Hours	24

Year 2

BIOL 2300	Principles of Ecology	3
BIOL 2500	Genetics 1	3
BIOL 2520	Cell Biology	3
BIOL 2200 or BIOL 2210	The Invertebrates or The Chordates	3
One of:		3
BIOL 2240	The Non-Flowering Plants	
BIOL 2242	The Flowering Plants	
BIOL 2260	Biology of Fungi and Lichens	
BIOL 2262	Biology of Algae	
One additional course from:		3
BIOL 2200	The Invertebrates	
BIOL 2210	The Chordates	
BIOL 2240	The Non-Flowering Plants	
BIOL 2242	The Flowering Plants	
BIOL 2260	Biology of Fungi and Lichens	
BIOL 2262	Biology of Algae	
STAT 2150 or STAT 2000	Statistics and Computing ^{3,4} or Basic Statistical Analysis 2	3
Hours		21

Year 3

Co-op Requirements (if selected):

SCI 3980	Co-operative Education Work Term 1	0
SCI 3990	Co-operative Education Work Term 2	0
Hours		0

Years 3-4

BIOL 3300	Evolutionary Biology	3
One of:		3
BIOL 3360	Animal Behaviour	
BIOL 4300	Evolution and Adaptation	
BIOL 4362	Behavioural Ecology and Cognitive Ethology	
BIOL 4510	Evolutionary Genetics	
One of:		3
BIOL 3200	Advanced Invertebrate Biology	
BIOL 3242	Vascular Flora of Manitoba	
BIOL 3250	Lichens and Bryophytes	
BIOL 3270	Introductory Parasitology	
BIOL 3340	Biology of Primitive Fungi and Allies	
BIOL 4212	Systematics and Biogeography of Fishes	
BIOL 4214	Biology of Amphibians and Reptiles	
BIOL 4216	Biology of Birds	
BIOL 4218	Biology of Mammals	
One of:		3
BIOL 3400	Plant Physiology	
BIOL 3470	Environmental Physiology of Animals 1	
BIOL 3472	Environmental Physiology of Animals 2	
24 credit hours of 3000 or 4000 level Biology courses ⁵		24

24 credit hours of electives	24
Hours	60
Year 4	
Co-op Requirements (if selected):	
SCI 4980 Co-operative Education Work Term 3	0
SCI 4990 Co-operative Education Work Term 4 (if a 4th work term is selected)	0
Hours	0
Total Hours	120

¹ The program need not be completed in the manner prescribed in the grid above. The grid indicates one possible arrangement of the 120 credit hours that make up the degree and is meant to be a guide around which students can plan their program with a view to satisfying the prerequisites of the required courses. These 120 credit hours are a combination of the courses outlined in the grid above and elective courses chosen by the student in consultation with the program advisors.

² The former courses CHEM 1300 and CHEM 1310 may be used in place of CHEM 1100 and CHEM 1120. CHEM 1122 and CHEM 1126 may be used in lieu of CHEM 1120.

³ STAT 1150 is recommended over STAT 1000; and STAT 2150 is strongly recommended over STAT 2000.

⁴

- MATH 1230, MATH 1510, MATH 1520, or MATH 1690 may be taken in place of MATH 1500;
- MATH 1220 or MATH 1310 may be taken in place of MATH 1300;
- MATH 1200 may be used in place of MATH 1240.

Note that STAT 2150 has a prerequisite of one of MATH 1230, MATH 1500, MATH 1510, or MATH 1690.

⁵ Courses from other departments or faculties may be acceptable for use towards the 24 credit hours of 3000/4000 level Biological Sciences courses required in the Major Degree program. Please consult with the theme advisor for permission to use alternate courses.

(Letters in brackets indicate minimum prerequisite standing for further study.)

Four Year Major: Integrative Biology Theme (Including Co-operative Option)

Important Note¹

Course	Title	Hours
Year 1		
BIOL 1020	Biology 1: Principles and Themes	3
BIOL 1030	Biology 2: Biological Diversity, Function and Interactions (C+)	3
CHEM 1100	Introductory Chemistry 1: Atomic and Molecular Structure and Energetics	3
CHEM 1110	Introductory Chemistry 2: Interaction, Reactivity, and Chemical Properties	3
CHEM 1120	Introduction to Chemistry Techniques ²	3
MBIO 1010	Microbiology I	3
STAT 1150 or STAT 1000	Introduction to Statistics and Computing ³ or Basic Statistical Analysis 1	3
Hours		21

Years 1-2

In Year 1 or Year 2 the following must be completed:

3 credit hours of Mathematics or Physics chosen from:	3
MATH 1240 Elementary Discrete Mathematics ⁴	
MATH 1300 Vector Geometry and Linear Algebra ⁴	
MATH 1500 Introduction to Calculus ⁴	
PHYS 1020 General Physics 1 or PHYS 1050 or Physics 1: Mechanics	
6 credit hours from the Faculty of Arts, including a required "W" course	6
0-3 credit hours of electives ⁵	0-3

Hours	12
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Year 2

BIOL 2300 Principles of Ecology	3
BIOL 2500 Genetics 1	3
BIOL 2520 Cell Biology	3
Three of:	9
BIOL 2200 The Invertebrates (theme course)	
BIOL 2210 The Chordates (theme course)	
BIOL 2240 The Non-Flowering Plants (theme course)	
BIOL 2242 The Flowering Plants (theme course)	

One additional course from:	3
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BIOL 2200 The Invertebrates	
BIOL 2210 The Chordates	
BIOL 2240 The Non-Flowering Plants	
BIOL 2242 The Flowering Plants	
BIOL 2260 Biology of Fungi and Lichens	
BIOL 2262 Biology of Algae	
BIOL 2420 Human Physiology 2	
BIOL 2600 Introduction to Computational Biology	

Select A or B:	6
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A - two of: ⁵	
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CHEM/MBIO 2700 Biochemistry 1: Biomolecules and an Introduction to Metabolic Energy	
CHEM/MBIO 2710 Biochemistry 2: Catabolism, Synthesis, and Information Pathways	
CHEM 2720 Principles and Practices of the Modern Biochemistry Laboratory	

B - two of: ⁵	
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CHEM/MBIO 2730 Elements of Biochemistry 1	
CHEM/MBIO 2750 Elements of Biochemistry 2	
CHEM 2740 Introduction to the Biochemistry Laboratory	

Hours	27
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Year 3

Co-op Requirements (if selected):

SCI 3980 Co-operative Education Work Term 1	0
SCI 3990 Co-operative Education Work Term 2	0

Hours	0
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Years 3-4

BIOL 3300 Evolutionary Biology	3
One of:	3
BIOL 3400 Plant Physiology	

BIOL 3470	Environmental Physiology of Animals 1	
BIOL 3472	Environmental Physiology of Animals 2	
24 credit hours of 3000 or 4000 level Biology courses ⁶		24
6 credit hours of 3000 or 4000 level Microbiology courses ⁷		6
24 credit hours of electives		24
Hours		60
Year 4		
Co-op Requirements (if selected):		
SCI 4980	Co-operative Education Work Term 3	0
SCI 4990	Co-operative Education Work Term 4 (if a 4th work term is selected)	0
Hours		0
Total Hours		120

¹ The program need not be completed in the manner prescribed in the grid above. The grid indicates one possible arrangement of the 120 credit hours that make up the degree and are meant to be a guide around which students can plan their program with a view to satisfying the prerequisites of the required courses. These 120 credit hours are a combination of the courses outlined in the grid above and elective courses chosen by the student in consultation with the program advisors.

² The former courses CHEM 1300 and CHEM 1310 may be used in place of CHEM 1100, CHEM 1110, and CHEM 1120. CHEM 1122 and CHEM 1126 may be used in lieu of CHEM 1120.

³ STAT 1150 is recommended over STAT 1000.

⁴

- MATH 1230, MATH 1510, MATH 1520, or MATH 1690 may be taken in place of MATH 1500;
- MATH 1220 or MATH 1310 may be taken in place of MATH 1300;
- MATH 1200 may be used in place of MATH 1240.

⁵ The former courses CHEM 2360 (MBIO 2360) and CHEM 2370 (MBIO 2370) may be used in place of CHEM 2700 (MBIO 2700), CHEM 2710 (MBIO 2710), and CHEM 2720. The former courses CHEM 2770 (MBIO 2770) and CHEM 2780 (MBIO 2780) may be used in place of CHEM 2730 (MBIO 2730), CHEM 2740, and CHEM 2750 (MBIO 2750). Number of credit hours of electives depends on the choice of Biochemistry courses and the inclusion of CHEM 2100 (or the former CHEM 2210).

⁶ Courses from other departments or faculties may be acceptable for use towards the 24 credit hours of 3000/4000 level Biological Sciences courses required in the Major Degree program. Please consult with the theme advisor for permission to use alternate courses.

⁷ Many MBIO courses have specific biochemistry requirements. Students are advised to plan ahead to take all required courses. If a student takes more than 6 credit hours of biochemistry, they will count as electives.

(Letters in brackets indicate minimum prerequisite standing for further study.)