

# BIOCHEMISTRY, B.SC. MAJOR

## Biochemistry Major Entrance, Continuation, and Graduation Requirements

To **enter** the joint four year Major program, a student must have completed a minimum of 24 credit hours with a minimum DGPA of 2.00, and also obtained a minimum grade of "C+" in CHEM 1110, and a minimum grade of "C" in CHEM 1120 and BIOL 1020. CHEM 1100, BIOL 1030, PHYS 1050 (or PHYS 1020), MATH 1500, STAT 1150 (or STAT 1000), and 6 credit hours from the Faculty of Arts, including a course that satisfies the "W" requirement are required courses in the program and students are strongly encouraged to complete these courses in first year.

To **continue** in the Bachelor of Science Major degree program, students must maintain a minimum DGPA of 2.00.

To **graduate** with the Bachelor of Science Major in Biochemistry, a student must complete 120 credit hours or more, with minimum grades of "C" on all Major Program Specific courses (see below), passing grades ("D" or better) on the remaining courses, and a minimum DGPA of 2.00.

### Major Program Specific Courses

#### Chemistry

Course	Title	Hours
CHEM 2100	Organic Chemistry 1: Foundations of Organic Chemistry	3
CHEM 2110	Organic Chemistry 2: Foundations of Organic Synthesis	3
CHEM 2122	Experimental Organic Chemistry	3
CHEM 2510	Introduction to Analytical Chemistry	3
CHEM 2520	Introduction to Analytical Chemistry Techniques	2
CHEM/MBIO 2700	Biochemistry 1: Biomolecules and an Introduction to Metabolic Energy	3
CHEM/MBIO 2710	Biochemistry 2: Catabolism, Synthesis, and Information Pathways	3
CHEM 2720	Principles and Practices of the Modern Biochemistry Laboratory	3
CHEM 3700	Biophysical Chemistry	3
CHEM 3760	Advanced Methods for the Biochemistry Laboratory	4
CHEM 4360 or CHEM 4620	Signalling and Regulation of Gene Expression Biochemistry of Nucleic Acids	3
CHEM 4630	Biochemistry of Proteins	3

#### MICROBIOLOGY

Course	Title	Hours
MBIO 1010	Microbiology I	3
MBIO 2020	Microbiology II	3
MBIO 3410	Molecular Biology	3
One of the following:		3
BIOL 2520	Cell Biology	
MBIO 3450	Regulation of Biochemical Processes	
MBIO 3460	Membrane and Cellular Biochemistry	

MBIO 4540	Biological Energy Transduction
MBIO 4612	Molecular Genetics of Eukaryotes - Lectures

Students in this program should note the following:

Students must satisfy any course prerequisites and co-requisites for courses selected. Care should be taken to select courses in their proper sequence, e.g. CHEM 2710 (MBIO 2710) and MBIO 2020 should be taken in Year 2 as they are prerequisite to a number of subsequent required or optional courses.

Normally 4000 level courses are available only to students in their fourth year. MBIO 4530 and MBIO 4670 are not available to Major students.

Students are encouraged to elect other courses pertinent to the study of biochemistry although this is not required for completion of the degree. The departments of Microbiology and Chemistry will be glad to suggest such supplementary courses upon request.

Students who may wish to transfer to the Honours program in Biochemistry following Year 2 should be sure to complete all courses recommended in Year 2 (see program chart (<https://catalog.umanitoba.ca/undergraduate-studies/science/biochemistry/biochemistry-bsc-joint-honours/#degreerequirementstext>)).

## Major Co-operative Option

A co-operative education option is available for Major students. Students should refer to the Co-operative Education (p. 2) for further information on the Co-op programs.

The course and minimum grade requirements for entry and continuation in the Co-operative Option are the same as those required for the regular Major program. However, the entry and continuation DGPA requirement is set at a minimum of 2.5.

Students are encouraged, but not required, to take 15 credit hours in each academic term in the third and subsequent years. Students are required to complete the first and second year requirements of the program and MBIO 3410 before beginning their first co-op work term.

## Degree Requirements

### Four Year Major (Including Co-operative Option if Selected)<sup>1,2</sup>

Course	Title	Hours
<b>Year 1</b>		
CHEM 1100	Introductory Chemistry 1: Atomic and Molecular Structure and Energetics	3
CHEM 1110	Introductory Chemistry 2: Interaction, Reactivity, and Chemical Properties (C+)	3
CHEM 1120	Introduction to Chemical Techniques (C) <sup>3</sup>	3
BIOL 1020	Biology 1: Principles and Themes (C)	3
BIOL 1030	Biology 2: Biological Diversity, Function and Interactions	3
PHYS 1050 or PHYS 1020	Physics 1: Mechanics or General Physics 1	3
MATH 1500	Introduction to Calculus <sup>4</sup>	3
STAT 1150 or STAT 1000	Introduction to Statistics and Computing or Basic Statistical Analysis 1	3
<b>Hours</b>		<b>24</b>

**Years 1-2**

In Year 1 or Year 2 the following must be completed:	
6 credit hours from the Faculty of Arts including the University Written English "W" requirement <sup>5</sup>	6
<b>Hours</b>	<b>6</b>

**Year 2**

CHEM 2100	Organic Chemistry 1: Foundations of Organic Chemistry	3
CHEM 2110	Organic Chemistry 2: Foundations of Organic Synthesis	3
CHEM 2122	Experimental Organic Chemistry	3
CHEM 2510	Introduction to Analytical Chemistry	3
CHEM 2520	Introduction to Analytical Chemistry Techniques	2
CHEM 2700	Biochemistry 1: Biomolecules and an Introduction to Metabolic Energy	3
CHEM 2710	Biochemistry 2: Catabolism, Synthesis, and Information Pathways	3
CHEM 2720	Principles and Practices of the Modern Biochemistry Laboratory	3
MBIO 1010	Microbiology I <sup>6</sup>	3
MBIO 2020	Microbiology II	3
<b>Hours</b>		<b>29</b>

**Year 3**

CHEM 3700	Biophysical Chemistry	3
CHEM 3760	Advanced Methods for the Biochemistry Laboratory	4
MBIO 3410	Molecular Biology	3
<b>Hours</b>		<b>10</b>

**Years 3-4**

One of:		3
BIOL 2520	Cell Biology	
MBIO 3450	Regulation of Biochemical Processes	
MBIO 3460	Membrane and Cellular Biochemistry	
MBIO 4540	Biological Energy Transduction	
MBIO 4612	Molecular Genetics of Eukaryotes - Lectures	
CHEM 4360 or CHEM 4620	Signalling and Regulation of Gene Expression or Biochemistry of Nucleic Acids	3
21 credit hours of Chemistry and Microbiology (minimum of 6 credit hours from each department). Of these 21 credit hours, at least 12 hours must be 4000 level courses.		21
21 credit hours of electives <sup>7</sup>		21
<b>Co-op Requirements (if selected):</b>		
SCI 3980	Co-operative Education Work Term 1	0
SCI 3990	Co-operative Education Work Term 2	0
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
<b>Hours</b>		<b>48</b>

**Year 4**

CHEM 4630	Biochemistry of Proteins	3
<b>Hours</b>		<b>3</b>
<b>Total Hours</b>		<b>120</b>

<sup>1</sup> IMPORTANT: Students in the co-operative program must ensure that they are able to satisfy the prerequisites for all 3000 and 4000 level courses they plan to take.

<sup>2</sup> The four year Major program need not be completed in the manner prescribed above. This indicates one possible arrangement of the required courses and is meant to be a guide around which students can plan their program.

<sup>3</sup> CHEM 1126 may be used in lieu of CHEM 1120.

<sup>4</sup> MATH 1230 or MATH 1510 or MATH 1520 or MATH 1690 may be taken in place of MATH 1500.

<sup>5</sup> As there are no electives in Year 2 of the program, students should complete the university written English requirement in Year 1. If not completed in Year 1, a "W" course must be completed prior to Year 3 in addition to the required Year 2 courses.

<sup>6</sup> MBIO 1010 can be taken in Year 1 after BIOL 1020.

<sup>7</sup> MATH 1010, MATH 1020, the former MATH 1190, the former COMP 1260, the former COMP 1270, COMP 1500 and COMP 1600 may not be chosen to satisfy this requirement.

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

**Co-operative Education****Co-operative Education Option Academic Regulations: B.Sc. (Major) & B.Sc. and B.C.Sc. (Honours)**

Co-operative education is a form of experiential learning which integrates the academic education (classroom-based learning) of interested and qualified students with relevant, supervised, and paid work experience (work-based learning) with employers. Co-op students gain valuable skills to guide them through their academic education and prepare them for future careers after graduation.

The Faculty of Science offers a Co-operative Education Option in the following Major programs:

- Biochemistry
- Biological Sciences
- Biotechnology (As of Fall 2018, admission to the Biotechnology programs has been temporarily suspended. For further information, see the Faculty of Science office.)
- Chemistry
- Computer Science
- Data Science
- Genetics
- Mathematics
- Microbiology
- Physics & Astronomy
- Psychology
- Statistics.

The Honours programs offering a Co-operative Education Option are:

- Biochemistry
- Biological Sciences
- Biotechnology (As of Fall 2018, admission to the Biotechnology programs has been temporarily suspended. For further information, see the Faculty of Science office.)
- Chemistry
- Computer Science
- Genetics
- Mathematics
- Microbiology
- Physics & Astronomy
- Statistics
- Joint Computer Science – Mathematics
- Joint Computer Science – Physics and Astronomy
- Joint Computer Science – Statistics
- Joint Mathematics – Physics and Astronomy
- Joint Statistics – Mathematics program.

Co-operative education is optional and supplementary to academic requirements of the chosen degree. All regulations governing regular Major and Honours programs apply to the Co-operative Education Option. In addition, the following variations apply:

### Entrance

To enter the Co-operative Education Option a student must be eligible to enter the Major or Honours program offered by the department. At the time of application, students must have a minimum Degree Grade Point Average (DGPA) of 2.5 for the Major and 3.0 for the Honours Programs. For Psychology, students must have a minimum Degree Grade Point Average (DGPA) of 3.0 for the Major. Co-op is not available for students in the Honours Psychology Program.

The normal point of entry to the Co-operative Education Option is following the completion of second year in the Faculty of Science. Students seeking admission will submit an application during their second year and complete an intake process with the appropriate departmental Co-op Coordinator. Application deadlines are established by the Science Co-op Office.

Students are advised that satisfying the entrance requirements does not guarantee a place in the Co-operative Education Option. The Science Co-op Office reserves the right to determine and select the best-qualified applicants.

Students admitted into the Co-operative Education Option will complete pre-employment training, including workshops, prior to the start of their first co-op work term. The structure and content of this training is developed by the Science Co-op Office. Attendance and completion of this training is mandatory.

### Structure and Sequencing

The Co-operative Education Option consists of both academic terms and co-op work terms.

Each academic term can be either four months in duration or eight months in duration, as designated by the Major or Honours department.

Each co-op work term can be either four months in duration or eight months in duration, as designated by the Science Co-op Office. An eight month work term would be counted as the equivalent of two 4 month terms.

Each academic term and each co-op work term will commence in January, May or September.

The sequence of academic terms and co-op work terms is variable to suit the needs of each department, and is designated by the Science Co-op Office in conjunction with each Major or Honours department. All Faculty of Science Co-operative Education Options must end on an academic term.

Students are expected to follow the academic/co-op work term sequence defined by their Major or Honours department from admission through to graduation.

### Co-op Work Term Requirements

All Co-operative Education Options require participating students to complete at least three (3) 4-month co-op work terms for a total of a minimum of 12 months' work experience. Each co-op work term is completed with one employer.

Students are required to register in the appropriate co-op work term course and pay the work term fee prior to starting their co-op work term.

Co-operative Education Option students are required to submit a work term report at the end of each co-op work term. These reports are due at times designated by the Science Co-op Office. In order to remain in the Co-operative Education program, a student must obtain a grade of "Pass" for each work term report. The Science Co-op Office will provide students with instructions regarding the content and format requirements of the work term reports.

While on a co-op work term, students are not permitted to take more than six hours of academic credit, and may not take more than one course at a time.

### Academic Term Requirements

Coursework requirements of the Co-operative Education Option are equivalent to the coursework requirements of the four-year Major program. For students completing an Honours program, the coursework requirements of the Co-operative Education Option are equivalent to the coursework requirements of the Honours program with the exception of the Biochemistry, Biotechnology, Genetics and Microbiology programs.

Co-operative Education Option students are required to maintain full-time study while registered for an academic term.

To continue in a four year Major Co-operative Education Option, students must maintain a minimum DGPA of 2.50 at each point of assessment; except for students in Psychology where a minimum DGPA of 3.00 must be maintained at each point of assessment. A student's performance will be evaluated following each academic term. In addition, the student must meet all individual course prerequisites for further study and departmental continuation and graduation requirements. Please see department entries for further information. Continuation in the Major Co-operative Education Option is also contingent upon satisfactory performance during co-op work terms.

To continue in an Honours Co-operative Education Option a student must maintain a minimum DGPA of 3.00 or higher at each point of assessment. A student's performance will be evaluated following each academic term. In addition, the student must meet all individual course prerequisites for further study and departmental continuation and graduation requirements. Please see department entries for further information. Continuation in the Honours Co-operative Education Option

is also contingent upon satisfactory performance during co-op work terms.

Students may be required to withdraw from the Co-operative Education Option for any of the following reasons:

- Failure to maintain the minimum academic requirements of the Faculty of Science and/or Major/Honours program.
- Failure to maintain the minimum credit hour requirements of the academic term in the co-op option.
- Unsatisfactory performance during a co-op work term.
- Failure to submit a co-op work term report or the submitted report does not achieve a "Pass" grade.
- Failure to observe the policies outlined in university governing documents related to Behavioural Policies and Academic Misconduct.
- Having consulted with the Co-op Director and/or Faculty Advisor, in the opinion of the Co-op Coordinator, the student does not possess sufficient ability, skills, aptitude, attitude, diligence or motivation to successfully complete the Co-operative Education Option.

Students who wish to voluntarily withdraw from the Co-operative Education Option must obtain the written approval from their Co-op Coordinator and the Science Co-op Director. Students must submit their withdrawal request to their Co-op Coordinator and receive approval by the withdrawal dates set by the Science Co-op Office for each co-op work term.

Students are not normally permitted to withdraw from the Co-operative Education Option once they have secured a position for their co-op work term; whether the position was obtained through the Science Co-op Office or through students' own self-directed job search. Enrollment in the applicable co-op course(s) will be maintained and students are responsible for all assessed fees for the duration of the co-op work term and for meeting all academic requirements.

Students who accumulate more than 18 credit hours of failed courses after entering the four-year Major program (regardless of the origin of the grade or if the course has been repeated) will be required to withdraw from the Major Co-op program. Students are also subject to the academic assessment policy found in the Faculty Academic Regulations (<https://catalog.umanitoba.ca/undergraduate-studies/science/#facultyacademicregulationstext>).

Students who accumulate more than 15 credit hours of failed courses after entering the Honours degree program (regardless of the origin of the grade or if the course has been repeated) will be required to withdraw from the Honours Co-op program. Students required to withdraw from the Honours program may be eligible to pursue the B.Sc. Major program or the B.Sc. General degree program. Students are also subject to the academic assessment policy found in the Faculty Academic Regulations (<https://catalog.umanitoba.ca/undergraduate-studies/science/#facultyacademicregulationstext>).

Four year Major Co-operative Education Option students who are required to withdraw, or voluntarily revert to an alternative degree program must fulfil all academic requirements of that degree.

Honours Co-operative Education Option students who are required to withdraw or voluntarily revert to an alternative degree program must fulfill all academic requirements of that degree.