

Biochemistry and Molecular Biology

BMB Major Requirements: 2020

General information on the BMB Major: The BMB curriculum is an exciting, rigorous and extremely rewarding course of study that prepares undergraduates for employment in a wide range of scientific, technical, and educational fields. These include positions with university, government, and medical laboratories; positions related to science policy, patent law, biotechnology companies, food industries, clinical laboratories, and scientific equipment suppliers, to name a few. BMB graduates are well positioned to undertake Masters (MS) and PhD graduate work in areas such as agricultural biotechnology, genomics, molecular genetics, immunology, pharmacology, virology, physiology, and nutrition. Many BMB graduates go on to medical school, dental school, pharmacy school, physician's assistant programs, and advanced training in many other healthcare professions.

Four Foundational predictor courses: General Chemistry I, General Chemistry II, Calculus I and Calculus II

- Strong predictors of success in BMB and in science.
- Chemistry and Math essential for developing needed quantitative/organizational skills to do science.
- BMB majors should aim to earn B- or better in each of these four courses.
- BMB Continuation Policy: BMB majors have to achieve a GPA of 2.5 or better across these four courses in their first three semesters in order to continue in the BMB major.

Gateway Predictor course: Biochem 285 – Cellular & Molecular Biology

- BMB majors must achieve a B- or better in this course as a prerequisite for all other Biochem courses.
- Statistics show that earning below a B- in Biochem 285 frequently leads to earning below a C in upper level Biochemistry courses.

Commit yourself to doing well in predictor courses!

Many courses have prerequisites; it is up to the student to determine these and satisfy them. In addition to a minimum grade of B- in Biochem 285, BMB majors should achieve a C- or above in all other courses required for the major. For more information, visit the BMB website (www.umass.edu/biochem) for details about courses and advising.

BMB First Year (Freshman):

Introductory Biology:

Bio 151, Bio 152, Bio 153; BMB majors should earn a grade of C or better as a prerequisite for future courses.

- Bio 151, 152 and 153 cannot be replaced by advanced placement (AP) Biology credits and are not waived by the BMB department.
- Bio 153 can be taken concurrent with or after Bio 152.
- BIOTAP members take Bio 161H instead of Bio 151.

General Chemistry:

Chem 111 and 112 with lab (4 cr each)

- Requires a Math Placement Test score of 20 or above on Part A.
- Commonwealth Honors College (CHC) students take Chem 121H and 122H.
- Chem AP score of 4 or 5 is accepted as Chem 111 only.

Math options (BMB requires 3 semesters of math):

- Calc I
 - Math 127, requires Math Placement Test score of 20 or above on Part A; OR
 - Math 131, requires Math Placement Test score of 23 or above on Part A.
- Calc II (Math 128 or 132)
- 3rd Math/Stat:
 - One Statistics course: Approved statistics courses include Stats 240, Stats 501 (restricted to Junior and Senior students), Psych 240 (Psych majors only), and ResEcon 212.
 - Or Statistics Advanced Placement score of 4 or 5.
 - Calc III (Math 233, pre-req: Math 131 and 132; or Calculus AP credit) can be substituted.

College Writing: EnglWrit 112 College Writing is required for all first year students; EnglWrit 112H should be taken by CHC students. First year students need to take the writing placement test. Students may be exempted from the EnglWrit112 with an appropriate score on the placement test, or a 4 or 5 AP score in English **Language** and Composition exam.

General Education (GenEd) Course Requirements:

- BMB major requirements will fulfill 4 GenEd math and science requirements. BMB majors must take at least 5 additional GenEd courses (19 cr).
- BMB students should periodically check their Academic Requirements Report (ARR) in SPIRE for their progress on GenEd course requirements (please note that these requirements are determined by the University, *not* the BMB program). Students should direct all GenEd questions to the Records Office, 213 Whitmore; or see www.umass.edu/gened.

BMB Second Year (Sophomore):

Biochem 285: Cellular & Molecular Biology (offered Fall and Spring):

This is the first BIOCHEM course that BMB majors take (often taken in the fall semester, however taking this course in the spring semester is sufficient to stay on track for timely graduation).

- **A grade of B- or better is required** to continue in the BMB major.
- Prerequisites: Bio 151 (with a grade of C or better) AND Chem 111 (or 121H) AND Chem 112 (or 122H) with a grade of C- or better in both.
- Biochem 291H is a 1-credit seminar required for BMB majors who are CHC students; non-CHC BMB majors are encouraged to take the course and are accommodated as space permits.

Organic Chemistry:

- Chem 261 Prerequisite: Chem 112 or Chem 122H with a grade of C- or better.
- Chem 262 Prerequisite: Chem 261 or Chem 265 with a grade of C- or better.
- Chem 269 Prerequisite: Chem 261 or Chem 265 with a grade of C- or better.
 - o Chem 269 can be taken either concurrent with Chem 262 or in a subsequent semester. Students can take Chem 265, Chem 266, Chem 267 and Chem 268 with permission from the Chemistry Department.

Physics I and II:

- Introductory Physics: Physics 131, Physics 132, 4 cr each; OR
- General Physics: Physics 151, (with lab; co-requisite, Math 131), Physics 152 (with lab; prerequisites Physics 151, co- requisite Math 132) 4 cr each; OR
- Physics 181 Mechanics, Physics 182; Electricity and Magnetism (consent of instructor for non-Physics majors), 4 credits each.

Physics requirement can be covered by Advanced Placement scores; see the BMB Academic Advisor for details.

BMB Third and Fourth Years (Junior and Senior):

A grade of B- or better in Biochem 285 is required to take all of the following Biochem courses, and additional prerequisites are indicated below.

Introductory Biochemistry Lab: Biochem 276

Molecular Genetics and Genomics: Biochem 311; Prerequisites: Biology 151 with a grade of 'C' or better AND Biology 152 with a grade of 'C' or better. (Bio 311, Micro 330 or AnSci 311 can be substituted if necessary and, if so, cannot be counted towards required Advanced Elective credits).

Real World Biochemistry and Molecular Biology (IE): Biochem 394RI (Fall only). NatSci 494I (Spring only) also satisfies this requirement. Other departments' Integrative Experience (IE) courses may be taken to satisfy this requirement only with prior approval from a BMB Academic Advisor. (iCons students satisfy the IE requirement with different courses and should not take Biochem 394RI or NatSci 494I.)

General Biochemistry I: Biochem 423; Prerequisite: Chem 261 and Chem 262.

General Biochemistry II: Biochem 424; Prerequisite: Biochem 423, Chem 261, and Chem 262.

Advanced Biochemistry Lab: General Biochemistry Lab for Majors, Biochem 426; Prerequisite: Biochem 276 and Biochem 423.

Biochemistry Writing Seminar (JYW): Biochem 430H; Prerequisites: Biochem 423. (iCons students satisfy the junior year writing requirement with different courses so should not take Biochem 430H.)

Elementary Physical Chemistry: Biochem 471; Prerequisites: Chem 112, 122, or 122H AND Physics 132, 152 or 182 AND Math 128 or 132, all with a grade of C- or better.

Advanced Elective Course Requirements: minimum total of **8 credits**

- Many Math and Science courses numbered 300 and above. Courses required for the BMB major, including Biochem 430H and Biochem 471, and courses intended for non-BMB majors, such as Biochem 420 and 421, do **not** count toward advanced elective requirement. For Advanced Elective Course Options, see the Undergraduate page of the BMB website or inquire about courses not listed on the website with BMB CUGA Amy Springer.
- Independent Study/Research credits (e.g. Biochem 396, 396H, 496, 499Y or 499T).
- Note: Practica, including Biology 398 or Biochem 498, do NOT count as advanced elective credits.

BMB Thesis Research

Honors research and thesis projects (Biochem 499Y and 499T), for CHC students and for Departmental Honors. These credits may also be used to satisfy the Advanced Elective course requirement.

Total credits: UMass Amherst requires a minimum total of 120 credits for graduation.

Completion Time: BMB keeps close track of graduation dates and eligibility and prioritizes primary majors getting out in 4 years. If students choose to add majors and minors, it may take them longer because our focus is on a single major in BMB in 4 years. To ensure that BMB majors graduate in a timely manner, enrollment in upper-level courses is monitored and students are prioritized based on how long they've been in the major.

BMB MAJOR SAMPLE PROGRESSION Example 1

(Following is a sample progression and is *one of many ways* a BMB major can progress to a degree in 4 years)

FRESHMEN				SOPHOMORE			
<u>Fall</u>		<u>Spring</u>		<u>Fall</u>		<u>Spring</u>	
Courses	Credits	Courses	Credits	Courses	Credits	Courses	Credits
Introductory Biology I (Biol 151) GenEd BS	4	Introductory Biology II (Biol 152) Intro Bio Lab (Biol 153)	3 2	Cellular & Molecular Biology (Biochem 285)	3	Intro Biochem Lab (Biochem 276) Biochem 291H (Honors)	3 1
General Chem I (Chem 111 or 121H) GenEd PS	4	General Chem II (Chem 112 or 122H)	4	Organic Chem 1 Chem 261	3	Organic Chem 2 Chem 262	3
Calculus I (Math 127) (or Math 131, 4 cr) GenEd R1	3	Calculus II (Math 128) (or Math 132, 4 cr) GenEd R2	3	Stats 240 or equiv.	3	Organic Chem Lab Chem 269	2
EnglWrit 112 (or 112H if Honors) or Gen Ed 1 4 cr	3	Gen Ed-1 or EnglWrit 112	4	Physics 1, Phys 131, 151 or 181 (131 recommended)	4	Physics 2, Phys 132, 152 or 182 (132 recommended)	4
Honors Seminar and/or Freshman Seminar	1	Honors Seminar and/or (opt.) Freshman Seminar	1	Gen-Ed – 2	4	Gen-Ed –3	4
<u>TOTAL CREDITS: 15-17</u>		<u>TOTAL CREDITS: 16-18</u>		<u>TOTAL CREDITS: 17</u>		<u>TOTAL CREDITS: 16-17</u>	
JUNIOR				SENIOR			
<u>Fall</u>		<u>Spring</u>		<u>Fall</u>		<u>Spring</u>	
Courses	Credits	Courses	Credits	Courses	Credits	Courses	Credits
Str/func Biomolecules Biochem 423 (Fall or Spring)	3	Elective	3	Gen'l Biochem Lab Biochem 426 (Fall or Spring)	3	Adv Cell & Molec Bio Biochem 424 (Fall or Spring)	3
Integrative Experience Biochem 394RI (Fall) or NatSci 494 (Spring)	3	Genetics, Biochem 311- (Spring Only) or Biol 311 (Fall or Spring)	3	Elective	3	Physical Chemistry Biochem 471 (Fall or Spring)	3
Elective	3	Advanced Elective or Indep Study/Research*	3	BMB Thesis (499Y)** (Honors) OR Indep Study/Research*	3	BMB Thesis (499T)** (Honors)	3
Advanced Elective or Indep Study/Research*	3	Gen-Ed –4	4	Advanced Elective	3	Scientific Writing, Biochem 430H, (Fall or Spring)	3
Elective	3	Elective	3	Elective	3	Gen Ed – 5	4
<u>TOTAL CREDITS: 15</u>		<u>TOTAL CREDITS: 13-16</u>		<u>TOTAL CREDITS: 15</u>		<u>TOTAL CREDITS: 16</u>	

*Independent Studies/Research can count as advanced electives

**499Y/499T can count as advanced electives for Honors students

BMB MAJOR SAMPLE PROGRESSION Example 2

(Following is a sample progression and is *one of many ways* a BMB major can progress to a degree in 4 years)

FRESHMEN				SOPHOMORE			
<u>Fall</u>		<u>Spring</u>		<u>Fall</u>		<u>Spring</u>	
Courses	Credits	Courses	Credits	Courses	Credits	Courses	Credits
Introductory Biology I (Biol 151) <small>GenEd BS</small>	4	Introductory Biology II (Biol 152) Intro Bio Lab (Biol 153)	3 2	Elective	3	Cellular & Molecular Biology (Biochem 285) Biochem 291H (Honors)	3 1
General Chem I (Chem 111 or 121H) <small>GenEd PS</small>	4	General Chem II (Chem 112 or 122H)	4	Organic Chem 1 Chem 261	3	Organic Chem 2 Chem 262	3
Calculus I (Math 127) (or Math 131, 4 cr) <small>GenEd R1</small>	3	Calculus II (Math 128) (or Math 132, 4 cr) <small>GenEd R2</small>	3	Stats 240 or equiv.	3	Elective	3
EnglWrit 112 (or 112H if Honors) or Gen Ed 1 4 cr	3	Gen Ed-1 or EnglWrit 112	4	Elective	3	Physics 1, Phys 131, 151 or 181 (131 recommended)	4
Honors Seminar and/or Freshman Seminar	1	Honors Seminar and/or (opt.) Freshman Seminar	1	Gen-Ed – 2	4	Gen-Ed –3	4
<u>TOTAL CREDITS: 15-17</u>		<u>TOTAL CREDITS: 16-18</u>		<u>TOTAL CREDITS: 17</u>		<u>TOTAL CREDITS: 16-18</u>	
JUNIOR				SENIOR			
<u>Fall</u>		<u>Spring</u>		<u>Fall</u>		<u>Spring</u>	
Courses	Credits	Courses	Credits	Courses	Credits	Courses	Credits
Intro Biochem Lab (Biochem 276)	3	Str/func Biomolecules Biochem 423 (Fall or Spring)	3	Scientific Writing, Biochem 430H, (Fall or Spring)	3	[Adv Cell & Molec Bio Biochem 424 (Fall or Spring)]	3
Integrative Experience Biochem 394RI (Fall) or NatSci 494 (Spring)	3	Genetics, Biochem 311 (Spring Only) or Biol 311 (Fall or Spring)	3	Elective	3	Physical Chemistry Biochem 471 (Fall or Spring)	3
Phys 2, Phys 132, 152 or 182 (132 recommended)	4	Advanced Elective or Indep Study/Research*	3	BMB Thesis (499Y)** (Honors) OR Indep Study/Research*	3	BMB Thesis (499T)** (Honors)	3
Advanced Elective or Indep Study/Research*	3	Gen-Ed –4	4	[Advanced Elective]	3	Gen'l Biochem Lab Biochem 426	3
Elective	3	Organic Chem Lab Chem 269	2	Elective	3	Gen Ed – 5	4
<u>TOTAL CREDITS: 16</u>		<u>TOTAL CREDITS: 13-16</u>		<u>TOTAL CREDITS: 15</u>		<u>TOTAL CREDITS: 16</u>	