

BIOTECHNOLOGY, B.S.

Begin Campus: Any Penn State Campus

End Campus: University Park

Program Description

Biotechnology may be broadly defined as the application of principles of molecular and cell science in the production of biologically important or industrially useful products. Therefore, students in the Biotechnology major will

1. acquire a strong foundation in the life and chemical sciences,
2. learn how fundamental science is applied to problems through biotechnology,
3. develop basic laboratory skills, perform standard techniques, work with state-of-the-art instrumentation, describe and evaluate analytical methodology used in biotechnology, and
4. become familiar with societal concerns and governmental regulations regarding the biotechnology industry.

One very important strength of this major is the extensive laboratory experience each student receives. In the General option, students are very strongly encouraged to consider Cooperative Education with industry as an integral part of their curriculum. In addition to the General option in Biotechnology, the major also offers the Clinical Laboratory Science option.

What is Biotechnology?

Biotechnology is broadly defined as the application of principles of molecular and cell science to the production of biologically important or industrially useful products. Topics in biotechnology include genetic engineering, pharmaceutical development, and bio-manufacturing.

You Might Like This Program If...

- You like learning by doing experiments.
- You enjoy complex problem solving, teamwork, and collaboration with specialists from different fields (e.g. sciences and engineering).
- You desire to understand how to apply scientific concepts to the development of new products and technologies for human benefit or to benefit human surroundings.
- You are interested in medicine but don't want to work directly with patients (Clinical Lab Science Option).

Entrance to Major

In order to be eligible for entrance to the Biotechnology major, a student must have:

1. attained at least a 2.00 cumulative grade-point average, and
2. completed CHEM 110, CHEM 111, CHEM 112, and MATH 140 and earned a grade of C or better in each of these courses.

Degree Requirements

For the Bachelor of Science degree in Biotechnology, a minimum of 125 credits is required:

Requirement	Credits
General Education	45
Requirements for the Major	95

15 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses.

General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (<http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/>) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)

- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

Knowledge Domains

- **Arts (GA):** 6 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 6 credits
- **Social and Behavioral Sciences (GS):** 6 credits
- **Natural Sciences (GN):** 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)

- **Inter-Domain or Approved Linked Courses:** 6 credits

University Degree Requirements

First Year Engagement

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement

6 credits are required and may satisfy other requirements

- **United States Cultures:** 3 credits
- **International Cultures:** 3 credits

Writing Across the Curriculum

3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits

A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work

Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition

The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80>)). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major

To graduate with a B.S. degree in Biotechnology, a grade of C or better is required in 9 credits of any BIOTC, B M B, or MICRB 400-level course except BMB 442, BMB 443W, BMB 445W, BMB 448, BMB 488, BMB 496, MICRB 421W, MICRB 422, MICRB 447.

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44>).

Common Requirements for the Major (All Options)

Code	Title	Credits
Prescribed Courses		
BMB 211	Elementary Biochemistry	3
BMB 221	Applied Biochemistry	2
BMB 251	Molecular and Cell Biology I ¹	3
BMB 252	Molecular and Cell Biology II ¹	3
CHEM 113	Experimental Chemistry II	1
MATH 141	Calculus with Analytic Geometry II	4
MICRB 201	Introductory Microbiology ¹	3
MICRB 202	Introductory Microbiology Laboratory	2
MICRB 410	Principles of Immunology	3
MICRB 421W	Laboratory of General and Applied Microbiology	3
PHYS 250	Introductory Physics I	4
PHYS 251	Introductory Physics II	4
PSU 16	First-Year Seminar Science	1
<i>Prescribed Courses: Require a grade of C or better</i>		
CHEM 110	Chemical Principles I	3
CHEM 111	Experimental Chemistry I	1
CHEM 112	Chemical Principles II	3
MATH 140	Calculus With Analytic Geometry I	4

Requirements for the Option

Select an option 48

¹ To graduate with a B.S. degree in Biotechnology, a grade of C or better is required in two of the following courses:

- MICRB 201
- BMB 251/MICRB 251
- BMB 252/MICRB 252

Requirements for the Option

General Biotechnology Option (48 credits)

Code	Title	Credits
Prescribed Courses		
BIOL 322	Genetic Analysis	3
BIOTC 416	Microbial Biotechnology	2
BIOTC 459	Plant Tissue Culture and Biotechnology	3
BIOTC 479	Methods in Biofermentations	3
BIOTC 489	Animal Cell Culture Methods	3
BMB 442	Laboratory in Proteins, Nucleic Acids, and Molecular Cloning	3
STAT 250	Introduction to Biostatistics	3

Additional Courses

Select one of the following sequences: 6-8

CHEM 202 Fundamentals of Organic Chemistry I
& CHEM 203 and Fundamentals of Organic Chemistry II

CHEM 210 Organic Chemistry I
& CHEM 212 and Organic Chemistry II
& CHEM 213 and Laboratory in Organic Chemistry

Supporting Courses and Related Areas

Select 14-16 credits from department list C 14-16

Select 6 credits of the following: 6

Any 400-level BMB/BIOTC/MICRB lecture course

FDSC 408 Food Microbiology

Additional courses from department list D

Clinical Laboratory Science Option (48 credits)

This option provides both the academic and clinical preparation for students interested in a career as a clinical laboratory scientist. Positions are found in hospital, physician-office, reference, industrial, and research laboratories. To complete baccalaureate degree requirements, students enter a ten-month clinical practicum (MICRB 405A, MICRB 405B, MICRB 405C, MICRB 405D, MICRB 405E, MICRB 405F) at an affiliate hospital for the senior year. (Current affiliations are with Mount Nittany Medical Center, State College and Pennsylvania Hospital, Philadelphia.) Students are recommended for a fixed number of hospital positions on a competitive basis. Cumulative grade-point average and hospital school admission requirements serve as criteria for recommendation. The B.S. degree is awarded at the first commencement following completion of the clinical practicum.

Code	Title	Credits
Prescribed Courses		
BMB 212	Elementary Biochemistry Laboratory	1
MICRB 405A	Seminar and Practicum in Medical Technology	8
MICRB 405B	Seminar and Practicum in Medical Technology	1
MICRB 405C	Seminar and Practicum in Medical Technology	6
MICRB 405D	Seminar and Practicum in Medical Technology	5

MICRB 405E	Seminar and Practicum in Medical Technology	7
MICRB 405F	Seminar and Practicum in Medical Technology	3
MICRB 412	Medical Microbiology	3
MICRB 422	Medical Microbiology Laboratory	2

Additional Courses

BIOL 322 or BIOL 222	Genetic Analysis Genetics	3
Select one of the following sequences:		6-8
CHEM 202 & CHEM 203	Fundamentals of Organic Chemistry I and Fundamentals of Organic Chemistry II	
CHEM 210 & CHEM 212 & CHEM 213	Organic Chemistry I and Organic Chemistry II and Laboratory in Organic Chemistry	

Supporting Courses and Related Areas

Select 1-3 credits from department list		1-3
---	--	-----

Integrated B.S. in Biotechnology and M.BIOT. in Biotechnology

Requirements for the Integrated B.S. in Biotechnology and M.BIOT. in Biotechnology can be found in the Graduate Bulletin (<http://bulletins.psu.edu/graduate/programs/majors/biotechnology/#integratedundergradgradprogramstext>).

Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (<https://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/>)

University Park

Jennifer Keefer

Academic Adviser
239 Ritenour Building
University Park, PA 16802
814-863-5487
jls227@psu.edu

Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2021-22 academic year. To access previous years' suggested academic plans, please visit the archive (<https://bulletins.psu.edu/undergraduate/archive/>) to view the appropriate Undergraduate Bulletin edition (*Note: the archive only contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin*).

General Biotechnology Option: Biotechnology, B.S. at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits	Spring	Credits
PSU 16	1	MICRB 201 ¹	3
CHEM 110 ^{*#†}	3	MICRB 202 or 203 (Consult with an academic adviser for options)	2
CHEM 111 ^{*#†}	1	CHEM 112 ^{*#†}	3
MATH 140 or 140B ^{*†#†}	4	CHEM 113 [†]	1
ENGL 15 or 30H [†]	3	MATH 141 or 141B ^{††}	4
General Education Course	3	CAS 100A, 100B, or 100C [‡]	3
	15		16

Second Year

Fall	Credits	Spring	Credits
BMB 251 ¹	3	BMB 252 ¹	3
CHEM 202 or 210	3	CHEM 203 or 212 <i>and</i> 213	3
PHYS 250 [†]	4	PHYS 251 [†]	4
Department List C (Consult with an academic adviser for options)	3	General Education Course	3
General Education Course	3	General Education Course	3
	16		16

Third Year

Fall	Credits	Spring	Credits
BIOTC 489 ²	3	BIOTC 459 ²	3
BMB 211	3	BMB 221	2
MICRB 421W	3	BMB 442	3
Department List C (Consult with an academic adviser for options)	3	BIOL 322	3
General Education Course	3	ENGL 202C, 202A, 202B, or 202C [‡]	3
General Education Course (GHW)	1.5	General Education Course (GHW)	1.5
	16.5		15.5

Fourth Year

Fall	Credits	Spring	Credits
BIOTC 416 ²	2	MICRB 410 ²	3
BIOTC 479 ²	3	BIOTC 400-Level Lecture Selections (Consult with an academic adviser for options) ²	3
BIOTC 400 Level Lecture Selections (Consult with an academic adviser for options) ²	3	STAT 250	3

Department list C Free (Consult with an academic adviser for options)	4 Department List C (Consult with an academic adviser for options)	3
General Education Course	3 Department List C (Consult with an academic adviser for options)	3
15		15

Total Credits 125

- * Course requires a grade of C or better for the major
 - ‡ Course requires a grade of C or better for General Education
 - # Course is an Entrance to Major requirement
 - † Course satisfies General Education and degree requirement
- ¹ To graduate, a grade of C or better is required in two of the following courses: Introductory Microbiology (MICRB 201), Molecular and Cell Biology I (BMB 251)/Molecular and Cell Biology I (MICRB 251), and/or Molecular and Cell Biology II (BMB 252)/Molecular and Cell Biology II (MICRB 252).
- ² To graduate, a grade of C or better is required in 9 credits of any BIOTC, BMB or MICRB 400-level course except those listed in the requirements for the major (consult with an academic adviser for clarification)

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and replace both ENGL 30H and CAS 100. Each course is 3 credits.

General Biotechnology Option (math 22 sTART): Biotechnology, B.S. at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits Spring	Credits Summer	Credits
PSU 16	1 CHEM 110 ^{*#†}	3 CHEM 112 ^{*#†}	3
MATH 22 ¹	3 CHEM 111 ^{*#†}	1 CHEM 113 [†]	1
MATH 26 ¹	3 MATH 140 or 140B ^{*#†1}	4	
ENGL 15, ESL 15, or ENGL 30H [†]	3 CAS 100A, 100B, or 100C [‡]	3	
General Education Course	6 General Education Course	3	
16		14	4

Second Year

Fall	Credits Spring	Credits Summer	Credits
MICRB 201 ²	3 BMB 251 ²	3 PHYS 251 (Consult with an academic adviser for alternative options) [†]	4
MICRB 202	2 CHEM 203	3	
CHEM 202	3 PHYS 250 (Consult with an academic adviser for alternative options) [†]	4	
MATH 141 or 141B ^{†1}	4 General Education Course	3	
General Education Course	3		
15		13	4

Third Year

Fall	Credits Spring	Credits
BMB 252 ²	3 BIOTC 459 ³	3
BMB 211	3 BMB 221	2
MICRB 421W	3 BMB 442	3
Department List C (Consult with an academic adviser for options)	2 BIOL 322	3

General Education Course	3 ENGL 202C, 202A, 202B, or 202D [†]	3
General Education Course (GHW)	1.5 General Education Course (GHW)	1.5

15.5

15.5

Fourth Year

Fall	Credits Spring	Credits
BIOTC 416 ³	3 BIOTC 479 ³	3
BIOTC 489 ³	3 BIOTC 400-Level Lecture Selections (Consult with an academic adviser for options) ³	3
BIOTC 400 Level Lecture Selections (Consult with an academic adviser for options) ³	3 MICRB 410 ³	3
Department List C (Consult with an academic adviser for options)	5 STAT 250 ¹	3
	Department List C (Consult with an academic adviser for options)	3
14		15

Total Credits 126

- * Course requires a grade of C or better for the major
- ‡ Course requires a grade of C or better for General Education
- # Course is an Entrance to Major requirement
- † Course satisfies General Education and degree requirement

¹ 6 credits of MATH 22, MATH 26, MATH 140, MATH 141, or STAT 250 require a grade of C or better for General Education.

² To graduate, a grade of C or better is required in two of the following courses: Introductory Microbiology (MICRB 201), Molecular and Cell Biology I (BMB 251)/Molecular and Cell Biology I (MICRB 251), and/or Molecular and Cell Biology II (BMB 252)/Molecular and Cell Biology II (MICRB 252).

³ To graduate, a grade of C or better is required in 9 credits of any BIOTC, BMB or MICRB 400-level course except those listed in the requirements for the major (consult with an academic adviser for clarification).

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and replace both ENGL 30H and CAS 100. Each course is 3 credits.

Clinical Laboratory Science Option: Biotechnology, B.S. at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits Spring	Credits
PSU 16	1 MICRB 201 ¹	3
CHEM 110 ^{**†}	3 MICRB 202 or 203 (Consult with an academic adviser for options)	2
CHEM 111 ^{**†}	1 CHEM 112 ^{**†}	3
MATH 140 or 140B ^{*†#††}	4 CHEM 113 [†]	1
ENGL 15, 30H, or ESL 15 [†]	3 MATH 141 or 141B ^{††}	4
General Education Course	3 CAS 100A, 100B, or 100C [†]	3
	15	16

Second Year

Fall	Credits Spring	Credits
MICRB 251 ¹	3 MICRB 252 ¹	3
CHEM 202 or 210	3 BMB 211	3
PHYS 250 [†]	4 CHEM 203 or 212 <i>and</i> 213	3
General Education Course	3 PHYS 251 [†]	4
General Education Course	3 General Educaiton Course	3
	16	16

Third Year

Fall	Credits Spring	Credits
BMB 212	1 BMB 221	2
BIOL 222 or MICRB 410 ²	3 BIOL 322 or MICRB 410 ²	3
MICRB 421W	3 MICRB 412 ²	3
Department List C (Consult with an academic adviser for options)	1.5 MICRB 422	2
General Education Course	3 Department List C (Consult with an academic adviser for options)	1.5
General Education Course	3 ENGL 202C, 202A, 202B, or 202D [†]	3
General Education Course (GHW)	1.5 General Education Course (GHW)	1.5
	16	16

Fourth Year

Fall	Credits Spring	Credits
MICRB 405A ²	8 MICRB 405D ²	5
MICRB 405B ²	1 MICRB 405E ²	7
MICRB 405C ²	6 MICRB 405F ²	3
	15	15

Total Credits 125

* Course requires a grade of C or better for the major

† Course requires a grade of C or better for General Education

Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

¹ To graduate, a grade of C or better is required in two of the following courses: Introductory Microbiology (MICRB 201), Molecular and Cell Biology I (BMB 251)/Molecular and Cell Biology I (MICRB 251), and/or Molecular and Cell Biology II (BMB 252)/Molecular and Cell Biology II (MICRB 252).

² To graduate, a grade of C or better is required in 9 credits of any BIOTC, BMB or MICRB 400-level course except those listed in the requirements for the major (consult with an academic adviser for clarification)

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and replace both ENGL 30H and CAS 100. Each course is 3 credits.

Clinical Laboratory Science Option (MATH 22 Start): Biotechnology, B.S. at University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits Spring	Credits Summer	Credits
PSU 16	1 CHEM 110 ^{*#†}	3 CHEM 112 ^{*#†}	3
MATH 22 ¹	3 CHEM 111 ^{*#†}	1 CHEM 113 [†]	1
MATH 26 ¹	3 MATH 140 or 140B ^{*#†1}	4	
ENGL 15, ESL 15, or ENGL 30H [†]	3 CAS 100A, 100B, or 100C [†]	3	
General Education Course	6 General Education Course	3	
16		14	4

Second Year

Fall	Credits Spring	Credits Summer	Credits
MICRB 201 ²	3 BMB 251 ²	3 PHYS 251 (Consult with an academic adviser for alternative options) [†]	4
MICRB 202	2 BMB 211	3	
CHEM 202	3 CHEM 203	3	
MATH 141 or 141B ⁺¹	4 PHYS 250 (Consult with an academic adviser for alternative options) [†]	4	
General Education Course	3 General Education Course	3	
15		16	4

Third Year

Fall	Credits Spring	Credits
BMB 252 ²	3 BMB 221	2
BMB 212	1 BIOL 322 or MICRB 410 (Consult with an academic adviser for options) ³	3
BIOL 222 or MICRB 410 (Consult with an academic adviser for options) ³	3 MICRB 412 ³	3

MICRB 421W	3 MICRB 422	2
General Education Course	3 ENGL 202C, 202A, 202B, or 202D [†]	3
General Education Course (GHW)	1.5 General Education Course (GHW)	1.5
14.5		14.5

Fourth Year

Fall	Credits Spring	Credits
MICRB 405A ³	8 MICRB 405D ³	5
MICRB 405B ³	1 MICRB 405E ³	7
MICRB 405C ³	6 MICRB 405F ³	3
15		15

Total Credits 128

- * Course requires a grade of C or better for the major
- ‡ Course requires a grade of C or better for General Education
- # Course is an Entrance to Major requirement
- † Course satisfies General Education and degree requirement

- ¹ 6 credits of MATH 22, MATH 26, MATH 140, or MATH 141 require a grade of C or better for General Education.
- ² To graduate, a grade of C or better is required in two of the following courses: Introductory Microbiology (MICRB 201), Molecular and Cell Biology I (BMB 251)/Molecular and Cell Biology I (MICRB 251), and/or Molecular and Cell Biology II (BMB 252)/Molecular and Cell Biology II (MICRB 252).
- ³ To graduate, a grade of C or better is required in 9 credits of any BIOTC, BMB or MICRB 400-level course except those listed in the requirements for the major (consult with an academic adviser for clarification).

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and replace both ENGL 30H and CAS 100. Each course is 3 credits.

General Biotechnology Option: Biotechnology, B.S. at Commonwealth Campuses

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits	Spring	Credits
CHEM 110 ^{*#†}	3	CHEM 112 ^{*#†}	3
CHEM 111 ^{*#†}	1	CHEM 113 [†]	1
MATH 140 ^{*†#†}	4	MATH 141 ^{††}	4
BIOL 110 [†]	4	Department List C (Consult with an academic adviser for options)	4
ENGL 15, ESL 15, or ENGL 30H [†]	3	General Education Course	3
General Education Course (GHW)	1.5	General Education Course (GHW)	1.5
	16.5		16.5

Second Year

Fall	Credits	Spring	Credits
BIOL 230W ^{†1}	4	CHEM 212	3
CHEM 210	3	CHEM 213	2
PHYS 250 (Consult with an academic adviser for alternative options) [†]	4	PHYS 251 (Consult with an academic adviser for alternative options) [†]	4
General Education Course	3	STAT 200 [‡]	4
CAS 100A, 100B, or 100C [‡]	3	General Education Course	3
	17		16

Third Year

Fall	Credits	Spring	Credits
BMB 211	3	BIOTC 459 ²	3
BMB 252 ¹	3	BMB 221	2
MICRB 201 ¹	3	BMB 442	3
MICRB 202	2	BIOL 322	3
General Education Course	3	ENGL 202C, 202A, 202B, or 202D [‡]	3
Department List C (Consult with an academic adviser for options)	2		
	16		14

Fourth Year

Fall	Credits	Spring	Credits
BIOTC 416 ²	3	BIOTC 479 ²	3
BIOTC 489 ²	3	MICRB 410 ²	3
MICRB 421W	3	BIOTC 400 Level Lecture Selections (Consult with an academic adviser for options) ²	3

BIOTC 400 Level Lecture Selections (Consult with an academic adviser for options) ²	3	General Education Course	3
General Education Course	3	Department List C (Consult with an academic adviser for options)	2
	15		14

Total Credits 125

- * Course requires a grade of C or better for the major
- ‡ Course requires a grade of C or better for General Education
- # Course is an Entrance to Major requirement
- † Course satisfies General Education and degree requirement

¹ To graduate, a grade of C or better is required in two of the following courses: Introductory Microbiology (MICRB 201), Molecular and Cell Biology I (BMB 251)/Molecular and Cell Biology I (MICRB 251) or Biology: Molecules and Cells (BIOL 230W), and/or Molecular and Cell Biology II (BMB 252)/Molecular and Cell Biology II (MICRB 252).

² To graduate, a grade of C or better is required in 9 credits of any BIOTC, BMB or MICRB 400-level course except those listed in the requirements for the major (consult with an academic adviser for clarification).

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

General Biotechnology Option (math 22 sTART): Biotechnology, B.S. at Commonwealth Campuses

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits Spring	Credits Summer	Credits
BIOL 110 [†]	4 CHEM 110 ^{*#†}	3 CHEM 112 ^{*#†}	3
MATH 22 ¹	3 CHEM 111 ^{*#†}	1 CHEM 113 [†]	1
MATH 26 ¹	3 MATH 140 ^{*#†1}	4	
ENGL 15, ESL 15, or ENGL 30H [‡]	3 CAS 100A, 100B, or 100C [‡]	3	
General Education Course	3 General Education Course	3	
	16	14	4

Second Year

Fall	Credits Spring	Credits Summer	Credits
BIOL 230W ^{†2}	4 CHEM 212	3 PHYS 251 (Consult with an academic adviser for alternative options) [†]	4
CHEM 210	3 CHEM 213	2	
MATH 141 ^{†1}	4 PHYS 250 (Consult with and academic adviser for alternative options) [†]	4	
General Education Course	3 STAT 200 ¹	4	
General Education Course (GHW)	1.5 General Education Course	3	
	15.5	16	4

Third Year

Fall	Credits Spring	Credits
BMB 211	3 BIOTC 459 ³	3
BMB 252 ²	3 BMB 221	2
MICRB 201 ²	3 BMB 442	3
MICRB 202	2 BIOL 322	3
General Education Course	3 ENGL 202C, 202A, 202B, or 202D [†]	3
	14	14

Fourth Year

Fall	Credits Spring	Credits
BIOTC 416 ³	3 BIOTC 479 ³	3
BIOTC 489 ³	3 MICRB 410 ³	3
MICRB 421W	3 BIOTC 400 Level Lecture Selections (Consult with an academic adviser for options) ³	3
BIOTC 400 Level Lecture Selections (Consult with an academic adviser for options) ³	3 General Education Course	3
General Education Course (GHW)	1.5 Department List C (Consult with an academic adviser for options)	2
	13.5	14

Total Credits 125

* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

¹ 6 credits of MATH 22, MATH 26, MATH 140, MATH 141, or STAT 200 require a grade of C or better for General Education.

² To graduate, a grade of C or better is required in two of the following courses: Introductory Microbiology (MICRB 201), Molecular and Cell Biology I (BMB 251)/Molecular and Cell Biology I (MICRB 251) or Biology: Molecules and Cells (BIOL 230W), and/or Molecular and Cell Biology II (BMB 252)/Molecular and Cell Biology II (MICRB 252).

³ To graduate, a grade of C or better is required in 9 credits of any BIOTC, BMB or MICRB 400-level course except those listed in the requirements for the major (consult with an academic adviser for clarification).

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate

an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

X**Clinical Laboratory Science Option: Biotechnology, B.S. at Commonwealth Campus**

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits Spring	Credits Summer	Credits
CHEM 110 ^{*#†}	3 BIOL 230W ^{††}	4 General Education Course	3
CHEM 111 ^{*#†}	1 CHEM 112 ^{*#†}	3	
MATH 140 ^{*†#†}	4 CHEM 113 [†]	1	
BIOL 110 [†]	4 MATH 141 ^{††}	4	
ENGL 15, 30H, or ESL 15 [‡]	3 CAS 100A, 100B, or 100C [‡]	3	
	General Education Course (GHW)	1.5	
	15	16.5	3

Second Year

Fall	Credits Spring	Credits Summer	Credits
MICRB 201 ¹	3 BIOL 322 or 222 ²	3 BMB 211	3
MICRB 202	2 CHEM 212	3	
CHEM 210	3 CHEM 213	2	
PHYS 250 (Consult with an academic adviser for alternative options) [†]	4 PHYS 251 (Consult with an academic adviser for alternative options) [†]	4	
General Education Course	3 General Education Course	3	
	15	15	3

Third Year

Fall	Credits Spring	Credits
BMB 212	1 BMB 221	2
BMB 252 ¹	3 MICRB 410 ³	3
MICRB 421W	3 MICRB 412 ³	3
General Education Course (GHW)	1.5 MICRB 422	2
General Education Course	6 ENGL 202C, 202A, 202B, or 202D [†]	3
	General Education Course	3
	14.5	16

Fourth Year

Fall	Credits Spring	Credits
MICRB 405A ³	8 MICRB 405D ³	5
MICRB 405B ³	1 MICRB 405E ³	7
MICRB 405C ³	6 MICRB 405F ³	3
	15	15

Total Credits 128

* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

¹ To graduate, a grade of C or better is required in two of the following courses: Introductory Microbiology (MICRB 201), Molecular and Cell Biology I (BMB 251)/Molecular and Cell Biology I (MICRB 251) or Biology: Molecules and Cells (BIOL 230W), and/or Molecular and Cell Biology II (BMB 252)/Molecular and Cell Biology II (MICRB 252).

² BIOL 222 is an approved substitute for BIOL 322.

³ To graduate, a grade of C or better is required in 9 credits of any BMB or MICRB 400-level course except those listed in the requirements for the major (consult with an academic adviser for clarification).

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

Clinical Laboratory Science Option (MATH 22 Start): Biotechnology, B.S. at Commonwealth Campuses

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If report**). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

First Year

Fall	Credits Spring	Credits Summer	Credits
BIOL 110 [†]	4 CHEM 110 ^{*#†}	3 CHEM 112 ^{*#†}	3
MATH 22 ¹	3 CHEM 111 ^{*#†}	1 CHEM 113 [†]	1
MATH 26 ¹	3 MATH 140 ^{*#†1}	4	
ENGL 15, ESL 15, or ENGL 30H [†]	3 CAS 100A, 100B, or 100C [‡]	3	
General Education Course	3 General Education Course	3	
	General Education Course (GHW)	1.5	
	16	15.5	4

Second Year

Fall	Credits Spring	Credits Summer	Credits
MICRB 201 ²	3 BIOL 230W ²	4 PHYS 251 (Consult with an academic adviser for alternative options) [†]	4
MICRB 202	2 CHEM 212	3 BMB 211	3
CHEM 210	3 CHEM 213	2	
MATH 141 ^{†1}	4 PHYS 250 (Consult with an academic adviser for alternative options) [†]	4	
General Education Course	3 General Education Course	3	
	15	16	7

Third Year

Fall	Credits Spring	Credits
BIOL 222 or MICRB 410 (Consult with an academic adviser for options) ³	3 BIOL 322 or MICRB 410 (Consult with an academic adviser for options) ³	3
BMB 212	1 BMB 221	2
BMB 252 ²	3 MICRB 412 ³	3
MICRB 421W	3 MICRB 422	2

General Education Course	3 ENGL 202C, 202A, 202B, or 202D [†]	3
General Education Course (GHW)	1.5 General Education Course	3

14.5

16

Fourth Year

Fall	Credits Spring	Credits
MICRB 405A ³	8 MICRB 405D ³	5
MICRB 405B ³	1 MICRB 405E ³	7
MICRB 405C ³	6 MICRB 405F ³	3
	15	15

Total Credits 134

* Course requires a grade of C or better for the major

‡ Course requires a grade of C or better for General Education

Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

¹ 6 credits of MATH 22, MATH 26, MATH 140, or MATH 141 require a grade of C or better for General Education.

² To graduate, a grade of C or better is required in two of the following courses: Introductory Microbiology (MICRB 201), Molecular and Cell Biology I (BMB 251)/Molecular and Cell Biology I (MICRB 251) or Biology: Molecules and Cells (BIOL 230W), and/or Molecular and Cell Biology II (BMB 252)/Molecular and Cell Biology II (MICRB 252).

³ To graduate, a grade of C or better is required in 9 credits of any BIOTC, BMB or MICRB 400-level course except those listed in the requirements for the major (consult with an academic adviser for clarification).

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

Career Paths

This major has two options: Clinical Laboratory Option or General Option. Graduates from the General option frequently accept positions in the bio-pharmaceutical industry or with newly-emerging biotechnology companies bringing new products to market. Graduates from the Clinical Lab Science Option are prepared to complete the certification exam

necessary to work as a Medical Laboratory Scientist in a hospital or other medical laboratory.

http://bmb.psu.edu/about/copy_of_contact (http://bmb.psu.edu/about/copy_of_contact/)

Careers

A BS in Biotechnology prepares students for a wide variety of careers, including industry, health related professions, and careers in academic or government labs. Examples of biotechnology related careers are:

- Biomedical or Clinical Research Health Professions – e.g. Dentist, Optometrist, Pharmacist, Physician, Physician Assistant
- Manufacturing Associate
- Medical Lab Scientist (CLS option)
- Pharmaceutical Sales
- Pharmaceutical Sciences
- Quality Control and Assurance
- Research and Development
- Science Policy Expert
- Science Writer
- Patent Attorney
- Professor

Opportunities for Graduate Studies

Many students with a BS in Biotechnology will pursue graduate education in biotechnology, management, policy or other related disciplines. Penn State students interested in pursuing a MS in Biotechnology can enroll in the integrated undergraduate graduate (IUG) program. IUG students complete a BS and MS with 5 years of coursework, which includes a nine-month internship in industry, government or academia. A BS in Biotechnology also prepares students to pursue higher degrees in the health professions. Opportunities for graduate studies include, but are not limited to, the following:

- Graduate Studies (MS or PhD)
- Dental School Medical School (MD or DO)
- Optometry School
- Pharmacy School
- Veterinary School

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (<http://bmb.psu.edu/undergraduate/academic-planning/the-integrated-undergraduate-graduate-iug-degree-program-in-biotechnology/>)

Accreditation

All affiliated programs that provide the fourth-year clinical experience for the Biotechnology major, CLS option students are accredited by the National Accreditation Agency for Clinical Laboratory Science.

MORE INFORMATION ABOUT THE NATIONAL ACCREDITATION AGENCY FOR CLINICAL LABORATORY SCIENCE (<https://www.naacls.org/about.aspx>)

Contact

University Park

DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY
108 Althouse Laboratory
University Park, PA 16802
814-863-5487
bmbundergrad@psu.edu