

# MICROBIOLOGY, B.S.

**Begin Campus:** Any Penn State Campus

**End Campus:** University Park

## Program Description

Microbiology is the science of single cell forms of life and of the response of more complex life forms to their presence and activities. Students in the Microbiology major will complete a comprehensive study of life processes at the molecular and cellular level, with particular emphasis on prokaryotes (bacteria), and use basic and advanced techniques in laboratory methodology.

Through advanced course study, the many subdisciplines of microbiology such as molecular genetics, immunology, and virology may be explored more fully. Ample opportunities exist for participation in faculty-initiated research projects. Extensive laboratory experience is a particular strength of the major. Courses in such applied areas as industrial, medical, and food microbiology help prepare students for careers in the pharmaceutical, biotechnical, and agricultural industries.

### General Microbiology Option

The General Microbiology Option allows students to tailor their major toward specific areas of expertise, such as environmental microbiology, microbial pathology of plants, microbiomes, etc. This is achieved through the flexibility of an expanded list of electives that includes courses dealing with various aspects of microbiology.

### Medical Microbiology Option

The Medical Microbiology Option is useful for students who desire careers in the human health sector. This option includes courses such as Viral Pathogenesis, Medical Microbiology and Immunology.

## What is Microbiology?

Microbiology is the study of microscopic organisms and how they interact with other organisms and the environment. Topics in microbiology include how microbes benefit and harm human health, the role of microbes in the environment, and how microbes can be used in medicine, agriculture, and engineering.

### You Might Like This Program If...

- You like learning by doing experiments.
- You are fascinated by the diversity and interconnectedness of life.
- You are interested in learning about the interplay between infectious disease and the immune response.
- You want to pursue a career in genetic engineering, medicine, public health, or environmental studies.

## Entrance to Major

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

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

## Degree Requirements

For the Bachelor of Science degree in Microbiology, a minimum of 121 credits is required:

Requirement	Credits
General Education	45
Requirements for the Major	94-98

**15-18 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; and 0-3 credits of GWS courses (3 credits if BMB 491 or BIOL 403 is taken as an elective).**

### Requirements for the Major

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 (<https://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
<b>Prescribed Courses</b> <sup>1</sup>		
BMB 400	Molecular Biology of the Gene	2
BMB 401	General Biochemistry	3
BMB 402	General Biochemistry	3
BMB 442	Laboratory in Proteins, Nucleic Acids, and Molecular Cloning	3
CHEM 113	Experimental Chemistry II	1
CHEM 210	Organic Chemistry I	3
CHEM 212	Organic Chemistry II	3
CHEM 213	Laboratory in Organic Chemistry	2
MICRB 201	Introductory Microbiology <sup>2</sup>	3
MICRB 401	Microbial Physiology and Structure	3
MICRB 421W	Laboratory of General and Applied Microbiology	3
MICRB 450	Microbial/Molecular Genetics	3
PEEM 456	Applied Microbial Ecology	3
<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
<b>Additional Courses</b>		
MICRB 202 or MICRB 203	Introductory Microbiology Laboratory Inquiry-based Microbiology Laboratory	2
PHYS 250 or PHYS 211	Introductory Physics I General Physics: Mechanics	4
PHYS 251 or PHYS 212	Introductory Physics II General Physics: Electricity and Magnetism	4
<i>Additional Courses: Require a grade of C or better</i>		
Select 3-4 credits from the following:		3-4
MATH 141	Calculus with Analytic Geometry II	
STAT 200	Elementary Statistics	
STAT 240	Introduction to Biometry	
STAT 250	Introduction to Biostatistics	

**Supporting Courses and Related Areas**

Select 3 credits from MICRB Elective List A (Applied) <sup>3</sup>	3
Select 3 credits from MICRB Elective List B <sup>3</sup>	3
Select 11 credits from MICRB Elective List C (free electives)	11

**Requirements for the Option**

Select an option	18-21
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<sup>1</sup> To graduate, a grade of C or better is required in 9 credits of prescribed 400-level courses, excluding BMB 442 and MICRB 421W.

<sup>2</sup> To graduate, a grade of C or better is required in two of the following courses:

- MICRB 201
- BMB 251/MICRB 251 or BIOL 230W
- BMB 252/MICRB 252 or BIOL 220W

<sup>3</sup> In Elective List A (Applied) and Elective List B, students can apply a total maximum of 3 credits in BMB 408 and/or MICRB 408 and a maximum of 4 credits in BMB 488 and/or BMB 496

**Requirements for the Option****General Microbiology Option (18-21 Credits)**

Code	Title	Credits
<b>Prescribed Courses</b>		
MICRB 415	General Virology: Bacterial and Animal Viruses	3
<b>Additional Courses</b>		
Select one of the following Sequences:		9-12
<i>Sequence 1</i>		
BIOL 222	Genetics	
	or BIOL 322 Genetic Analysis	
BMB 251	Molecular and Cell Biology I <sup>1</sup>	
	or BIOL 230W Biology: Molecules and Cells	
BMB 252	Molecular and Cell Biology II <sup>1</sup>	
<i>Sequence 2</i>		
BIOL 110	Biology: Basic Concepts and Biodiversity	
BIOL 220W	Biology: Populations and Communities <sup>1</sup>	
BIOL 230W	Biology: Molecules and Cells <sup>1</sup>	
<b>Supporting Courses and Related Areas</b>		
Select 6 credits from MICRB Elective List B		6

<sup>1</sup> To graduate, a grade of C or better is required in two of the following courses:

- MICRB 201
- BMB 251/MICRB 251 or BIOL 230W
- BMB 252/MICRB 252 or BIOL 220W

**Medical Microbiology Option (18-19 Credits)**

Code	Title	Credits
<b>Prescribed Courses</b>		
BMB 252	Molecular and Cell Biology II	3
MICRB 410	Principles of Immunology	3
MICRB 412	Medical Microbiology	3
<b>Additional Courses</b>		
BIOL 322	Genetic Analysis	3
	or BIOL 222 Genetics	

BMB 251	Molecular and Cell Biology I <sup>1</sup>	3-4
	or BIOL 230W Biology: Molecules and Cells	
MICRB 435	Viral Pathogenesis	3
	or MICRB 415 General Virology: Bacterial and Animal Viruses	

<sup>1</sup> To graduate, a grade of C or better is required in two of the following courses:

- MICRB 201
- BMB 251/MICRB 251 or BIOL 230W
- BMB 252/MICRB 252

**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 (<https://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 and Inter-Domain courses do not meet this requirement.)**

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

**Breadth in the Knowledge Domains (Inter-Domain courses do not meet this requirement.)**

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

**Integrative Studies**

- **Inter-Domain Courses (Inter-Domain):** 6 credits

**Exploration**

- **GN**, may be completed with Inter-Domain courses: 3 credits
- **GA, GH, GN, GS, Inter-Domain courses.** This may include 3 credits of World Language course work beyond the 12th credit level or the requirements for the student's degree program, whichever is higher: 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 (<https://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.

## 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

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## Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2024-25 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.

### General Microbiology Option, Emphasis in Cell Biology and Genetics: Microbiology, 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
First-Year Seminar	1 MICRB 201 <sup>*1</sup>	3
CHEM 110 (GN) <sup>**†</sup>	3 MICRB 202 or 203	2
CHEM 111 (GN) <sup>**†</sup>	1 CHEM 112 (GN) <sup>**†</sup>	3
MATH 140 (GQ) <sup>*†††</sup>	4 CHEM 113 (GN) <sup>†</sup>	1
ENGL 15 or 30H (GWS) <sup>‡</sup>	3 MATH 141, STAT 200, STAT 240, or STAT 250 (GQ) <sup>††8</sup>	3-4
General Education Course	3 CAS 100A, 100B, or 100C (GWS) <sup>‡</sup>	3
	<b>15</b>	<b>15-16</b>

#### Second Year

Fall	Credits Spring	Credits
BMB/MICRB 251 <sup>*1,3,4</sup>	3 BMB/MICRB 252 <sup>*1,3</sup>	3
CHEM 210	3 CHEM 212	3
PHYS 211 or 250 (GN) <sup>†</sup>	4 CHEM 213W	2
Department List C <sup>9</sup>	3 PHYS 212 or 251 (GN)	4
General Education Course	3 BIOL 322 <sup>3,4</sup>	3
	<b>16</b>	<b>15</b>

#### Third Year

Fall	Credits Spring	Credits
BMB 400 <sup>*2</sup>	2 BMB 402 <sup>*2</sup>	3
BMB 401 <sup>*2</sup>	3 BMB 442	3
MICRB 401 <sup>*2</sup>	3 MICRB 415 <sup>*2,4</sup>	3
MICRB 421W	3 MICRB Elective (List A) <sup>4,5,9</sup>	3
General Education Course	3 General Education Course	3
General Education Course (GHW)	1.5 General Education Course (GHW)	1.5
	<b>15.5</b>	<b>16.5</b>

#### Fourth Year

Fall	Credits Spring	Credits
MICRB 450 <sup>*2</sup>	3 MICRB Elective (List B) <sup>5,6,7,9</sup>	0-3
PPEM 456 <sup>*2</sup>	3 Department List C <sup>9</sup>	2
MICRB Elective (List B) <sup>5,9</sup>	3 Department List C <sup>9</sup>	3
MICRB Elective (List B) <sup>5,9</sup>	3 General Education Course (GWS) <sup>††4,6</sup>	3
Department List C <sup>9</sup>	3 General Education Course	3

General Education Course	3
15	14-17

**Total Credits 122-126**

- \* 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

<sup>1</sup> All three courses are required for the major, but a grade of C or better is required in two of the following: MICRB 201, BMB 251/MICRB 251 or BIOL 230W, BMB 252/MICRB 252 (Cell Biology and Genetics Emphasis) or BIOL 220W (Ecology Emphasis)

<sup>2</sup> To graduate, a grade of C or better is required in 9 credits of prescribed 400-level courses, excluding BMB 442 and MICRB 421W.

<sup>3</sup> Two series of courses can be taken – Cell Biology and Genetics Emphasis: BMB 251 (or BIOL 230W), BMB 252 and BIOL 322 (or BIOL 222); Cell Biology and Ecology Emphasis: BIOL 110, BIOL 230W and BIOL 220W. Students must complete either three-course series in full. No mixing courses between series.

<sup>4</sup> There may be an alternative option offered in a different semester. See adviser for more information.

<sup>5</sup> 12-credit microbiology-based elective requirement from List A (Applied) and List B (Lecture) electives, with a minimum of 3 credits taken from List A. Although, if a student wants more lab experience, more courses can be taken from List A to fulfill the requirement. A maximum of 3 credits of BMB 408/MICRB 408 and a maximum of 4 credits of BMB 488 and/or BMB 496 can be used to fulfill this requirement but will not count toward the 3-cr. minimum of List A category requirement.

<sup>6</sup> BIOL 403 or BMB 491 can double count for GWS credit and List B elective. If student does not take BIOL 403 or BMB 491, ENGL 202C/ENGL 202A/ENGL 202B/ENGL 202D can be taken instead.

<sup>7</sup> If students takes a List B elective that also satisfies GWS, then do not need additional List B credits here.

<sup>8</sup> If a student takes the course with the higher amount of credits, the extra credit can apply towards the List C elective category.

**University Requirements and General Education Notes:**

US and IL are abbreviations used to designate courses that satisfy Cultural Diversity 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.

General Education includes Foundations (GWS and GQ), Knowledge Domains (GHW, GN, GA, GH, GS) and Integrative Studies (Inter-domain) requirements. N or Q (Honors) is the suffix at the end of a course number used to help identify an Inter-domain course, but the inter-domain attribute is used to fill audit requirements. Foundations courses (GWS and GQ) require a grade of 'C' or better.

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 satisfy a portion of that General Education requirement. If the student's program prescribes GWS these courses will replace both ENGL 15/ENGL 30H and CAS 100A/CAS 100B/CAS 100C. Each course is 3 credits.

## General Microbiology Option, Emphasis in Cell Biology and Ecology: Microbiology, 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
First-Year Seminar	1 MICRB 201 <sup>*1</sup>	3
BIOL 110	4 MICRB 202 or 203	2
CHEM 110 (GN) <sup>**†</sup>	3 CHEM 112 (GN) <sup>**†</sup>	3
CHEM 111 (GN) <sup>**†</sup>	1 CHEM 113 (GN) <sup>†</sup>	1
MATH 140 (GQ) <sup>**††</sup>	4 MATH 141, STAT 200, STAT 240, or STAT 250 (GQ) <sup>††8</sup>	3-4
ENGL 15 or 30H (GWS) <sup>‡</sup>	3 CAS 100A, 100B, or 100C (GWS) <sup>‡</sup>	3
	<b>16</b>	<b>15-16</b>

### Second Year

Fall	Credits Spring	Credits
BIOL 220W <sup>*1,3,4</sup>	4 BIOL 230W <sup>*1,3</sup>	4
CHEM 210	3 CHEM 212	3
PHYS 211 or 250 (GN) <sup>†</sup>	4 CHEM 213W	2
Department List C <sup>9</sup>	3 PHYS 212 or 251 (GN)	4
General Education Course	3 General Education Course	3
	<b>17</b>	<b>16</b>

### Third Year

Fall	Credits Spring	Credits
BMB 400 <sup>*2</sup>	2 BMB 402 <sup>*2</sup>	3
BMB 401 <sup>*2</sup>	3 BMB 442	3
MICRB 401 <sup>*2</sup>	3 MICRB 415 <sup>*2,4</sup>	3
MICRB 421W	3 MICRB Elective (List A) <sup>4,5,9</sup>	3
General Education Course	3 General Education Course	3
General Education Course (GHW)	1.5 General Education Course (GHW)	1.5
	<b>15.5</b>	<b>16.5</b>

### Fourth Year

Fall	Credits Spring	Credits
MICRB 450 <sup>*2</sup>	3 MICRB Elective (List B) <sup>5,9</sup>	3
PPEM 456 <sup>*2</sup>	3 MICRB Elective (List B) <sup>5,9</sup>	3
MICRB Elective (List B) <sup>5,6,7,9</sup>	0-3 Department List C <sup>9</sup>	2
Department List C <sup>9</sup>	3 Department List C <sup>9</sup>	3
General Education Course (GWS) <sup>††4,6</sup>	3 General Education Course	3
General Education Course	3	
	<b>15-18</b>	<b>14</b>

### Total Credits 125-129

\* 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

<sup>1</sup> All three courses are required for the major, but a grade of C or better is required in two of the following: MICRB 201, BMB 251/MICRB 251 or BIOL 230W, BMB 252/MICRB 252 (Cell Biology and Genetics Emphasis) or BIOL 220W (Ecology Emphasis)

<sup>2</sup> To graduate, a grade of C or better is required in 9 credits of prescribed 400-level courses, excluding BMB 442 and MICRB 421W.

<sup>3</sup> Two series of courses can be taken – Cell Biology and Genetics Emphasis: BMB 251 (or BIOL 230W), BMB 252 and BIOL 322 (or BIOL 222); Cell Biology and Ecology Emphasis: BIOL 110, BIOL 230W and BIOL 220W. Students must complete either three-course series in full. No mixing courses between series.

<sup>4</sup> There may be an alternative option offered in a different semester. See adviser for more information.

<sup>5</sup> 12-credit microbiology-based elective requirement from List A (Applied) and List B (Lecture) electives, with a minimum of 3 credits taken from List A. Although, if a student wants more lab experience, more courses can be taken from List A to fulfill the requirement. A maximum of 3 credits of BMB 408/MICRB 408 and a maximum of 4 credits of BMB 488 and/or BMB 496 can be used to fulfill this requirement but will not count toward the 3-cr. minimum of List A category requirement.

<sup>6</sup> BIOL 403 or BMB 491 can double count for GWS credit and List B elective. If student does not take BIOL 403 or BMB 491, ENGL 202C/ENGL 202A/ENGL 202B/ENGL 202D can be taken instead.

<sup>7</sup> If students takes a List B elective that also satisfies GWS, then do not need additional List B credits here.

<sup>8</sup> If a student takes the course with the higher amount of credits, the extra credit can apply towards the List C elective category.

<sup>9</sup> Consult with an academic adviser for options.

### University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy Cultural Diversity 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.

General Education includes Foundations (GWS and GQ), Knowledge Domains (GHW, GN, GA, GH, GS) and Integrative Studies (Inter-domain) requirements. N or Q (Honors) is the suffix at the end of a course number used to help identify an Inter-domain course, but the inter-domain attribute is used to fill audit requirements. Foundations courses (GWS and GQ) require a grade of 'C' or better.

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 satisfy a portion of that General Education requirement. If the student's program prescribes GWS these courses will replace both ENGL 15/ENGL 30H and CAS 100A/CAS 100B/CAS 100C. Each course is 3 credits.

## Medical Microbiology Option: Microbiology, 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
First-Year Seminar	1 MICRB 201 <sup>*1</sup>	3
CHEM 110 (GN) <sup>*#†</sup>	3 MICRB 202 or 203	2
CHEM 111 (GN) <sup>*#†</sup>	1 CHEM 112 (GN) <sup>*#†</sup>	3
MATH 140 (GQ) <sup>*†#†</sup>	4 CHEM 113 (GN) <sup>†</sup>	1
ENGL 15 or 30H (GWS) <sup>‡</sup>	3 MATH 141, STAT 200, STAT 240, or STAT 250 (GQ) <sup>††8</sup>	3-4
General Education Course	3 CAS 100A, 100B, or 100C (GWS) <sup>‡</sup>	3
	<b>15</b>	<b>15-16</b>

### Second Year

Fall	Credits Spring	Credits
BMB/MICRB 251 <sup>*1,3</sup>	3 BMB/MICRB 252 <sup>*1</sup>	3
CHEM 210	3 CHEM 212	3
PHYS 211 or 250 (GN) <sup>†</sup>	4 CHEM 213W	2
Department List C <sup>9</sup>	3 PHYS 212 or 251 (GN)	4
General Education Course	3 BIOL 322 <sup>3</sup>	3
	<b>16</b>	<b>15</b>

### Third Year

Fall	Credits Spring	Credits
BMB 401 <sup>*2</sup>	3 BMB 400 <sup>*2</sup>	2
MICRB 410 <sup>*2,3</sup>	3 BMB 402 <sup>*2</sup>	3
MICRB 421W	3 BMB 442	3
MICRB 450 <sup>*2</sup>	3 Department List C <sup>9</sup>	3
General Education Course	3 General Education Course	3
General Education Course (GHW)	1.5 General Education Course (GHW)	1.5
	<b>16.5</b>	<b>15.5</b>

### Fourth Year

Fall	Credits Spring	Credits
MICRB 401 <sup>*2</sup>	3 MICRB 412 <sup>*2</sup>	3
PPEM 456 <sup>*2</sup>	3 MICRB 415 <sup>*2,3</sup>	3
MICRB Elective (List B) <sup>4,7</sup>	0-3 MICRB Elective (List A) <sup>3,4</sup>	3
Department List C <sup>9</sup>	2 Department List C <sup>9</sup>	3
General Education Course (GWS) <sup>††,5</sup>	3 General Education Course	3
General Education Course	3	
	<b>14-17</b>	<b>15</b>

**Total Credits 122-126**

\* 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

<sup>1</sup> All three courses are required for the major, but a grade of C or better is required in two of the following: MICRB 201, BMB 251/MICRB 251 or BIOL 230W, BMB 252/MICRB 252.

<sup>2</sup> To graduate, a grade of C or better is required in 9 credits of prescribed 400-level courses, excluding BMB 442 and MICRB 421W.

<sup>4</sup> There may be an alternative option offered in a different semester. See adviser for more information.

<sup>5</sup> 6-credit microbiology-based elective requirement (List B electives). A maximum of 3 credits of BMB/MICRB, BMB 488 and/or BMB 496 can be used to fulfill this requirement.

<sup>6</sup> BIOL 403 or BMB 491 can double count for GWS credit and List B elective. If student does not take BIOL 403 or BMB 491, ENGL 202C/ENGL 202A/ENGL 202B/ENGL 202D can be taken instead.

<sup>7</sup> If students takes a List B elective that also satisfies GWS, then do not need additional List B credits here.

<sup>8</sup> When a range of credits is listed for the GQ courses, if a student takes a course with the higher amount of credits, the extra credit can apply towards the List C elective category.

<sup>9</sup> Consult with an academic adviser for options.

### University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy Cultural Diversity 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.

General Education includes Foundations (GWS and GQ), Knowledge Domains (GHW, GN, GA, GH, GS) and Integrative Studies (Inter-domain) requirements. N or Q (Honors) is the suffix at the end of a course number used to help identify an Inter-domain course, but the inter-domain attribute is used to fill audit requirements. Foundations courses (GWS and GQ) require a grade of 'C' or better.

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 satisfy a portion of that General Education requirement. If the student's program prescribes GWS these courses will replace both ENGL 15/ENGL 30H and CAS 100A/CAS 100B/CAS 100C. Each course is 3 credits.

## Career Paths

Penn State students with a BS in Microbiology are prepared for jobs in industry as well as government, medical and university research laboratories. Many students also decide to continue their studies by attending graduate programs or professional schools including medical, dental, business and law school.

## Careers

A BS in Microbiology prepares students for a wide variety of careers, including health related professions, professions in academia, government, and industry. Examples of microbiology related careers are:

- Agricultural or Environmental Scientist
- Biological / Media Illustrator

- Biomedical Researcher
- Biosecurity and Biodefense
- Brewery Scientist
- Clinical Microbiology Lab Director
- Drug Development
- Food Safety Expert
- Genetic Engineer
- Health Professions – e.g. Dentist, Optometrist, Pharmacist, Physician, Physician Assistant
- Industrial Microbiologist
- Patent Attorney
- Pharmaceutical Sales
- Pharmaceutical Sciences
- Professor
- Public Health Scientist
- Research Technician
- Science Policy Expert
- Science Writer / Editor

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE MICROBIOLOGY PROGRAM (<https://asm.org/careers/>)

## Opportunities for Graduate Studies

Many Penn State students with a BS in Microbiology will pursue graduate education (MS or PhD) in microbiology or other related disciplines (biochemistry, biology, bioinformatics, cell biology, chemistry, genomics, geo-microbiology, immunology, neurobiology, toxicology, pharmacology, plant pathology, and others). A BS in microbiology will also prepare 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
- Physical Therapy School
- Public Health (MPH)
- Veterinary School

In addition, graduates with a Microbiology degree may decide to pursue further education in law or business.

## Professional Resources

- American Society for Microbiology (<https://asm.org>)

## Contact

### University Park

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