

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/students/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/>).

Common Requirements for the Major (All Options)

| Code | Title | Credits |
|---|--|---------|
| Prescribed Courses ¹ | | |
| 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 ² | 3 |
| MICRB 401 | Microbial Physiology and Structure | 3 |
| MICRB 421W | Laboratory of General and Applied Microbiology | 3 |
| MICRB 450 | Microbial/Molecular Genetics | 3 |
| PPEM 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 |
| Additional Courses | | |
| MICRB 202 | Introductory Microbiology Laboratory | 2 |
| or MICRB 203 | Inquiry-based Microbiology Laboratory | |
| PHYS 250 | Introductory Physics I | 4 |
| or PHYS 211 | General Physics: Mechanics | |
| PHYS 251 | Introductory Physics II | 4 |
| or PHYS 212 | General Physics: Electricity and Magnetism | |
| <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) ³ | 3 |
| Select 3 credits from MICRB Elective List B ³ | 3 |
| Select 11 credits from MICRB Elective List C (free electives) | 11 |
| Requirements for the Option | |
| Select an option | 18-21 |

- ¹ To graduate, a grade of C or better is required in 9 credits of prescribed 400-level courses, excluding BMB 442 and MICRB 421W.
- ² 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
- ³ 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 |
|---|---|---------|
| Prescribed Courses | | |
| MICRB 415 | General Virology: Bacterial and Animal Viruses | 3 |
| Additional Courses | | |
| 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 ¹ | |
| or BIOL 230W | Biology: Molecules and Cells | |
| BMB 252 | Molecular and Cell Biology II ¹ | |
| <i>Sequence 2</i> | | |
| BIOL 110 | Biology: Basic Concepts and Biodiversity | |
| BIOL 220W | Biology: Populations and Communities ¹ | |
| BIOL 230W | Biology: Molecules and Cells ¹ | |
| Supporting Courses and Related Areas | | |
| Select 6 credits from MICRB Elective List B | | 6 |

- ¹ 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 |
|--------------------|-------------------------------|---------|
| Prescribed Courses | | |
| BMB 252 | Molecular and Cell Biology II | 3 |
| MICRB 410 | Principles of Immunology | 3 |
| MICRB 412 | Medical Microbiology | 3 |
| Additional Courses | | |
| BIOL 322 | Genetic Analysis | 3 |
| or BIOL 222 | Genetics | |

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

- ¹ 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/students/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/>)). For more information, check the Suggested Academic Plan for your intended program.

Program Learning Objectives

Students will:

- synthesize information from a variety of sources in order to create a comprehensive presentation regarding a microbiology topic
 - access, analyze, and evaluate the primary and secondary literature
 - effectively extract central points and summarize research literature in the field of microbiology
- formulate and support one's own scholarly opinion based on reading, interpreting, and synthesizing scientific literature
- effectively communicate ideas both orally and in written form to a variety of audiences, both lay and professional
- present, analyze and interpret quantitative data using statistics, graphs, and data tables

Students will:

- acquire and recognize why a background in the biological, chemical, and physical sciences is necessary for advanced study in specialty microbiology courses
- be able to demonstrate knowledge of the core principles of microbiology by:
 - explaining the fundamental processes required for cellular life (metabolism, cell structure/function, genetics)

- describing how forces of evolution (e.g., competition, genetic exchange) affect microorganisms.
- comparing and contrasting results of evolution in terms of diversity and relatedness
- explaining interactions among microbes and between microbes and multicellular organisms
- describing how microorganisms and their environment interact with and modify each other
- apply and integrate knowledge of microbiology principles to real-life scenarios
- identify skills necessary for a professional career in microbiology and other fields related to the life sciences

Students will be able to:

- recognize and discuss ethical issues that relate to scientific research and scientific practices
- discuss the impact of microbiology in a global, economic, environmental, and societal context
- explore careers related to the field of microbiology
- work collaboratively with a diverse set of individuals

Students will be able to:

- formulate a hypothesis, design experiments, acquire and analyze data, and use the results to test a stated hypothesis
- demonstrate proficiency in techniques used in microbiology and an ability to select appropriate techniques that will allow an individual to address a scientific question related to the field of microbiology
- compare and contrast conclusions from a set of data with models developed to represent a process related to the experimental scenario
- work safely in a lab
- use quantitative and statistical reasoning

Students will be able to:

- use reflection to evaluate one's own progress in accomplishing a defined goal
- identify situations in which more information is needed to develop a comprehensive understanding
- identify and use strategies that allow the individual to gain the information needed to answer problems for which the solution is not initially evident

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/students/policies-and-rules-for-undergraduate-students/32-00-advising-policy/>)

University Park

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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 2025-26 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 ¹ | 3 |
| CHEM 110 ^{*#†} | 3 MICRB 202 or 203 ⁷ | 2 |
| CHEM 111 ^{*#†} | 1 CHEM 112 ^{*#†} | 3 |
| MATH 140 ^{*†#†} | 4 CHEM 113 [†] | 1 |
| ENGL 15 or 30H [†] | 3 MATH 141, STAT 200, STAT 240, or STAT 250 ^{††6} | 3-4 |
| General Education Course | 3 CAS 100A, 100B, or 100C [†] | 3 |
| | 15 | 15-16 |

Second Year

| Fall | Credits Spring | Credits |
|--------------------------------|--------------------------------|-----------|
| BMB/MICRB 251 ^{1,3,4} | 3 BMB/MICRB 252 ^{1,3} | 3 |
| CHEM 210 | 3 BIOL 322 ⁴ | 3 |
| PHYS 211 or 250 [†] | 4 CHEM 212 | 3 |
| Department List C ⁷ | 3 CHEM 213W | 2 |
| General Education Course | 3 PHYS 212 or 251 [†] | 4 |
| | 16 | 15 |

Third Year

| Fall | Credits Spring | Credits |
|----------------------------|--|---------|
| BMB 400 ² | 2 BMB 402 ² | 3 |
| BMB 401 ² | 3 BMB 442 | 3 |
| MICRB 421W | 3 MICRB 415 ² | 3 |
| MICRB/BMB 450 ² | 3 MICRB Elective (List B) ^{2,5,7} | 3 |
| General Education Course | 3 General Education Course | 3 |

| General Education Course (GHW) | 1.5 General Education Course (GHW) | 1.5 |
|--|---|--------------|
| | 15.5 | 16.5 |
| Fourth Year | | |
| Fall | Credits Spring | Credits |
| MICRB 401 ² | 3 MICRB Elective (List A) ^{2,5,7} | 3 |
| MICRB/PPEM 456 ² | 3 MICRB Elective (List B) ^{2,5,7} | 3 |
| MICRB Elective (List B) ^{2,5,7} | 3 ENGL 202C, 202A, 202B, or 202D [†] | 3 |
| Department List C ⁷ | 3-4 Department List C ⁷ | 3-4 |
| General Education Course | 3 General Education Course | 3 |
| | 15-16 | 16-15 |

Total Credits 124-125

* 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 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.

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

³ 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 one of the three-course series in full. No mixing courses between series.

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

⁵ 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. 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.

⁶ If a student takes the course with the higher amount of credits, the extra credit can apply towards the List C elective category.

⁷ 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.

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 ¹ | 3 |
| BIOL 110 [†] | 4 MICRB 202 or 203 ⁷ | 2 |
| CHEM 110 ^{*#†} | 3 CHEM 112 ^{*#†} | 3 |
| CHEM 111 ^{*#†} | 1 CHEM 113 [†] | 1 |
| MATH 140 ^{*#†} | 4 MATH 141, STAT 200, STAT 240, or STAT 250 ^{††6} | 3-4 |
| ENGL 15, 30H, or ESL 15 [‡] | 3 CAS 100A, 100B, or 100C [‡] | 3 |
| | 16 | 15-16 |

Second Year

| Fall | Credits Spring | Credits |
|--------------------------------|--------------------------------|-----------|
| BIOL 220W ^{†1,3} | 4 BIOL 230W ^{†1,3} | 4 |
| CHEM 210 | 3 CHEM 212 | 3 |
| PHYS 211 or 250 [†] | 4 CHEM 213W | 2 |
| Department List C ⁷ | 1 PHYS 212 or 251 [†] | 4 |
| General Education Course | 3 General Education Course | 3 |
| | 15 | 16 |

Third Year

| Fall | Credits Spring | Credits |
|--------------------------------|--|-------------|
| BMB 400 ² | 2 BMB 402 ² | 3 |
| BMB 401 ² | 3 BMB 442 | 3 |
| MICRB 421W | 3 MICRB 415 ² | 3 |
| MICRB/BMB 450 ² | 3 MICRB Elective (List B) ^{2,5,7} | 3 |
| General Education Course | 3 General Education Course | 3 |
| General Education Course (GHW) | 1.5 General Education Course (GHW) | 1.5 |
| | 15.5 | 16.5 |

Fourth Year

| Fall | Credits Spring | Credits |
|--|---|-----------|
| MICRB 401 ² | 3 MICRB Elective (List A) ^{2,5,7} | 3 |
| MICRB/PPEM 456 ² | 3 MICRB Elective (List B) ^{2,5,7} | 3 |
| MICRB Elective (List B) ^{2,5,7} | 3 ENGL 202C, 202A, 202B, or 202D [‡] | 3 |
| Department List C ⁷ | 3-4 Department List C ⁷ | 3 |
| General Education Course | 3 General Education Course | 3 |
| | 16-15 | 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 All three courses are required for the major, but a grade of C or better is required in two of the following: MICRB 201, BIOL 220W, and BIOL 230W.
- ² To graduate, a grade of C or better is required in 9 credits of prescribed 400-level courses, excluding BMB 442 and MICRB 421W.
- ³ 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 one of the three-course series in full. No mixing courses between series.
- ⁴ There may be an alternative option offered in a different semester. See adviser for more information.
- ⁵ 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.
- ⁶ If a student takes the course with the higher amount of credits, the extra credit can apply towards the List C elective category.
- ⁷ 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 ¹ | 3 |
| CHEM 110 ^{*#†} | 3 MICRB 202 or 203 ⁷ | 2 |
| CHEM 111 ^{*#†} | 1 CHEM 112 ^{*#†} | 3 |
| MATH 140 ^{*†#†} | 4 CHEM 113 [†] | 1 |
| ENGL 15, 30H, or ESL 15 [†] | 3 MATH 141, STAT 200, STAT 240, or STAT 250 ^{††6} | 3-4 |
| General Education Course | 3 CAS 100A, 100B, or 100C [‡] | 3 |
| | 15 | 15-16 |

Second Year

| Fall | Credits Spring | Credits |
|--------------------------------|--------------------------------|-----------|
| BMB/MICRB 251 ^{1,3,4} | 3 BMB/MICRB 252 ^{1,3} | 3 |
| CHEM 210 | 3 BIOL 322 ⁴ | 3 |
| PHYS 211 or 250 [†] | 4 CHEM 212 | 3 |
| Department List C ⁷ | 3 CHEM 213W | 2 |
| General Education Course | 3 PHYS 212 or 251 [†] | 4 |
| | 16 | 15 |

Third Year

| Fall | Credits Spring | Credits |
|--------------------------------|------------------------------------|-------------|
| BMB 400 ² | 2 BMB 402 ² | 3 |
| BMB 401 ² | 3 BMB 442 | 3 |
| MICRB 421W | 3 MICRB 410 ² | 3 |
| MICRB/BMB 450 ² | 3 Department List C ⁷ | 3 |
| General Education Course | 3 General Education Course | 3 |
| General Education Course (GHW) | 1.5 General Education Course (GHW) | 1.5 |
| | 15.5 | 16.5 |

Fourth Year

| Fall | Credits Spring | Credits |
|--|---|--------------|
| MICRB 401 ² | 3 MICRB 412 ² | 3 |
| MICRB/PPEM 456 ² | 3 MICRB 415 ^{2,4} | 3 |
| MICRB Elective (List B) ^{2,5,7} | 3 MICRB Elective (List A) ^{2,5,7} | 3 |
| Department List C ⁷ | 3-4 ENGL 202C, 202A, 202B, or 202D [‡] | 3 |
| General Education Course | 3 Department List C ⁷ | 0-1 |
| | General Education Course | 3 |
| | 15-16 | 16-15 |

Total Credits 124-125

* 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 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.

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

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

⁵ 6-credit microbiology-based elective requirement from List A (Applied) and List B (Lecture) electives, with a minimum 3 credits taken from List A. 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 3 credits of BMB 488 and/or BMB 496 can be used to fulfill this requirement but will not count toward the 3-credit minimum of the List A category requirement.

⁶ If a student takes the course with the higher amount of credits, the extra credit can apply towards the List C elective category.

⁷ Consult with an academic adviser for options.

University Requirements and General Education Notes:

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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 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 |
|--------------------------------------|--|--------------|
| First-Year Seminar | 1 CHEM 112 ^{*#†} | 3 |
| BIOL 110 [†] | 4 CHEM 113 [†] | 1 |
| CHEM 110 ^{*#†} | 3 MATH 141, STAT 200, STAT 240, or STAT 250 ^{††6} | 3-4 |
| CHEM 111 ^{*#†} | 1 CAS 100A, 100B, or 100C [‡] | 3 |
| MATH 140 ^{*#††} | 4 Department List C ⁷ | 3 |
| ENGL 15, 30H, or ESL 15 [‡] | 3 General Education Course | 3 |
| | 16 | 16-17 |

Second Year

| Fall | Credits Spring | Credits |
|-----------------------------------|-------------------------------------|-----------|
| BIOL 220W or 230W ^{+1,3} | 4 BIOL 220W or 230W ^{+1,3} | 4 |
| CHEM 210 | 3 CHEM 212 | 3 |
| PHYS 211 or 250 [†] | 4 CHEM 213W | 2 |
| Department List C ⁷ | 1 PHYS 212 or 251 [†] | 4 |
| General Education Course | 3 General Education Course | 3 |
| General Education Course (GHW) | 1.5 | |
| | 16.5 | 16 |

Third Year

| Fall | Credits Spring | Credits |
|--------------------------------|--|-------------|
| MICRB 201 ¹ | 3 BMB 400 ² | 2 |
| MICRB 202 ⁷ | 2 BMB 402 ² | 3 |
| BMB 401 ² | 3 BMB 442 | 3 |
| MICRB/BMB 450 ² | 3 MICRB Elective (List B) ^{2,5,7} | 3 |
| Department List C ⁷ | 1-2 General Education Course | 3 |
| General Education Course | 3 General Education Course (GHW) | 1.5 |
| | 16-15 | 15.5 |

Fourth Year

| Fall | Credits Spring | Credits |
|--|---|-----------|
| MICRB 401 ² | 3 MICRB 415 ² | 3 |
| MICRB 421W | 3 MICRB Elective (List A) ^{2,5,7} | 3 |
| MICRB/PPEM 456 ² | 3 MICRB Elective (List B) ^{2,5,7} | 3 |
| MICRB Elective (List B) ^{2,5,7} | 3 ENGL 202C, 202A, 202B, or 202D [‡] | 3 |
| General Education Course | 3 Department List C ⁷ | 2 |
| | 15 | 14 |

Total Credits 125

Course is an Entrance to Major requirement

† Course satisfies General Education and degree requirement

- 1 All three courses are required for the major, but a grade of C or better is required in two of the following: MICRB 201, BIOL 220W, and BIOL 230W.
- 2 To graduate, a grade of C or better is required in 9 credits of prescribed 400-level courses, excluding BMB 442 and MICRB 421W.
- 3 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 one of the three-course series in full. No mixing courses between series.
- 4 There may be an alternative option offered in a different semester. See adviser for more information.
- 5 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.
- 6 If a student takes the course with the higher amount of credits, the extra credit can apply towards the List C elective category.
- 7 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.

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

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

Medical Microbiology Option: Microbiology, 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 |
|--------------------------------------|--|------------------|
| BIOL 110 [†] | 4 BIOL 230W ^{†1} | 4 |
| CHEM 110 ^{*#†} | 3 CHEM 112 ^{*#†} | 3 |
| CHEM 111 ^{*#†} | 1 CHEM 113 [†] | 1 |
| MATH 140 ^{*†#†} | 4 MATH 141, STAT 200, STAT 240, or STAT 250 ^{††6} | 3-4 |
| ENGL 15, 30H, or ESL 15 [†] | 3 CAS 100A, 100B, or 100C [‡] | 3 |
| | General Education Course (GHW) | 1.5 |
| | 15 | 15.5-16.5 |

Second Year

| Fall | Credits Spring | Credits Summer | Credits |
|---|--------------------------------|------------------------|----------|
| CHEM 210 | 3 CHEM 212 | 3 BMB 401 ² | 3 |
| PHYS 211 or 250 [†] | 4 CHEM 213W | 2 | |
| ENGL 202C, 202A, 202B, or 202D [‡] | 3 PHYS 212 or 251 [†] | 4 | |
| General Education Course | 6 General Education Course | 6 | |
| | 16 | 15 | 3 |

Third Year

| Fall | Credits Spring | Credits Summer | Credits |
|--------------------------------|----------------------------|--------------------------|----------|
| BIOL 222 ^{3,4} | 3 BMB 400 ² | 2 MICRB 410 ² | 3 |
| BMB/MICRB 252 ¹ | 3 BMB 402 ² | 3 | |
| MICRB 201 ¹ | 3 BMB 442 | 3 | |
| MICRB 202 | 2 MICRB 412 ^{2,7} | 3 | |
| General Education Course | 3 General Education Course | 3 | |
| General Education Course (GHW) | 1.5 | | |
| | 15.5 | 14 | 3 |

Fourth Year

| Fall | Credits Spring | Credits |
|------------------------|--|---------|
| MICRB 401 ² | 3 MICRB 415 ^{2,4,7} | 3 |
| MICRB 421W | 3 MICRB Elective (List A) ^{2,5,7} | 3 |

| | | |
|--------------------------------|--|--------------|
| MICRB/BMB 450 ² | 3 MICRB Elective (List B) ^{2,5,7} | 3 |
| MICRB/PPEM 456 ² | 3 Department List C ⁷ | 4-5 |
| Department List C ⁷ | 2 | |
| | 14 | 14-13 |

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 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.

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

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

⁵ 6-credit microbiology-based elective requirement from List A (Applied) and List B (Lecture) electives, with a minimum 3 credits taken from List A. 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 3 credits of BMB 488 and/or BMB 496 can be used to fulfill this requirement but will not count toward the 3-credit minimum of the List A category requirement.

⁶ If a student takes the course with the higher amount of credits, the extra credit can apply towards the List C elective category.

⁷ 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-Professional-Development/>)

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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