University Core and Graduation Requirements

**University Core Requirements:**

### Religion Cornerstones
- Teachings and Doctrine of The Book of Mormon
- Jesus Christ and the Everlasting Gospel
- Foundations of the Restoration
- The Eternal Family

### American Heritage
- First Year Writing
- Advanced Written and Oral Communications

### Quantitative Reasoning
- General Education courses
- General electives

### Languages of Learning (Math or Language)
- First-year Writing or American Heritage
- Advanced Written and Oral Communications

### Arts, Letters, and Sciences
- Civilization
- Arts
- Letters
- Biological Science
- Physical Science

### Core Enrichment: Electives
- Religion Electives
- Open Electives

### Graduation Requirements:
- Minimum residence hours required
- Minimum hours needed to graduate

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**Suggested Sequence of Courses**

**FRESHMAN YEAR**

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-year Writing or American Heritage*</td>
<td>3.0</td>
</tr>
<tr>
<td>REL A 275</td>
<td>2.0</td>
</tr>
<tr>
<td>MMBIO 122 or PDBIO 120 or BIO 130</td>
<td>3.0-4.0</td>
</tr>
<tr>
<td>CHEM 105</td>
<td>4.0</td>
</tr>
<tr>
<td>General Education courses, and/or general electives</td>
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</tr>
<tr>
<td>Total Hours</td>
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**2nd Semester**

<table>
<thead>
<tr>
<th>1st Semester</th>
<th>Hours</th>
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<tbody>
<tr>
<td>First-year Writing or American Heritage*</td>
<td>3.0</td>
</tr>
<tr>
<td>REL A 250</td>
<td>2.0</td>
</tr>
<tr>
<td>MMBIO 151</td>
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<tr>
<td>CHEM 106</td>
<td>3.0</td>
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<tr>
<td>CHEM 107</td>
<td>1.0</td>
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<tr>
<td>Arts or Letters elective*</td>
<td>3.0</td>
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<tr>
<td>Total Hours</td>
<td>16.0</td>
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**SOPHOMORE YEAR**

<table>
<thead>
<tr>
<th>3rd Semester</th>
<th>Hours</th>
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<tbody>
<tr>
<td>REL C 225</td>
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<tr>
<td>MMBIO 240</td>
<td>3.0</td>
</tr>
<tr>
<td>MMBIO 241</td>
<td>1.0</td>
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<tr>
<td>PHSCS 105</td>
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<tr>
<td>Civilization 1 elective</td>
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<tr>
<td>Social Science elective*</td>
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<tr>
<td>Total Hours</td>
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<table>
<thead>
<tr>
<th>4th Semester</th>
<th>Hours</th>
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<tbody>
<tr>
<td>REL C 200</td>
<td>2.0</td>
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<tr>
<td>MMBIO 261</td>
<td>3.0</td>
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<tr>
<td>Major elective</td>
<td>3.0</td>
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<tr>
<td>Civilization 2 elective*</td>
<td>3.0</td>
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<tr>
<td>Languages of Learning (MATH or language)</td>
<td>3.0-4.0</td>
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<tr>
<td>Total Hours</td>
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**JUNIOR YEAR**

<table>
<thead>
<tr>
<th>5th Semester</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Religion elective*</td>
<td>2.0</td>
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<tr>
<td>CHEM 351 or CHEM 285</td>
<td>3.0-4.0</td>
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<tr>
<td>Quantitative Reasoning choice</td>
<td>3.0-4.0</td>
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<tr>
<td>MMBIO 360, 363, or 461 (Option 3.1)</td>
<td>3.0-4.0</td>
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<tr>
<td>Major elective</td>
<td>3.0</td>
</tr>
<tr>
<td>Total Hours</td>
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</table>

<table>
<thead>
<tr>
<th>6th Semester</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Religion elective*</td>
<td>2.0</td>
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<tr>
<td>Option 3.2 choice</td>
<td>3.0-4.0</td>
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<tr>
<td>Major electives</td>
<td>8.0</td>
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<tr>
<td>General elective</td>
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<tr>
<td>Total Hours</td>
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**SENIOR YEAR**

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<tr>
<th>7th Semester</th>
<th>Hours</th>
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</thead>
<tbody>
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<td>Religion elective*</td>
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<tr>
<td>Major elective</td>
<td>3.0</td>
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<tr>
<td>Option 3.2 choice</td>
<td>2.4-4.0</td>
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<tr>
<td>Adv. Written &amp; Oral Communication</td>
<td>3.0</td>
</tr>
<tr>
<td>Arts or Letters elective</td>
<td>3.0</td>
</tr>
<tr>
<td>Total Hours</td>
<td>13-15.0</td>
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</table>

<table>
<thead>
<tr>
<th>8th Semester</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Open electives</td>
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<tr>
<td>Global and Cultural Awareness*</td>
<td>3.0</td>
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<tr>
<td>Major electives</td>
<td>3.0</td>
</tr>
<tr>
<td>Total Hours</td>
<td>14.0</td>
</tr>
</tbody>
</table>

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*Quantitative Reasoning can be fulfilled by ACT Math subscore of 22 or higher.

Note: Students are encouraged to complete an average of 15 credit hours each semester or 30 credit hours each year, which could include spring and/or summer terms. Taking fewer credits substantially increases the cost and the number of semesters to graduate.

*Double counting options available for some GE courses
BS in Microbiology (285120)
2020-2021 Program Requirements (53 - 59 Credit Hours)

REQUIREMENT 1: Complete 1 course
* BIO 110 - Biology
MMBIO 121 - General Biology: Health and Disease
* PDBIO 120 - Science of Biology

REQUIREMENT 2: Complete 4 courses
MMBIO 151 - Introduction to Microbiology
MMBIO 240 - Molecular Biology
MMBIO 241 - Molecular and Cellular Biology Laboratory
MMBIO 261 - Infection and Immunity

REQUIREMENT 3: Complete 1 course

OPTION 3.1: Complete 1 course
MMBIO 360 - Microbial Genetics
MMBIO 461 - Advanced Bacterial Physiology

OPTION 3.2: Complete 2 courses
MMBIO 363 - Microbial Ecology
MMBIO 366 - Microbial Ecology Laboratory

REQUIREMENT 4: Complete 2 courses

COMPLETE TWO OR MORE COURSES FROM THE FOLLOWING (NOTE: THE COURSE TAKEN ABOVE WILL NOT DOUBLE COUNT FOR THIS REQUIREMENT):

MMBIO 360 - Microbial Genetics
MMBIO 363 - Microbial Ecology
MMBIO 364 - Bacterial Pathogenesis
MMBIO 418 - Medical Parasitology
MMBIO 461 - Advanced Bacterial Physiology
MMBIO 463 - Immunology
MMBIO 465 - Virology

Note: it is recommended students take any courses not used to fill this requirement as electives.

REQUIREMENT 5: Complete 4 courses

PHYSICAL SCIENCE COURSES:
CHEM 105 - General College Chemistry 1 with Lab (Integrated)
CHEM 106 - General College Chemistry 2
CHEM 107 - General College Chemistry Laboratory
PHSCS 105 - General Physics 1

REQUIREMENT 6: Complete 1 course

CHEM 285 - Introductory Bio-organic Chemistry
CHEM 351 - Organic Chemistry 1

REQUIREMENT 7: Complete 1 option

OPTION 7.1: Complete 1 course

QUANTITATIVE COURSES:
* MATH 112 - Calculus 1
MATH 119 - Introduction to Calculus
* STAT 121 - Principles of Statistics

Note: Math 119 is offered through BYU Independent Study.

OPTION 8.1: Complete up to 14.0 hours from the following course(s)

BIO 365 - Introduction to Bioinformatics
BIO 350 - Ecology
BIO 430 - Evolutionary Biology
BIO 463 - Genetics of Human Disease
CHEM 351 - Organic Chemistry 1
CHEM 352 - Organic Chemistry 2
CHEM 353 - Organic Chemistry Laboratory--Nonmajors
CHEM 481 - Biochemistry
CHEM 482 -  Genomics
CHEM 483 - Mechanisms of Molecular Biology
CHEM 100R - Extremophiles: Life in Extreme Environments
CHEM 122 - General Biology: Health and Disease Laboratory
CHEM 160R - Careers in Biomedical Sciences
CHEM 350 - Genetic Counseling
CHEM 365 - Bacterial Pathogenesis Laboratory
CHEM 390R - Readings in Molecular Biology
CHEM 409 - Hematology
CHEM 411 - Molecular Diagnostics
CHEM 441 - Advanced Molecular Biology
CHEM 442 - Advanced Molecular Biology Laboratory
CHEM 466 - Virology Laboratory
CHEM 467 - Immunology Lab
CHEM 468 - (MMBio-Bio-PWS) Genomics
CHEM 471 - Applied and Industrial Microbiology
CHEM 493R - Curriculum and Instruction Practicum
CHEM 510 - History and Philosophy of Microbiology and Molecular Bio: 2.0
CHEM 512 - Gene Regulation
CHEM 514 - Advanced Immunology
CHEM 516 - Bacteria-Host Interactions
CHEM 518 - Select Pathogens
CHEM 520 - Molecular Virology
CHEM 521 - Flow Cytometry
CHEM 528R - Current Topics in Pathogenesis

You may take this course up to 1 time.
NDFS 361 - Food Microbiology

OPTION 8.2: Complete up to 6.0 hours from the following course(s)

NDFS 361 - Food Microbiology
MMBIO 510 - History and Philosophy of Microbiology and Molecular Bio: 2.0
MMBIO 512 - Gene Regulation
MMBIO 514 - Advanced Immunology
MMBIO 516 - Bacteria-Host Interactions
MMBIO 518 - Select Pathogens
MMBIO 520 - Molecular Virology
MMBIO 521 - Flow Cytometry
MMBIO 528R - Current Topics in Pathogenesis

You may take up to 4 credit hours.

OPTION 8.3: Complete up to 6.0 hours from the following course(s)

NDFS 361 - Food Microbiology
MMBIO 510 - History and Philosophy of Microbiology and Molecular Bio: 2.0
MMBIO 512 - Gene Regulation
MMBIO 514 - Advanced Immunology
MMBIO 516 - Bacteria-Host Interactions
MMBIO 518 - Select Pathogens
MMBIO 520 - Molecular Virology
MMBIO 521 - Flow Cytometry
MMBIO 528R - Current Topics in Pathogenesis

You may take up to 4 credit hours.

OPTION 8.4: Complete up to 14.0 hours from the following course(s)

PHYSICAL SCIENCE COURSES:
CHEM 105 - General College Chemistry 1 with Lab (Integrated)
CHEM 106 - General College Chemistry 2
CHEM 107 - General College Chemistry Laboratory
PHSCS 105 - General Physics 1

REQUIREMENT 8: Complete 14.0 hours from the following option(s)

OPTION 8.1: Complete up to 14.0 hours from the following course(s)

BIO 365 - Introduction to Bioinformatics
BIO 350 - Ecology
BIO 430 - Evolutionary Biology
BIO 463 - Genetics of Human Disease
CHEM 351 - Organic Chemistry 1
CHEM 352 - Organic Chemistry 2
CHEM 353 - Organic Chemistry Laboratory--Nonmajors
CHEM 481 - Biochemistry
CHEM 482 -  Genomics
CHEM 483 - Mechanisms of Molecular Biology
CHEM 100R - Extremophiles: Life in Extreme Environments
CHEM 122 - General Biology: Health and Disease Laboratory
CHEM 160R - Careers in Biomedical Sciences
CHEM 350 - Genetic Counseling
CHEM 365 - Bacterial Pathogenesis Laboratory
CHEM 390R - Readings in Molecular Biology
CHEM 409 - Hematology
CHEM 411 - Molecular Diagnostics
CHEM 441 - Advanced Molecular Biology
CHEM 442 - Advanced Molecular Biology Laboratory
CHEM 466 - Virology Laboratory
CHEM 467 - Immunology Lab
CHEM 468 - (MMBio-Bio-PWS) Genomics
CHEM 471 - Applied and Industrial Microbiology
CHEM 493R - Curriculum and Instruction Practicum
CHEM 510 - History and Philosophy of Microbiology and Molecular Bio: 2.0
CHEM 512 - Gene Regulation
CHEM 514 - Advanced Immunology
CHEM 516 - Bacteria-Host Interactions
CHEM 518 - Select Pathogens
CHEM 520 - Molecular Virology
CHEM 521 - Flow Cytometry
CHEM 528R - Current Topics in Pathogenesis

You may take this course up to 1 time.
NDFS 361 - Food Microbiology

OPTION 8.2: Complete up to 6.0 hours from the following course(s)

NDFS 361 - Food Microbiology
MMBIO 510 - History and Philosophy of Microbiology and Molecular Bio: 2.0
MMBIO 512 - Gene Regulation
MMBIO 514 - Advanced Immunology
MMBIO 516 - Bacteria-Host Interactions
MMBIO 518 - Select Pathogens
MMBIO 520 - Molecular Virology
MMBIO 521 - Flow Cytometry
MMBIO 528R - Current Topics in Pathogenesis

You may take up to 4 credit hours.

OPTION 8.3: Complete up to 6.0 hours from the following course(s)

PHYSICAL SCIENCE COURSES:
CHEM 105 - General College Chemistry 1 with Lab (Integrated)
CHEM 106 - General College Chemistry 2
CHEM 107 - General College Chemistry Laboratory
PHSCS 105 - General Physics 1

REQUIREMENT 9: Successfully pass the Biology Major Field Exam.

REQUIREMENT 10: Complete an exit interview.

RECOMMENDED: Complete 4 courses

ALTHOUGH NOT REQUIRED, THESE COURSES ARE RECOMMENDED.

MATH 113 - Calculus 2
PHSCS 107 - General Physics Lab 1
PHSCS 108 - General Physics Lab 2
WRTG 316 - Technical Communication

Note: Students desiring a minor in chemistry must take Chem 223 and 2 hours of Chem 353.
THE DISCIPLINE:
Microbiology applies the tools of chemistry, molecular biology, mathematics, and physics to the study of the structure, biochemistry, genetics, immunology, physiology, and ecology of microorganisms (bacteria, viruses, fungi, protozoa). This is an excellent degree for majors who desire an advanced degree in microbiology, virology, immunology, parasitology, cell biology, or epidemiology (master’s or doctorate).

CAREERS:
Environmental microbiologists are concerned with microorganisms that cause pollution as well as those that can degrade pollutants in bioremediation processes. Microbial ecologists work on land and in water studying how microbes recycle dead plants and animals and how they can be used to maintain environmental quality or correct environmental mishaps. Industrial microbiologists fit into many categories. Food microbiologists seek better strains of organisms used to make products; some microbiologists work in pharmaceutical plants, in antibiotic development; others work on the production of solvents and other products from waste material. Microbial geneticists and biotechnologists study microbial gene function, improve desirable microbial qualities and increase understanding of cell-regulation processes. Microbial physiologists and biochemists study life processes that employ microbial systems and conduct basic research on microbial growth and development. Clinical microbiologists are involved in diagnosis and identification of microbial infections and approaches to treatment. Medical microbiologists study the biology of bacterial pathogens and the mechanisms they use to cause disease.

Virologists study the biology of viruses, the etiology and mechanisms of viral infections and diseases in biological species, and the use of viruses as molecular and biological tools. Immunologists study the molecular and cellular biology of the immune system and its interactions with microorganisms. Parasitologists study the biology, etiology, and epidemiology of parasites and the mechanisms by which they interact with their hosts. Cell biologists study the molecular biology, signal transduction and cell signaling pathways involved in all aspects of biological function. This includes studies at the molecular level of diseases such as heart disease, cancer, diabetes, and AIDS, etc. Epidemiologists study disease epidemics with an effort to track down the method and cause of the disease. See faculty advisor for additional career choices.

RESEARCH OPPORTUNITIES:
Students are encouraged to participate in laboratory research. Faculty-directed research programs are available to undergraduates throughout the year.

FINANCING:
Students may be employed either as research or teaching assistants. Several endowed scholarships are available.

PROGRAM OBJECTIVES:
The objectives of the microbiology major program are to provide a conceptual knowledge base and critical thinking skills related to the following areas:
- Microbial cell biology
- Microbial genetics
- Interactions and impact of microorganisms and humans
- Interactions and impact of microorganisms in the environment
- Integrating themes (microbial evolution and diversity)
- Immunology
- Virology
- Parasitology
- Epidemiology
- Cell Biology

MAP DISCLAIMER
While every reasonable effort is made to ensure accuracy, there are some student populations that could have exceptions to listed requirements. Please refer to the university catalog and your college advisement center/department for complete guidelines.

DEPARTMENT INFORMATION
Microbiology and Molecular Biology
Brigham Young University
4007 Life Sciences Building
Provo, UT 84602
Telephone: (801) 422-2889

ADVISEMENT CENTER INFORMATION
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2060 Life Sciences Building
Provo, UT 84602
Telephone: (801) 422-3042
lifesciences@byu.edu