BIOLOGY, BS

Banner Code: SC-BS-BIOL

Academic Advising
1200 Exploratory Hall
Fairfax Campus

Website: biology.gmu.edu/academics/degree-programs/

The Bachelor of Science in Biology provides a sound liberal arts education with substantial experience in quantitative and analytical thought, along with preparation for related professions. The program provides the strong background necessary for not only graduate study in the life sciences, but also enables students to develop careers in a wide variety of disciplines, including teaching, environmental management, microbiology, molecular biology, biotechnology, genetics, wildlife management, fisheries biology, and marine science. Furthermore, our curriculum prepares students for careers in the health sciences including medicine, dentistry, veterinary science, and related allied health disciplines.

Admissions & Policies

Admissions

University-wide admissions policies can be found in Undergraduate Admissions Policies (http://catalog.gmu.edu/admissions/undergraduate-policies/).

To apply for this program, please complete the George Mason University Admissions Application (https://www2.gmu.edu/admissions-aid/apply-now/).

Policies

Students must fulfill all Requirements for Bachelor's Degrees (http://catalog.gmu.edu/policies/academic/undergraduate-policies/#ap-5-3-2), including the Mason Core (http://catalog.gmu.edu/mason-core/).

Important information and departmental policies are listed in the Department of Biology (http://catalog.gmu.edu/colleges-schools/science/biology/).

BIOL 308 Foundations of Ecology and Evolution meets the writing intensive requirement for this major. Transfer students who have transferred in BIOL 308 Foundations of Ecology and Evolution but did not meet the writing intensive requirement may take MLAB 300 Science Writing to meet the writing intensive requirement.

For policies governing all undergraduate degrees, see AP.5 Undergraduate Policies (http://catalog.gmu.edu/policies/academic/undergraduate-policies/).

Important Program Requirements

• Students may apply no more than 8 credits of BIOL 102 Introductory Biology I-Survey of Biodiversity and Ecology (Mason Core) (http://catalog.gmu.edu/mason-core/) or BIOL 103 Introductory Biology II-Survey of Cell and Molecular Biology (Mason Core) (http://catalog.gmu.edu/mason-core/) and BIOL 105 Introductory Biology II Laboratory (Mason Core) (http://catalog.gmu.edu/mason-core/) toward elective credit (or equivalent transfer credit at the 100 to 200-level) if taken before successful completion of BIOL 213 Cell Structure and Function.
• Biology majors must earn a minimum grade of 'C' in all biology core courses. A grade of 'C' or better must be earned in BIOL 213 Cell Structure and Function in order to advance to other core requirements.
• Students may repeat BIOL 213 Cell Structure and Function once, but a second time only with permission from the Department of Biology.
• Students may not count BIOL 124 Human Anatomy and Physiology and/or BIOL 125 Human Anatomy and Physiology toward any biology major requirement.
• Students who take BIOL 300 BioDiversity may not count BIOL 303 Animal Biology and/or BIOL 304 Plant Biology toward any biology major requirement.
• 44 credits must be in biology coursework.
• BIOL 493 Honors Research in Biology, BIOL 495 Directed Studies in Biology, and BIOL 497 Special Problems in Biology do not satisfy the requirements of the BS degree which state that students must complete at least two upper division courses that include a laboratory. The courses do, however, count as non-laboratory electives. The total limit for BIOL 493 Honors Research in Biology, BIOL 495 Directed Studies in Biology, and BIOL 497 Special Problems in Biology combined is 6 credits toward the 44 credits required for the BS.

Several optional concentrations are available; details on each can be found in the Requirements tab.

Teacher Licensure

Students majoring in biology who wish to pursue a career teaching secondary school may consider applying for the Secondary Education Program (http://catalog.gmu.edu/colleges-schools/education-human-development/secondary-education-biology-6-12-undergraduate-certificate/) offered by the College of Education and Human Development (http://catalog.gmu.edu/colleges-schools/education-human-development/) as an option in seeking an initial Virginia teaching license.

Other routes to licensure include the Biology, BA or BS/Curriculum and Instruction, Accelerated MED (http://catalog.gmu.edu/colleges-schools/education-human-development/secondary-education-biology-6-12-undergraduate-certificate/) (Secondary Education Biology Concentration) or select traditional Master's programs. Please contact the College of Education and Human Development (http://catalog.gmu.edu/colleges-schools/education-human-development/) for more information.

Requirements

Degree Requirements

Total credits: minimum 120

Students should refer to the Admissions & Policies tab for specific policies related to this program.
Students must complete their biology coursework and the supporting requirements which follow with a minimum GPA of 2.00.

All students must complete the Core Courses listed below. Students then elect to complete the BS degree either with a concentration or without a concentration.

### Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 213</td>
<td>Cell Structure and Function</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 214</td>
<td>Biostatistics for Biology Majors</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 300</td>
<td>BioDiversity</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 308</td>
<td>Foundations of Ecology and Evolution</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 311</td>
<td>General Genetics</td>
<td>4</td>
</tr>
</tbody>
</table>

**Chemistry**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 211 &amp; CHEM 213</td>
<td>General Chemistry I (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>) and General Chemistry Laboratory I (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>)</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 212 &amp; CHEM 214</td>
<td>General Chemistry II (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>) and General Chemistry Laboratory II (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>)</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 313 &amp; CHEM 315</td>
<td>Organic Chemistry I and Organic Chemistry Lab I</td>
<td>5</td>
</tr>
</tbody>
</table>

**Physics**

Select from one of the following Mason Core Natural Science sequences:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 160 &amp; PHYS 161 &amp; PHYS 260 &amp; PHYS 261</td>
<td>University Physics I (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>) and University Physics I Laboratory (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>) and University Physics II (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>) and University Physics II Laboratory (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>)</td>
<td>8</td>
</tr>
<tr>
<td>PHYS 243 &amp; PHYS 244 &amp; PHYS 245 &amp; PHYS 246</td>
<td>College Physics I (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>) and College Physics I Lab (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>) and College Physics II (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>) and College Physics II Lab (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>)</td>
<td>4</td>
</tr>
</tbody>
</table>

**Mathematics**

Select one from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 111</td>
<td>Linear Mathematical Modeling (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>)</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 113</td>
<td>Analytic Geometry and Calculus I (Mason Core) (<a href="http://catalog.gmu.edu/mason-core/">http://catalog.gmu.edu/mason-core/</a>)</td>
<td>3</td>
</tr>
</tbody>
</table>

- **MATH 123 & MATH 124** | Calculus with Algebra/Trigonometry, Part A and Calculus with Algebra/Trigonometry, Part B (Mason Core) (http://catalog.gmu.edu/mason-core/)
- **Computer Science**
  - Select one from the following: 3 credits
    - CDS 130 Computing for Scientists (Mason Core) (http://catalog.gmu.edu/mason-core/)
  - Any course(s) that fulfills the Mason Core: Information Technology requirement (http://catalog.gmu.edu/mason-core/#information-technology)

**BS without Concentration**

Students who do not select an optional concentration must complete the biology core and shared courses shown above in addition to the curriculum requirements listed below.

**Code**

**Title**

**Credits**

- **Biology Electives**
  - Complete 23 credits of additional biology courses (http://catalog.gmu.edu/courses/biol/) 1
  - **Additional Science Courses**
    - Students are encouraged to consult with a biology faculty advisor to determine which option (A, B, or C) best meets their career goals. Select one from the following options:
      - **Option A**:
        - CHEM 314 Organic Chemistry II
        - CHEM 318 and Organic Chemistry Lab II
      - **Option B**: One 3 credit chemistry course at the 300 or 400-level (not CHEM 314) (http://catalog.gmu.edu/courses/chem/)
      - **Option C**: GEOL 101 & GEOL 103 Physical Geology (Mason Core) (http://catalog.gmu.edu/mason-core/) and Physical Geology Lab (Natural Science courses)
        - GEOL 102 & GEOL 104 Historical Geology (Mason Core) (http://catalog.gmu.edu/mason-core/) and Historical Geology Laboratory (Mason Core) (http://catalog.gmu.edu/mason-core/)

**Total Credits**

26-31

**Note:**

Students expecting to enter a professional school are strongly encouraged to complete MATH 113 Analytic Geometry and Calculus I (Mason Core) (http://catalog.gmu.edu/mason-core/).
Of which, at least 15 credits must be upper division, and at least two of the upper division courses must include a laboratory.

**Concentration in Bioinformatics (BNF)**

The highly interdisciplinary field of bioinformatics has emerged as a powerful modern science. There is a great demand for undergraduate and graduate-level trained individuals with a background in bioinformatics in industry as well as in academia.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CDS 230</td>
<td>Modeling and Simulation I</td>
<td>3</td>
</tr>
</tbody>
</table>

**Bioinformatics**

- BINF 401: Bioinformatics and Computational Biology I
- BINF 402: Bioinformatics and Computational Biology II

**Biology**

- BIOL 312: Biostatistics for Bioinformatics
- BIOL 401: Phage Discovery
- BIOL 412: Phage Genomics

**Biology Lab Elective**

Select one from the following:

- BIOL 305 & BIOL 306: Biology of Microorganisms and Biology of Microorganisms Laboratory
- BIOL 320: Comparative Chordate Anatomy
- BIOL 322 & BIOL 323: Developmental Biology and Lab for Developmental Biology
- BIOL 331: Invertebrate Zoology
- BIOL 332: Insect Biology
- BIOL 334: Vertebrate Paleontology
- BIOL 336: Invertebrate Paleontology
- BIOL 344: Plant Diversity and Evolution
- BIOL 345: Plant Ecology
- BIOL 350: Freshwater Ecosystems
- BIOL 355: Ecological Engineering and Ecosystem Restoration
- BIOL 379: RS: Ecological Sustainability (Mason Core) (http://catalog.gmu.edu/mason-core/)
- BIOL 385 & BIOL 486: Biotechnology and Genetic Engineering and Molecular Biology and Biotechnology Laboratory
- BIOL 405: Microbial Genetics
- BIOL 407: Microbial Diversity
- BIOL 430: Advanced Human Anatomy and Physiology I
- BIOL 431: Advanced Human Anatomy and Physiology II
- BIOL 437: Ornithology
- BIOL 438: Mammalogy
- BIOL 439: Herpetology
- BIOL 452: Immunology
- & BIOL 453: and Immunology Laboratory
- BIOL 454: Marine Mammal Biology and Conservation
- & BIOL 455: and Marine Mammal Biology and Conservation Field Course
- BIOL 465: Histology
- BIOL 468: Vertebrate Natural History
- BIOL 472: Introductory Animal Behavior
- & BIOL 473: and Introductory Laboratory in Animal Behavior
- BIOL 484: Cell Signaling and Disease
- & BIOL 485: and Cell Signaling Laboratory
- BIOL 509: DNA Analysis of Biological Evidence
- & BIOL 510: and Forensic DNA Analysis Laboratory
- BIOL 543: Tropical Ecosystems

**Additional Science Courses**

Select one from the following options: 1

**Option A:**

- CHEM 314: Organic Chemistry II
- CHEM 318: Organic Chemistry Lab II

**Option B:**

One 3 credit chemistry course at the 300 or 400-level (http://catalog.gmu.edu/courses/chem/) 2

**Option C:**

- GEOL 101: Physical Geology (Mason Core) (http://catalog.gmu.edu/mason-core/)
- & GEOL 103: and Physical Geology Lab
- GEOL 102: Historical Geology (Mason Core) (http://catalog.gmu.edu/mason-core/)
- & GEOL 104: and Historical Geology Laboratory (Mason Core) (http://catalog.gmu.edu/mason-core/)

Total Credits: 26-33

1 Students are encouraged to consult with a biology advisor to determine which option (A, B, or C) best meets their career goals.

2 CHEM 314 Organic Chemistry II does not fulfill this requirement.

**Concentration in Biopsychology (BP)**

The biopsychology concentration consists of a selection of courses designed to address the needs and interest of students who wish to study biology in more depth while simultaneously exploring psychology and neurobiology. This concentration will help prepare students for the MCAT section related to psychology and provide veterinary students with a background in animal learning/behavior.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
</table>
- BIOL 430: Advanced Human Anatomy and Physiology I
- BIOL 431: Advanced Human Anatomy and Physiology II
- PSYC 372: Biopsychology
- PSYC 373: Biopsychology Laboratory

**Additional Psychology/Neuroscience Course**

Select 3-4 credits from the following:
### Additional Biology Courses
Select 7-8 credits from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 305</td>
<td>Biology of Microorganisms</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 306</td>
<td>Biology of Microorganisms Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 322</td>
<td>Developmental Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 323</td>
<td>Lab for Developmental Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 337</td>
<td>Ornithology</td>
<td></td>
</tr>
<tr>
<td>BIOL 338</td>
<td>Mammalogy</td>
<td></td>
</tr>
<tr>
<td>BIOL 472</td>
<td>Introductory Animal Behavior</td>
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</tr>
<tr>
<td>BIOL 473</td>
<td>Introductory Laboratory in Animal Behavior</td>
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</tr>
<tr>
<td>BIOL 483</td>
<td>General Biochemistry</td>
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</table>

### Additional Chemistry Courses
Select one from the following options:  

**Option A:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 314</td>
<td>Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 318</td>
<td>Organic Chemistry Lab II</td>
<td></td>
</tr>
</tbody>
</table>

**Option B:**

One chemistry course at the 300 or 400-level (http://catalog.gmu.edu/courses/chem/)

Total Credits: 26-30

1. Students are encouraged to consult with a biology faculty advisor to determine which option best meets their career goals.
2. CHEM 314 Organic Chemistry II alone does not fulfill this requirement.

### Concentration in Biotechnology and Molecular Biology (BTMB)

The biotechnology and molecular biology concentration consists of a selection of courses that provide essential skills to students who seek employment in the field or wish to include an applied component in their undergraduate training in biology.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 305</td>
<td>Biology of Microorganisms</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 306</td>
<td>Biology of Microorganisms Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 385</td>
<td>Biotechnology and Genetic Engineering</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 483</td>
<td>General Biochemistry</td>
<td>4</td>
</tr>
</tbody>
</table>

### Additional Biology Courses
Select 12 credits from the following, at least one of the courses must include a laboratory.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 402</td>
<td>Applied and Industrial Microbiology &amp; BIOL 403</td>
<td>Applied and Industrial Microbiology and Techniques in Applied and Industrial Microbiology</td>
</tr>
<tr>
<td>BIOL 405</td>
<td>Microbial Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOL 452</td>
<td>Immunology</td>
<td></td>
</tr>
<tr>
<td>&amp; BIOL 453</td>
<td>Immunology Laboratory</td>
<td></td>
</tr>
<tr>
<td>BIOL 465</td>
<td>Histology</td>
<td></td>
</tr>
<tr>
<td>BIOL 486</td>
<td>Molecular Biology and Biotechnology Laboratory</td>
<td></td>
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</tbody>
</table>

### Non-laboratory Courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 314</td>
<td>Introduction to Research Design and Analysis</td>
<td></td>
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<tr>
<td>BIOL 382</td>
<td>Introduction to Virology</td>
<td></td>
</tr>
<tr>
<td>BIOL 401</td>
<td>Phage Discovery</td>
<td></td>
</tr>
<tr>
<td>BIOL 411</td>
<td>Advanced General Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOL 412</td>
<td>Phage Genomics</td>
<td></td>
</tr>
<tr>
<td>BIOL 417</td>
<td>Selected Topics in Molecular and Cellular Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 418</td>
<td>Current Topics in Microbiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Vaccines</td>
<td></td>
</tr>
<tr>
<td>BIOL 421</td>
<td>Genetics of Human Diseases</td>
<td></td>
</tr>
<tr>
<td>BIOL 422</td>
<td>Stem Cell Biology and Regenerative Medicine</td>
<td></td>
</tr>
<tr>
<td>BIOL 482</td>
<td>Introduction to Molecular Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOL 484</td>
<td>Cell Signaling and Disease</td>
<td></td>
</tr>
<tr>
<td>BIOL 497</td>
<td>Special Problems in Biology</td>
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</tbody>
</table>

### Concentration in Environmental and Conservation Biology (ESCB)

This concentration is offered to students seeking a biology degree that focuses on ecology and organismal biology and prepares them for graduate work or employment in environmental and conservation fields, such as natural resources management, fisheries, forestry, water quality management, aquatic and wetland ecology, and conservation biology. The concentration is staffed and supported by the Department of Environmental Science and Policy (http://catalog.gmu.edu/offices/environmental-education/).

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 318</td>
<td>Conservation Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 377</td>
<td>Applied Ecology</td>
<td>3</td>
</tr>
</tbody>
</table>

### Biology Electives
Select 17 credits from the following:  

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 309</td>
<td>Oceanography</td>
<td></td>
</tr>
<tr>
<td>BIOL 314</td>
<td>Introduction to Research Design and Analysis</td>
<td></td>
</tr>
</tbody>
</table>
Biology, BS

BIOL 326  Animal Physiology
BIOL 331  Invertebrate Zoology
BIOL 332  Insect Biology
BIOL 344  Plant Diversity and Evolution
BIOL 345  Plant Ecology
BIOL 350  Freshwater Ecosystems
BIOL 351  Conservation Seminar
BIOL 352  Monitoring and Assessment of Biodiversity
BIOL 355  Ecological Engineering and Ecosystem Restoration
BIOL 357  Ecology Field Skills
BIOL 378  Applied Ecology Laboratory
BIOL 379  RS: Ecological Sustainability (Mason Core)

BIOL 437  Ornithology
BIOL 438  Mammalogy
BIOL 439  Herpetology
BIOL 440  Field Biology
BIOL 443  Tropical Ecology
BIOL 446  Ecological and Evolutionary Physiology
BIOL 449  Marine Ecology
BIOL 450  Marine Conservation
BIOL 454  Marine Mammal Biology and Conservation
BIOL 455  Marine Mammal Biology and Conservation Field Course
BIOL 457  Reproductive Strategies
BIOL 459  Fungi and Ecosystems
BIOL 468  Vertebrate Natural History
BIOL 472  Introductory Animal Behavior
& BIOL 473  Introductory Laboratory in Animal Behavior
BIOL 480  The Diversity of Fishes
BIOL 497  Special Problems in Biology

Additional Science Courses
Select one from the following options:  2  3-8

Option A:
CHEM 314  Organic Chemistry II
& CHEM 318  Organic Chemistry Lab II

Option B:
One chemistry course at the 300 or 400-level (http://catalog.gmu.edu/courses/chem/)

Option C:
GEOL 101  Physical Geology (Mason Core)
& GEOL 103  Physical Geology Lab
GEOL 102  Historical Geology (Mason Core)
& GEOL 104  Historical Geology Laboratory

Total Credits  26-31

1 Of which, two courses must be selected from the list above and must have either: 2 laboratory courses or 1 laboratory course and 1 field course (consult with an advisor for guidance).
2 Students are encouraged to consult with a biology faculty advisor to determine which option best meets their career goals.
3 CHEM 314 Organic Chemistry II alone does not fulfill this requirement.
4 Registration in BIOL 497 Special Problems in Biology is subject to approval by the Director of Undergraduate Studies and the Chairman of the Department of Biology.

Concentration in Microbiology (MIB)

This concentration offers lecture and laboratory courses in microbiology to prepare students for employment or advanced study in microbial genetics, physiology, diversity, and related fields.

Code  Title  Credits
Microbiology Courses
BIOL 305  Biology of Microorganisms  3
BIOL 306  Biology of Microorganisms Laboratory  1
BIOL 405  Microbial Genetics  4
BIOL 407  Microbial Diversity  4

Biology Electives
Select 11 credits from the following:

BIOL 314  Introduction to Research Design and Analysis
BIOL 382  Introduction to Virology
BIOL 385  Biotechnology and Genetic Engineering
BIOL 401  Phage Discovery
BIOL 402  Applied and Industrial Microbiology
BIOL 403  Techniques in Applied and Industrial Microbiology
BIOL 404  Medical Microbiology
BIOL 412  Phage Genomics
BIOL 418  Current Topics in Microbiology
BIOL 420  Vaccines
BIOL 452  Immunology
BIOL 453  Immunology Laboratory
BIOL 459  Fungi and Ecosystems
BIOL 483  General Biochemistry

Additional Chemistry Courses
CHEM 314  Organic Chemistry II  3
CHEM 318  Organic Chemistry Lab II  2

Total Credits  28

Mason Core and Elective Credits

In order to meet a minimum of 120 credits, this degree requires additional credits (specific credit counts by concentration are shown below), which may be applied toward any remaining Mason Core (http://catalog.gmu.edu/mason-core/) requirements (outlined below), Requirements for Bachelor's Degrees (https://catalog.gmu.edu/policies/academic/undergraduate-policies/#ap-5-3-2), and electives. Students are strongly encouraged to consult with their advisors to ensure that they fulfill all requirements.
Minimum requirements for invitation:

- Without concentration: 38-46 credits
- BNF concentration: 36-46 credits
- BP concentration: 39-46 credits
- BTMB concentration: 41-44 credits
- ESCB concentration: 38-46 credits
- MIB concentration: 41-44 credits

**Mason Core**

Some Mason Core ([http://catalog.gmu.edu/mason-core/](http://catalog.gmu.edu/mason-core/)) requirements may already be fulfilled by the major requirements listed above. Students are strongly encouraged to consult their advisors to ensure they fulfill all remaining Mason Core ([http://catalog.gmu.edu/mason-core/](http://catalog.gmu.edu/mason-core/)) requirements.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Written Communication (ENGH 101) (<a href="http://catalog.gmu.edu/mason-core/#written">http://catalog.gmu.edu/mason-core/#written</a>)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Oral Communication (<a href="http://catalog.gmu.edu/mason-core/#oral">http://catalog.gmu.edu/mason-core/#oral</a>)</td>
<td>3</td>
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</tr>
<tr>
<td>Quantitative Reasoning (<a href="http://catalog.gmu.edu/mason-core/#quantitative">http://catalog.gmu.edu/mason-core/#quantitative</a>)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Information Technology and Computing (<a href="http://catalog.gmu.edu/mason-core/#information-technology">http://catalog.gmu.edu/mason-core/#information-technology</a>)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Foundation Requirements**

- Written Communication (ENGH 101) ([http://catalog.gmu.edu/mason-core/#written](http://catalog.gmu.edu/mason-core/#written))
- Oral Communication ([http://catalog.gmu.edu/mason-core/#oral](http://catalog.gmu.edu/mason-core/#oral))
- Quantitative Reasoning ([http://catalog.gmu.edu/mason-core/#quantitative](http://catalog.gmu.edu/mason-core/#quantitative))
- Information Technology and Computing ([http://catalog.gmu.edu/mason-core/#information-technology](http://catalog.gmu.edu/mason-core/#information-technology))

**Exploration Requirements**

- Arts ([http://catalog.gmu.edu/mason-core/#arts](http://catalog.gmu.edu/mason-core/#arts))
- Global Understanding ([http://catalog.gmu.edu/mason-core/#global](http://catalog.gmu.edu/mason-core/#global))
- Literature ([http://catalog.gmu.edu/mason-core/#literature](http://catalog.gmu.edu/mason-core/#literature))
- Natural Science ([http://catalog.gmu.edu/mason-core/#natural-science](http://catalog.gmu.edu/mason-core/#natural-science))
- Social and Behavioral Sciences ([http://catalog.gmu.edu/mason-core/#social-behavioral-science](http://catalog.gmu.edu/mason-core/#social-behavioral-science))

**Integration Requirements**

- Written Communications (ENGH 302) ([http://catalog.gmu.edu/mason-core/#written](http://catalog.gmu.edu/mason-core/#written))
- Writing-intensive ([http://catalog.gmu.edu/mason-core/#wi](http://catalog.gmu.edu/mason-core/#wi))

**Total Credits**

40

1 Most programs include the writing-intensive course designated for the major as part of the major requirements; this course is therefore not counted towards the total required for Mason Core.

2 Minimum 3 credits required.

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### Honors in the Major

**Admissions**

Minimum requirements for invitation:

- GPA in biology courses must be 3.33 or better
- GPA in supporting requirements (math and other science) must be 3.00 or better
- Grade of ‘B’ or better in BIOL 213 Cell Structure and Function

Students should apply for admission to the Honors Program during their first or second year at the university. Contact the Department of Biology ([http://catalog.gmu.edu/colleges-schools/science/biology/](http://catalog.gmu.edu/colleges-schools/science/biology/)) for information on applying.

**Retention Requirements**

Students in honors biology must maintain a biology GPA of 3.33 or better and a supporting GPA of 3.00 or better from the time they have accumulated 30 hours and thereafter. Students who fall below this standard will be given a one semester probationary period in which to bring their GPA back up to the minimum standard.

**Requirements to Graduate with Biology Honors**

Students are required to take 6 to 8 credits in honors courses in BIOL including three semesters of BIOL 494 Honors Seminar in Biology or two semesters of BIOL 494 Honors Seminar in Biology and one semester of BIOL 493 Honors Research in Biology. BIOL 498 Research Seminar may count towards one of the semester requirements of BIOL 494 Honors Seminar in Biology. The GPA requirements are as follows:

- Minimum 3.33 GPA in honors biology courses
- Minimum 3.33 GPA in biology requirements
- Minimum 3.00 GPA in supporting requirements
- Minimum 3.00 GPA overall

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### Accelerated Master's

**Biology, BA or BS/Curriculum and Instruction, Accelerated MEd (Secondary Education Biology Concentration)**


See AP.6.7 Bachelor's/Accelerated Master's Degree ([http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7](http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7)) for policies related to this program.


Students in an accelerated degree program must fulfill all university requirements for the master’s degree. For policies governing all graduate
degrees, see AP6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/#text).

**BAM Pathway Admission Requirements**

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in Graduate Admissions Policies (https://catalog.gmu.edu/admissions/graduate-policies/) and Bachelor’s/ Accelerated Master’s Degree (https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) policies. For information specific to this accelerated master’s program, see Application Requirements and Deadlines (https://cehd.gmu.edu/bachelors-accelerated-masters-program/).

Students will be considered for admission into the BAM Pathway after completion of a minimum of 60 credits, and additional unit-specific criteria.

Students who are accepted into the BAM Pathway will be allowed to register for graduate level courses after successful completion of a minimum of 75 undergraduate credits and course-specific pre-requisites.

**Accelerated Master’s Admission Requirements**

Students already admitted in the BAM Pathway will be admitted to the MEd program, if they have met the following criteria, as verified on the Bachelor’s/Accelerated Master’s Transition form:

- 3.0 overall GPA
- Completion of specific undergraduate coursework
- Successfully meeting Mason’s requirements for undergraduate degree conferral (graduation) and completing the application for graduation.

**Accelerated Pathway Requirements**

To maintain the integrity and quality of both the undergraduate and graduate degree programs, undergraduate students interested in taking graduate courses must choose from the following which can be taken as Advanced Standing or Reserve Graduate credit (https://catalog.gmu.edu/policies/academic/graduate-policies/#text) (to be determined by the student and their advisor):

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDRD 619</td>
<td>Literacy in the Content Areas</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 547</td>
<td>Scientific Inquiry and the Nature of Science</td>
<td>3</td>
</tr>
<tr>
<td>SEED 522</td>
<td>Foundations of Secondary Education</td>
<td>3</td>
</tr>
<tr>
<td>SEED 540</td>
<td>Human Development and Learning: Secondary Education</td>
<td>3</td>
</tr>
<tr>
<td>SEED 573</td>
<td>Teaching Science in the Secondary School</td>
<td>3</td>
</tr>
<tr>
<td>SEED 673</td>
<td>Advanced Methods of Teaching Science in the Secondary School</td>
<td>3</td>
</tr>
<tr>
<td>SEED approved elective (<a href="http://catalog.gmu.edu/courses/seed/">http://catalog.gmu.edu/courses/seed/</a>)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

For more detailed information on coursework and timeline requirements, see AP6.7 Bachelor’s/Accelerated Master’s Degree (https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7) policies.

**Biology, BS/Biology, Accelerated MS Overview**

This bachelor’s/accelerated master’s degree program allows academically strong undergraduates with a commitment to advance their education to obtain both the Biology, BS and the Biology, MS (http://catalog.gmu.edu/colleges-schools/science/systems-biology/biology-ms/) degrees within an accelerated timeframe. Upon completion of this 138 credit accelerated program, students will be exceptionally well prepared for entry into their careers or into a doctoral program in the field or in a related discipline.

Students are eligible to apply for this accelerated program once they have earned at least 60 undergraduate credits and can enroll in up to 18 credits of graduate coursework after successfully completing 75 undergraduate credits. This flexibility makes it possible for students to complete a bachelor’s and a master’s in five years.

For more detailed information, see AP6.7 Bachelor’s/Accelerated Master’s Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-7). For policies governing all graduate degrees, see AP6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/). For more information on undergraduates enrolling in graduate courses, see AP1.4.4 Graduate Course Enrollment by Undergraduates (http://catalog.gmu.edu/policies/academic/registration-attendance/#text).

**Application Requirements**

Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in the Graduate Admission Policies (http://catalog.gmu.edu/admissions/graduate-policies/) section of this catalog.

Important application information and processes for this accelerated master’s program can be found here (https://www2.gmu.edu/admissions-aid/how-apply/accelerated-masters/).

Students should seek out the graduate program’s advisor who will aid in choosing the appropriate graduate courses and help prepare the student for graduate studies.

Three letters of recommendation, including one from a prospective thesis or project advisor, are required.

GRE scores are not required for students in this accelerated program.

Successful applicants will have an overall undergraduate GPA of at least 3.10. Additionally, they will have completed the following courses with a GPA of 3.00 or higher:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 213</td>
<td>Cell Structure and Function</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 214</td>
<td>Biostatistics for Biology Majors</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 300</td>
<td>BioDiversity 1</td>
<td>4</td>
</tr>
<tr>
<td>or BIOL 311</td>
<td>General Genetics</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 313 &amp; CHEM 315</td>
<td>Organic Chemistry I and Organic Chemistry Lab 1</td>
<td>5</td>
</tr>
</tbody>
</table>

1. Students should speak with an advisor to choose the course most appropriate for their post-graduation goals.

2. Grades of 2.50 in CHEM 313 and CHEM 315 are acceptable for admission into this accelerated pathway.
Accelerated Option Requirements
After the completion of 75 undergraduate credits, students may complete 3 to 12 credits of graduate coursework that can apply to both the undergraduate and graduate degrees.

In addition to applying to graduate from the undergraduate program, students in the accelerated program must submit a bachelor’s/accelerated master’s transition form (available from the Office of the University Registrar) to the College of Science’s Office of Academic and Student Affairs by the last day to add classes of their final undergraduate semester. Students should enroll for courses in the master’s program in the fall or spring semester immediately following conferral of the bachelor’s degree, but should contact an advisor if they would like to defer up to one semester.

Students must maintain an overall GPA of 3.00 or higher in all graduate coursework and should consult with their faculty advisor to coordinate their academic goals.

Reserve Graduate Credit
Accelerated master’s students may also take up to 6 graduate credits as reserve graduate credits. These credits do not apply to the undergraduate degree, but will reduce the master’s degree by up to 6 credits. With 12 graduate credits counted toward the undergraduate and graduate degrees plus the maximum 6 reserve graduate credits, the credits necessary for the graduate degree can be reduced by up to 18.

Graduate Course Suggestions
The following list of suggested courses is provided for general reference. To ensure an efficient route to graduation and post-graduation readiness, students are strongly encouraged to meet with an advisor before registering for graduate-level courses.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 508</td>
<td>Selected Topics in Animal Biology (When the topic is “Research and Development in a Biotechnological Company”)</td>
<td>1-4</td>
</tr>
<tr>
<td>BIOL 682</td>
<td>Advanced Eukaryotic Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 689</td>
<td>Interdisciplinary Tools in the Biosciences</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 690</td>
<td>Introduction to Graduate Studies in Biology</td>
<td>1-2</td>
</tr>
<tr>
<td>BIOL 695</td>
<td>Seminar in Molecular, Microbial, and Cellular Biology</td>
<td>1</td>
</tr>
</tbody>
</table>

Bachelor's Degree (selected), Bioinformatics Management, Accelerated PSM

Overview
This bachelor’s/accelerated master’s degree program allows academically strong undergraduates with a commitment to advance their education to obtain both the Biology, BS (https://catalog.gmu.edu/colleges-schools/science/biology/biology-bs/), or the Chemistry, BS (http://catalog.gmu.edu/colleges-schools/science/chemistry-biochemistry/chemistry-bs/), or the Computational and Data Sciences, BS (https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/computational-data-sciences-bs/), or the Physics, BS (https://catalog.gmu.edu/colleges-schools/science/physics-astronomy/physics-bs/), or the Neuroscience, BS (https://catalog.gmu.edu/colleges-schools/science/neuroscience-program/neuroscience-bs/) and the Bioinformatics Management, PSM (https://catalog.gmu.edu/colleges-schools/science/systems-biology/bioinformatics-management-professional-science-masters/) degrees within an accelerated timeframe. Upon completion of this 138 credit accelerated program, students will be exceptionally well prepared for entry into their careers or into a doctoral program in the field or in a related discipline.

Students are eligible to apply for this accelerated program once they have earned at least 60 undergraduate credits and can enroll in up to 18 credits of graduate coursework after successfully completing 75 undergraduate credits. This flexibility makes it possible for students to complete a bachelor’s and a master’s in five years.

For more detailed information, see AP6.7 Bachelor’s/Accelerated Master’s Degrees (http://catalog.gmu.edu/policies/academic/graduate-policies/#ap6-7). For policies governing all graduate degrees, see AP6 Graduate Policies (http://catalog.gmu.edu/policies/academic/graduate-policies/). For more information on undergraduates enrolling in graduate courses, see AP1.4.4 Graduate Course Enrollment by Undergraduates (https://catalog.gmu.edu/policies/academic/registration-attendance/#text).

Application Requirements
Applicants to all graduate programs at George Mason University must meet the admission standards and application requirements for graduate study as specified in the Graduate Admission Policies (http://catalog.gmu.edu/admissions/graduate-policies/) section of this catalog.

Important application information and processes for this accelerated master’s program can be found here (https://www2.gmu.edu/admissions-aid/how-apply/accelerated-masters/).

Students in the Biology, BS (https://catalog.gmu.edu/colleges-schools/science/biology/biology-bs/); Chemistry, BS (https://catalog.gmu.edu/colleges-schools/science/chemistry-biochemistry/chemistry-bs/); Computational and Data Sciences, BS (https://catalog.gmu.edu/colleges-schools/science/computational-data-sciences/computational-data-sciences-bs/); Neuroscience, BS (https://catalog.gmu.edu/colleges-schools/science/neuroscience-program/neuroscience-bs/); or Physics, BS (https://catalog.gmu.edu/colleges-schools/science/physics-astronomy/physics-bs/) with an overall GPA of at least 3.00 in their last 60 credits are welcome to apply to the Bioinformatics Management, PSM (http://catalog.gmu.edu/colleges-schools/science/systems-biology/bioinformatics-management-professional-science-masters/) accelerated master’s program. Applicants to this accelerated master’s should have previously taken courses in molecular biology, computer science, calculus, physical chemistry, and statistics. Students with deficiencies in one or more of these areas may be required to take additional courses from the undergraduate curriculum.

The GRE requirement is waived for students accepted into this accelerated program.

Students should seek out the graduate program’s advisor who will aid in choosing the appropriate graduate courses and help prepare the student for graduate studies.
Accelerated Option Requirements

After the completion of 75 undergraduate credits, students may complete 3 to 12 credits of graduate coursework that can apply to both the undergraduate and graduate degrees.

In addition to applying to graduate from the undergraduate program, students in the accelerated program must submit a bachelor’s/accelerated master’s transition form (available from the Office of the University Registrar (https://registrar.gmu.edu/forms/)) to the College of Science’s Office of Academic and Student Affairs (https://cos.gmu.edu/about/contact-us/) by the last day to add classes of their final undergraduate semester. Students should enroll for courses in the master’s program in the fall or spring semester immediately following conferral of the bachelor’s degree, but should contact an advisor if they would like to defer up to one semester.

Students must maintain an overall GPA of 3.00 or higher in all graduate coursework and should consult with their faculty advisor to coordinate their academic goals.

Reserve Graduate Credits

Accelerated master’s students may also take up to 6 graduate credits as reserve graduate credits. These credits do not apply to the undergraduate degree, but will reduce the master’s degree by up to 6 credits. With 12 graduate credits counted toward the undergraduate and graduate degrees plus the maximum 6 reserve graduate credits, the credits necessary for the graduate degree can be reduced by up to 18.

Graduate Course Suggestions

The following list of suggested courses is provided for general reference. To ensure an efficient route to graduation and post-graduation readiness, students are strongly encouraged to meet with an advisor before registering for graduate-level courses.

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<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BINF 630</td>
<td>Bioinformatics Methods</td>
<td>3</td>
</tr>
<tr>
<td>BINF 631</td>
<td>Molecular Cell Biology for Bioinformatics</td>
<td>3</td>
</tr>
<tr>
<td>GBUS 623</td>
<td>Marketing Management</td>
<td>3</td>
</tr>
<tr>
<td>GBUS 643</td>
<td>Managerial Finance</td>
<td>3</td>
</tr>
<tr>
<td>GBUS 738</td>
<td>Data Mining for Business Analytics</td>
<td>3</td>
</tr>
</tbody>
</table>