Biology B.S.

Click here to view the Suggested Plan of Study  (p. 5)

General Education Foundations

Please use this link to view a list of courses that meet each GEF requirement. (http://registrar.wvu.edu/gef/)

NOTE: Some major requirements will fulfill specific GEF requirements. Please see the curriculum requirements listed below for details on which GEFs you will need to select.

General Education Foundations

<table>
<thead>
<tr>
<th>F1 - Composition &amp; Rhetoric</th>
<th>3-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 101</td>
<td></td>
</tr>
<tr>
<td>&amp; ENGL 102</td>
<td></td>
</tr>
<tr>
<td>or ENGL 103</td>
<td></td>
</tr>
<tr>
<td>Introduction to Composition and Rhetoric and Composition, Rhetoric, and Research</td>
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<tr>
<td>Accelerated Academic Writing</td>
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</tbody>
</table>

| F2A/F2B - Science & Technology | 4-6 |
| F3 - Math & Quantitative Reasoning | 3-4 |
| F4 - Society & Connections | 3 |
| F5 - Human Inquiry & the Past | 3 |
| F6 - The Arts & Creativity | 3 |
| F7 - Global Studies & Diversity | 3 |
| F8 - Focus (may be satisfied by completion of a minor, double major, or dual degree) | 9 |

Total Hours 31-37

Please note that not all of the GEF courses are offered at all campuses. Students should consult with their advisor or academic department regarding the GEF course offerings available at their campus.

Degree Requirements

Students must complete WVU General Education Foundations requirements, College B.S. requirements, STEM Foundations requirements, major requirements, and electives with a minimum of 120 hours. For complete details on these requirements, visit the B.S. Degrees tab on the Eberly College of Arts and Sciences (http://catalog.wvu.edu/undergraduate/eberlycollegeofartsandsciences/#bachelorofsciencetext) page.

Departmental Requirements for the B.S. in Biology

Students intending to graduate with a B.S. in Biology must earn a minimum of 38 hours of coursework in biology or approved courses in the biological sciences, with a minimum of 120 hours total required for graduation. Students may not earn both a B.A. and a B.S. in Biology.

• Capstone Requirement: The university requires the successful completion of a Biology capstone course (BIOL 320 or BIOL 321). The three semester, BIOL 486, may be counted as the Biology Capstone Experience in place of BIOL 320 or BIOL 321. Two hours of BIOL 486 will be counted as part of the core requirements (replacing BIOL 320 or BIOL 321) and up to 6 hours may count as upper-level electives.

• Writing and Communication Skills Requirement: The Biology Bachelor of Science is a SpeakWrite Certified Program™. SpeakWrite Certified programs incorporate and develop students’ written, verbal, visual, and mediated communication skills across the curriculum.

• Calculation of Major GPA: A minimum GPA of a 2.0 is required in all courses applied to major requirements, with a minimum grade of a C- in BIOL 115, BIOL 115L, BIOL 117, and BIOL 117L. If a course is repeated, all attempts will be included in the calculation of the GPA, unless the course is eligible for a D/F repeat.

• Electives and Lab Requirement: Students must complete 20 hours of upper-division biology elective credits, with at least one course in each biology sub-discipline (1- Cell and Molecular, 2- Organismal, 3- Evolution and Ecology, 4- Integrative). Courses listed in more than one group may only be used to satisfy one group requirement. At least two of the selected classes must have a laboratory (lab courses are indicated with an asterisk in the curriculum table below). A maximum of three of the non-biology courses (AEM 341, AEM 401, AGBI 410, BIOC 339, BIOC 531, GEOL 331, PSYC 426, WMAN 446) may be used to fulfill the twenty-hour elective requirement. Special topics courses (BIOL 493) can be used to satisfy electives and may satisfy group-electives if appropriate. Additional elective courses may include any 300- or 400-level BIOL courses (except: BIOL 318, BIOL 320, BIOL 321, BIOL 327, BIOL 387, BIOL 487, BIOL 490, BIOL 491, BIOL 494 and above).

• Research Option: With permission of the department, students may enroll in BIOL 386 or BIOL 486. Six hours of BIOL 386 and BIOL 486 may be used towards the 20 hours of Biology upper division electives. One semester of BIOL 386 or BIOL 486 may be used to satisfy one of the lab requirements.
# Curriculum Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>University Requirements</td>
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<tr>
<td>ECAS B.S. Requirements</td>
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<tr>
<td>Biology Major Requirements</td>
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## University Requirements

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<td>Outstanding GEF Requirements 1, 4, 5, 6, and 7</td>
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## ECAS Bachelor of Science Requirements

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<td>Global Studies and Diversity Requirement</td>
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<td>MATH 150</td>
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<td>or MATH 155</td>
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## Biology Major Requirements

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<td>&amp; 115L</td>
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<td>&amp; CHEM 116</td>
<td>and Fundamentals of Chemistry 2</td>
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<td>&amp; CHEM 116L</td>
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<td>STAT 211</td>
<td>Elementary Statistical Inference</td>
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<td>&amp; STAT 215</td>
<td>and Introduction to Probability and Statistics</td>
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<td>PHYS 101</td>
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<td>&amp; 101L</td>
<td>and Introductory Physics 1 Laboratory</td>
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<td>or PHYS 111</td>
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<td>&amp; 111L</td>
<td>and General Physics 1 Laboratory</td>
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<td>&amp; PHYS 112</td>
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<td>BIOL 219</td>
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<td>BIOL 221</td>
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<tr>
<td>BIOL 387</td>
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<td>BIOL 487</td>
<td>Experimental Design &amp; Communication 2</td>
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<tr>
<td>CHEM 233</td>
<td>Organic Chemistry 1</td>
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<td>&amp; 233L</td>
<td>and Organic Chemistry 1 Laboratory</td>
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<tr>
<td>&amp; CHEM 234</td>
<td>and Organic Chemistry 2</td>
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<tr>
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<td>and Organic Chemistry 2 Laboratory</td>
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**BIOLOGY ELECTIVES ** 20

Select at least one from each of the following four groups, and please select two lab courses:

1- **Cell and Molecular Biology**

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<tbody>
<tr>
<td>BIOL 310</td>
<td>Advanced Cellular/Molecular Biology</td>
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<tr>
<td>BIOL 310L</td>
<td>Advanced Cellular/Molecular Biology Laboratory</td>
</tr>
<tr>
<td>BIOL 312</td>
<td>Introduction to Virology</td>
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<tr>
<td>BIOL 313</td>
<td>Molecular Basis of Cellular Growth</td>
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<tr>
<td>BIOL 316</td>
<td>Developmental Biology</td>
</tr>
<tr>
<td>BIOL 316L</td>
<td>Developmental Biology Laboratory</td>
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<tr>
<td>BIOL 324</td>
<td>Molecular Genetics</td>
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<tr>
<td>BIOL 324L</td>
<td>Molecular Genetics Laboratory</td>
</tr>
<tr>
<td>BIOL 335</td>
<td>Cell Physiology</td>
</tr>
<tr>
<td>BIOL 348</td>
<td>Neuroscience 1</td>
</tr>
<tr>
<td>BIOL 350</td>
<td>Plant Physiology</td>
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<tr>
<td>&amp; 350L</td>
<td>and Plant Physiology Laboratory (*)</td>
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<tr>
<td>BIOL 409</td>
<td>Biochemical Basis of Therapeutics</td>
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<tr>
<td>BIOL 410</td>
<td>Cell and Molecular Biology Methods</td>
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<tr>
<td>BIOL 411L</td>
<td>Introduction to Recombinant DNA Laboratory</td>
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<tr>
<td>BIOL 413</td>
<td>Molecular Endocrinology</td>
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<tr>
<td>BIOL 415</td>
<td>Epigenetics</td>
</tr>
<tr>
<td>BIOL 418</td>
<td>Medical Genetics</td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Genomics</td>
</tr>
<tr>
<td>BIOL 421</td>
<td>Experimental Biochemistry (*)</td>
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<tr>
<td>BIOL 423</td>
<td>Biochemistry of Nucleic Acids and Proteins</td>
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<tr>
<td>BIOL 423L</td>
<td>Biochemistry of Nucleic Acids and Proteins Laboratory</td>
</tr>
<tr>
<td>BIOL 424</td>
<td>Protein Structure and Function</td>
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<tr>
<td>BIOL 425</td>
<td>Developmental Genetics</td>
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<tr>
<td>BIOL 426</td>
<td>Molecular Biology of Cancer</td>
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<tr>
<td>BIOL 453</td>
<td>Molecular Basis of Disease</td>
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<tr>
<td>BIOL 454</td>
<td>Immunology</td>
</tr>
<tr>
<td>BIOL 455</td>
<td>Evolution of Infectious Diseases</td>
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<tr>
<td>BIOL 456</td>
<td>Microbial Symbiosis</td>
</tr>
<tr>
<td>BIOL 474</td>
<td>Neurogenetics and Behavior</td>
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<tr>
<td>BIOL 475</td>
<td>Neurobiological Diseases</td>
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2- **Organismal Biology**

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<td>Developmental Biology Laboratory</td>
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<tr>
<td>BIOL 324</td>
<td>Molecular Genetics</td>
</tr>
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<td>BIOL 324L</td>
<td>Molecular Genetics Laboratory</td>
</tr>
<tr>
<td>BIOL 338</td>
<td>Behavioral Ecology</td>
</tr>
<tr>
<td>BIOL 340</td>
<td>Invertebrate Zoology</td>
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<tr>
<td>BIOL 341</td>
<td>Ichthyology</td>
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<tr>
<td>&amp; 341L</td>
<td>and Ichthyology Laboratory (*)</td>
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<tr>
<td>BIOL 344</td>
<td>Advanced Human Physiology</td>
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<td>BIOL 344L</td>
<td>Advanced Human Physiology Laboratory (*)</td>
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<tr>
<td>BIOL 345</td>
<td>Human Anatomy</td>
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<tr>
<td>BIOL 345L</td>
<td>Human Anatomy Laboratory</td>
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<td>BIOL 349</td>
<td>Neuroscience 2</td>
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<tr>
<td>BIOL 350</td>
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<tr>
<td>&amp; 350L</td>
<td>and Plant Physiology Laboratory (*)</td>
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<tr>
<td>BIOL 353L</td>
<td>Flora of West Virginia Laboratory</td>
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<td>BIOL 363</td>
<td>Plant Geography</td>
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<td>BIOL 413</td>
<td>Molecular Endocrinology</td>
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<td>Medical Genetics</td>
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<td>BIOL 425</td>
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<td>BIOL 436</td>
<td>General Animal Physiology</td>
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<td>BIOL 438</td>
<td>Animal Behavior</td>
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<td>BIOL 439</td>
<td>Neuroethology</td>
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<td>BIOL 440</td>
<td>Comparative Anatomy (*)</td>
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<td>BIOL 450</td>
<td>Plant Systematics</td>
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<td>&amp; 450L</td>
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<td>BIOL 456</td>
<td>Microbial Symbiosis</td>
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<td>BIOL 474</td>
<td>Neurogenetics and Behavior</td>
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<td>BIOL 475</td>
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<td>BIOL 478</td>
<td>Sensory Neural Systems and Behavior</td>
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<td>AEM 341</td>
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<td>PSYC 426</td>
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3- Evolution and Ecology

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<td>Animal Communication</td>
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<td>BIOL 361</td>
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<td>&amp; 361L</td>
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<td>BIOL 363</td>
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<td>BIOL 365</td>
<td>Conservation Biology</td>
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<td>Plant-Microbial Interactions</td>
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<td>BIOL 461</td>
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<td>BIOL 462</td>
<td>Ecosystem Models</td>
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<td>BIOL 463</td>
<td>Global Ecology</td>
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<td>BIOL 464</td>
<td>Population and Quantitative Genetics</td>
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<td>&amp; 464L</td>
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<td>BIOL 477</td>
<td>Central Nervous System Evolution and Development</td>
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<td>AEM 401</td>
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<td>GEOL 331</td>
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<td>WMAN 446</td>
<td>Freshwater Ecology</td>
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4- Integrative Biology

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<td>Communicating Natural Science</td>
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<td>BIOL 430</td>
<td>Bioinformatics</td>
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<td>Microbial Symbiosis</td>
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<td>BIOL 476</td>
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<td>AGBI 410</td>
<td>Introductory Biochemistry</td>
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<td>BIOC 339</td>
<td>Introduction to Human Biochemistry</td>
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**CAPSTONE EXPERIENCE**  
Select one of the following options:  
- BIOL 320  The Total Science Experience: Genomics  
- BIOL 321  Total Science Experience Lab  
- or 2 semesters of the following:  
  - BIOL 486  Honors Investigation and Thesis (9 hours) ***  
- AND 1 semester of the following:  
  - BIOL 386  Undergraduate Research  
- Or 3 semesters of the following:  
  - BIOL 486  Honors Investigation and Thesis

| Total Hours | 68 |

STEM foundation courses are common to most STEM majors and excluded from the calculation of the percentage of upper-division courses.

Permission of the department must be obtained to enroll in BIOL 386, 486, 490, and 491. Only four credit hours of 386/486 may be used towards the fourteen hour elective requirement. BIOL 490 and BIOL 491 do not satisfy the required fourteen hours of electives in biology. These can serve as general electives.

**Suggested Plan of Study**

**First Year**

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<th>Spring</th>
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<td>BIOL 115 &amp; 115L (GEF 2; B.S. First Area 1)</td>
<td>4 CHEM 116 &amp; 116L (GEF 8; B.S. Second Area 2)</td>
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**Second Year**

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**Third Year**

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### Fourth Year

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Total credit hours: 120

* BIOL 321 / BIOL 320 (capstone) may be replaced with three semesters of BIOL 486 (research).

** At least two upper division lab courses must be taken, one of which can be 386 or 486.

*** At least one 300-level or above course must be taken in each biology sub-discipline (1-4).

### B.S. Biology: Pre-Medical track

The following information is included for advising purposes only and is not an approved curriculum. Completing the stipulations suggested below will not result in an additional designation on any official record.

- **Independent Research:** Students with aspirations to attend top-rank medical schools should include at least three hours of independent research (BIOL 386 or BIOL 486) in their program of study if they are to be competitive. The three semester, BIOL 486, may be counted as the Biology Capstone in place of BIOL 320 or BIOL 321. Six hours of BIOL 386 and BIOL 486 may be used to satisfy upper division electives. One semester of BIOL 386 or will satisfy one lab course.

- **MCAT and Medical School admission requirements:** Students who will take the MCAT in 2015 or later should take PSYC 101, SOC 101, ANTH 105, and one further course in Psychology and Sociology in order to be prepared for the new social sciences section of the MCAT - consult with your adviser for more detailed information. The course of study outlined below is recommended for students interested in attending medical school. However, admission requirements will vary from one medical school to another, so a review of specific requirements for each school of interest is recommended.

**Note:** The list of electives and recommendations outlined below are recommended for students interested in attending medical school. However, admission requirements will vary from one medical school to another, so a review of specific requirements for each school of interest is recommended. B.S. Biology students should select their biology electives from the list below. “General Requirements” and “Biochemistry Requirements” are strongly recommended for a competitive medical school application. Students interested in Graduate School and Research are strongly encouraged to take MATH 156. Please consult your adviser.

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<tr>
<td></td>
<td><strong>General Requirements</strong></td>
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<td>BIOL 310</td>
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<td>BIOL 436</td>
<td>General Animal Physiology</td>
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<td>BIOL 440</td>
<td>Comparative Anatomy</td>
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<td>BIOC 339</td>
<td>Introduction to Human Biochemistry</td>
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<td>BIOL 461</td>
<td>Principles of Evolution</td>
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<td>BIOL 464</td>
<td>Population and Quantitative Genetics</td>
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**Laboratory Requirement**  
Select one of the following:  
- AEM 341 General Microbiology  
- AEM 401 Environmental Microbiology

**Electives**  
Select remaining hours from the following:  
- BIOL 302 Biometry  
- BIOL 312 Introduction to Virology  
- BIOL 313 Molecular Basis of Cellular Growth  
- BIOL 316 Developmental Biology  
- BIOL 324 Molecular Genetics  
- BIOL 324L Molecular Genetics Laboratory  
- BIOL 335 Cell Physiology  
- BIOL 348 Neuroscience 1  
- BIOL 386 Undergraduate Research  
- BIOL 410 Cell and Molecular Biology Methods  
- BIOL 411L Introduction to Recombinant DNA Laboratory  
- BIOL 413 Molecular Endocrinology  
- BIOL 415 Epigenetics  
- BIOL 425 Developmental Genetics  
- BIOL 426 Molecular Biology of Cancer  
- BIOL 438 Animal Behavior  
- BIOL 453 Molecular Basis of Disease  
- BIOL 454 Immunology  
- BIOL 455 Evolution of Infectious Diseases  
- BIOL 456 Microbial Symbiosis  
- PSYC 426 Physiological Psychology

**Total Hours**  
23

**Areas of Emphasis Offered:**  
- Cellular and Molecular Biology (p. 7)  
- Genomics (p. 10)  
- Neuroscience (p. 12)  
- Ecology and Environmental Biology (p. 14)

**Bachelor of Arts or Sciences in Biology: Cellular and Molecular Biology Area of Emphasis**

A biology degree with an emphasis in cellular and molecular biology provides the student with all the preparation necessary for the health professions, pharmacy and pharmacology, and graduate school in cellular or molecular biology, virology, genetics, immunology and a variety of related fields. Biology majors pursuing the area of emphasis in Cellular and Molecular Biology take two introductory courses to learn about the processes within cells and the mechanisms for communication between cells. They then take a further concentration of courses in Biology that are related to cellular and molecular biology.

**Cellular and Molecular Biology Area of Emphasis Requirements:**

Students wishing to complete a Cellular and Molecular Biology Area of Emphasis must take the following selection of courses as part of their required Biology electives, either for the B.A. or the B.S.
## Curriculum Requirements

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<thead>
<tr>
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Select two of the following:

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<td>BIOL 313</td>
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<tr>
<td>BIOL 316</td>
<td>Developmental Biology</td>
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<td>BIOL 335</td>
<td>Cell Physiology</td>
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<td>BIOL 348</td>
<td>Neuroscience 1</td>
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<td>BIOL 409</td>
<td>Biochemical Basis of Therapeutics</td>
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<td>BIOL 410</td>
<td>Cell and Molecular Biology Methods</td>
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<tr>
<td>BIOL 411L</td>
<td>Introduction to Recombinant DNA Laboratory</td>
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<td>BIOL 413</td>
<td>Molecular Endocrinology</td>
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</tr>
<tr>
<td>BIOL 415</td>
<td>Epigenetics</td>
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<td>BIOL 418</td>
<td>Medical Genetics</td>
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<tr>
<td>BIOL 420</td>
<td>Genomics</td>
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<tr>
<td>BIOL 423</td>
<td>Biochemistry of Nucleic Acids and Proteins</td>
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<tr>
<td>BIOL 424</td>
<td>Protein Structure and Function</td>
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<td>BIOL 425</td>
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<td>BIOL 426</td>
<td>Molecular Biology of Cancer</td>
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<td>BIOL 430</td>
<td>Bioinformatics</td>
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<td>BIOL 454</td>
<td>Immunology</td>
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<td>BIOL 455</td>
<td>Evolution of Infectious Diseases</td>
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<td>BIOL 456</td>
<td>Microbial Symbiosis</td>
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<td>BIOL 464 &amp; 464L</td>
<td>Population and Quantitative Genetics &amp; Population Genetics Laboratory</td>
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<td>FIS 432</td>
<td>Forensic Biology</td>
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Total Hours: 12

## Suggested Plan of Study for the B.A. in Biology with an Area of Emphasis in Cellular and Molecular Biology

### First Year

#### Fall

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<td>BIOL 117 &amp; 117L</td>
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<td>CHEM 115 &amp; 115L</td>
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<td>CHEM 116 &amp; 116L</td>
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Total: 15

#### Spring

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Total: 15

### Second Year

#### Fall

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Total: 15
### Suggested Plan of Study for the B.S. in Biology with an Area of Emphasis in Cellular and Molecular Biology

#### First Year

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#### Second Year

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#### Third Year

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Total credit hours: 120
### Curriculum Requirements

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### Suggested Plan of Study for the B.A. in Biology with an Area of Emphasis in Genomics

#### First Year

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<th>Hours</th>
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<td>4 BIOL 117</td>
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<td>&amp; 116L (GEF 8)</td>
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Bachelor of Arts or Science in Biology: Genomics Area of Emphasis

A biology degree with an emphasis in Genomics provides the student with all the preparation necessary for graduate school in genomics or bioinformatics, or medical school and careers in the health fields. Biology majors pursuing the area of emphasis in Genomics take two introductory courses to learn about basic concepts and tools in genomics and the practice and application of bioinformatics and then take a further concentration of courses in Biology that are related to Genomics.

**Genomics Area of Emphasis Requirements:**

Students wishing to complete a Genomics Area of Emphasis must take the following selection of courses as part of their required Biology electives, either for the B.A. or the B.S.
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**Second Year**

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**Third Year**

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**Fourth Year**

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Total credit hours: 120

**Suggested Plan of Study for the B.S. in Biology with an Area of Emphasis in Genomics**

**First Year**

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**Second Year**

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3
Bachelor of Arts or Science in Biology: Neuroscience Area of Emphasis

A biology degree with an emphasis in Neuroscience provides the student with all the preparation necessary for graduate school in Neuroscience or medical school and the medical school entrance exam - the MCAT. Biology majors pursuing the area of emphasis in Neuroscience take two introductory courses to learn about basic features of neurons and the organization of the brain and then take a further concentration of courses in biology that are related to Neuroscience.

Neuroscience Area of Emphasis Requirements:

Students wishing to complete a Neuroscience Area of Emphasis must take the following selection of courses as part of their required Biology electives, either for the B.A. or the B.S.

Curriculum Requirements

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<td>BIOL 439</td>
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<tr>
<td>BIOL 474</td>
<td>Neurogenetics and Behavior</td>
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<td>BIOL 475</td>
<td>Neurobiological Diseases</td>
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<td>BIOL 476</td>
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<td>BIOL 477</td>
<td>Central Nervous System Evolution and Development</td>
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<td>BIOL 478</td>
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Total Hours: 120
Suggested Plan of Study the Biology B.A. with the Neuroscience Area of Emphasis

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Total credit hours: 120

Suggested Plan of Study the Biology B.S. with the Neuroscience Area of Emphasis

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**Ecology Electives**

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Total Hours: 12

**Suggested Plan of Study for the B.A. in Biology with an Area of Emphasis in Ecology/Environmental Biology**

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Total: 15

**Second Year**

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Total: 15

**Third Year**

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Total: 15

**Fourth Year**

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Total: 15

Total credit hours: 120
# Suggested Plan of Study for the B.S. in Biology with an Area of Emphasis in Ecology/Environmental Biology

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## Second Year

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## Third Year

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## Fourth Year

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Total credit hours: 120

*Maybe fulfilled by a course selected in Area of Emphasis.

### Major Learning Outcomes

**BIOLOGY**

Upon successful completion of the B.A. or B.S. degree, Biology majors will demonstrate competency in these areas:
1. Students will demonstrate competency in five content areas (listed below) at three biological levels - cellular/molecular, organismal/physiological, ecological and populations:
   - Information flow
   - Transformations of energy and matter
   - Structure-function relationships
   - Evolution
   - Systems and interactions

2. Students will be able to apply science process skills, including: reading the primary literature, developing a testable hypothesis, designing and experiment, collecting and analyzing data statistically.

3. Students will be able to communicate effectively with both fellow scientists and non-scientists in both written and oral forms.

4. Students will be able to synthesize knowledge and skills from across the curriculum and apply them to societal issues and problems.