Biology is the scientific study of life: the diversity and organization of organisms, from single-celled bacteria to multi-cellular plants and animals, including humans. These different levels of biological organization range from the molecules and cells that compose an organism, to the interacting organisms that make up an ecosystem. Hands-on experiences, from designing and conducting lab experiments to making field observations, using many different procedures and instruments, play an important role in gaining biological knowledge. Basic research in Biology provides many benefits. Faculty in the Biology Department at Penn State are exploring ways to cure neurological diseases, to conserve coral populations in tropical oceans, to discover more efficient ways to use plants for food and bioenergy, to develop vaccines for infectious diseases, and investigating many other facets of Biology, all with the goal of positively impacting humans and the environment.

You Might Like This Program If...

- You are interested in learning about aspects of biology of organisms that live on Earth.
- You enjoy a dynamic field of study, with new discoveries being made every day.
- You are interested in hands-on experiences, including courses with integrated laboratories and conducting research with faculty.
- You plan to pursue a career in biology research, education or outreach, or attend professional school in areas including medicine and dentistry.

Entrance Requirements
In order to be eligible for entrance to the Biology major, a student must have:

1. attained at least a 2.00 cumulative grade point average;
2. completed BIOL 110, CHEM 110, MATH 140, and earned a grade of C or better in each of these courses; and
3. completed at least one of the following courses with a grade of C or better: BIOL 220W, BIOL 230W, or BIOL 240W.

Degree Requirements
For the Bachelor of Science degree in Biology, a minimum of 124 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>94</td>
</tr>
</tbody>
</table>

15 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.

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 (http://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.)
- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

Knowledge Domains
- Arts (GA): 6 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 6 credits
- Social and Behavioral Sciences (GS): 6 credits
- Natural Sciences (GN): 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)
- Inter-Domain or Approved Linked Courses: 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 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80)). For more information, check the Suggested Academic Plan for your intended program.

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 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

Common Requirements for the Major (All Options)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Prescribed Courses</td>
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<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
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<tr>
<td>CHEM 113</td>
<td>Experimental Chemistry II</td>
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<tr>
<td>MATH 141</td>
<td>Calculus with Analytic Geometry II</td>
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<tr>
<td>Prescribed Courses: Require a grade of C or better</td>
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<tr>
<td>BIOL 110</td>
<td>Biology: Basic Concepts and Biodiversity</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 220W</td>
<td>Biology: Populations and Communities</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 230W</td>
<td>Biology: Molecules and Cells</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 240W</td>
<td>Biology: Function and Development of Organisms</td>
<td>4</td>
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<tr>
<td>CHEM 110</td>
<td>Chemical Principles I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 112</td>
<td>Chemical Principles II</td>
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</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
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<tr>
<td>Additional Courses</td>
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<tr>
<td>Select one of the following:</td>
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<tr>
<td>PHYS 211 &amp; PHYS 212 &amp; PHYS 213 &amp; PHYS 214</td>
<td>General Physics: Mechanics and General Physics: Electricity and Magnetism and General Physics: Fluids and Thermal Physics and General Physics: Wave Motion and Quantum Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 250 &amp; PHYS 251</td>
<td>Introductory Physics I &amp; Introductory Physics II</td>
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<tr>
<td>STAT 200</td>
<td>Elementary Statistics</td>
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<tr>
<td>STAT 240</td>
<td>Introduction to Biometry</td>
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</tr>
<tr>
<td>STAT 250</td>
<td>Introduction to Biostatistics</td>
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Requirements for the Option

Ecology Option (46-51 credits)
Available at the following campuses: Altoona, University Park

<table>
<thead>
<tr>
<th>Code</th>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Prescribed Courses</td>
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<td></td>
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<tr>
<td>BIOL 463</td>
<td>General Ecology</td>
<td>3</td>
</tr>
<tr>
<td>Additional Courses</td>
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<td></td>
</tr>
<tr>
<td>STAT 462</td>
<td>Applied Regression Analysis</td>
<td>3</td>
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<tr>
<td>or STAT 464</td>
<td>Applied Nonparametric Statistics</td>
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<tr>
<td>Select one of the following:</td>
<td>6-8</td>
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<tr>
<td>CHEM 210 &amp; CHEM 212 &amp; CHEM 213</td>
<td>Organic Chemistry I &amp; Organic Chemistry II &amp; Laboratory in Organic Chemistry</td>
<td></td>
</tr>
</tbody>
</table>

Groups
Select a minimum of 15 credits of 400-level biology courses, with at least 6 credits from the Ecology group, 3 credits from the Evolution group, and 3 credits from the Practicum group. A maximum of 3 credits of BIOL 400, 494, 495, 496, and SC 295, 395, 495 may be used to fulfill 15 credits minimum in the 400-level biology course requirements.

Ecology Group:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
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<tr>
<td>BIOL 412</td>
<td>Ecology of Infectious Diseases</td>
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</tr>
<tr>
<td>BIOL 415</td>
<td>Ecotoxicology</td>
<td></td>
</tr>
<tr>
<td>BIOL 417</td>
<td>Invertebrate Zoology</td>
<td></td>
</tr>
<tr>
<td>BIOL 419</td>
<td>Ecological and Environmental Problem Solving</td>
<td></td>
</tr>
<tr>
<td>BIOL/PPEM 425</td>
<td>Biology of Fungi</td>
<td></td>
</tr>
<tr>
<td>BIOL 429</td>
<td>Animal Behavior</td>
<td></td>
</tr>
<tr>
<td>BIOL 435</td>
<td>Ecology of Lakes and Streams</td>
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<tr>
<td>BIOL 436</td>
<td>Population Ecology and Global Climate Change</td>
<td></td>
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<tr>
<td>BIOL 438</td>
<td>Theoretical Population Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 444</td>
<td>Field Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 446</td>
<td>Physiological Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 450W</td>
<td>Experimental Field Biology</td>
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<tr>
<td>BIOL 464</td>
<td>Sociobiology</td>
<td></td>
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<tr>
<td>BIOL 474</td>
<td>Astrobiology</td>
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<tr>
<td>BIOL 482</td>
<td>Coastal Biology</td>
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<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
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Evolution Group:

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<tr>
<td>BIOL 405</td>
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</tr>
<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
<td></td>
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<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
<td></td>
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<tr>
<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
<td></td>
</tr>
<tr>
<td>BIOL 417</td>
<td>Invertebrate Zoology</td>
<td></td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Paleobotany</td>
<td></td>
</tr>
<tr>
<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
<td></td>
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<tr>
<td>BIOL 422</td>
<td>Advanced Genetics</td>
<td></td>
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<tr>
<td>BIOL/PPEM 425</td>
<td>Biology of Fungi</td>
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<tr>
<td>BIOL 427</td>
<td>Evolution</td>
<td></td>
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<tr>
<td>BIOL 428</td>
<td>Population Genetics</td>
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<tr>
<td>BIOL 429</td>
<td>Animal Behavior</td>
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<td>BIOL 432</td>
<td>Developmental Genetics</td>
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<tr>
<td>BIOL 433</td>
<td>Evolution of Vertebrates</td>
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</tr>
<tr>
<td>Code</td>
<td>Title</td>
<td>Credits</td>
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<tr>
<td>BIOL 434</td>
<td>Pathobiology of Emerging Infectious Disease</td>
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<td>BIOL 436</td>
<td>Population Ecology and Global Climate Change</td>
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<td>BIOL 438</td>
<td>Theoretical Population Ecology</td>
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<tr>
<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
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<tr>
<td>BIOL 443</td>
<td>Evo-devo: Evolution of Developmental Mechanisms</td>
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<tr>
<td>BIOL 446</td>
<td>Physiological Ecology</td>
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<td>BIOL 451</td>
<td>Biology of RNA</td>
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<tr>
<td>BIOL 460</td>
<td>Human Genetics</td>
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<tr>
<td>BIOL 463</td>
<td>General Ecology</td>
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<tr>
<td>BIOL 464</td>
<td>Sociobiology</td>
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<tr>
<td>BIOL 474</td>
<td>Astrobiology</td>
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<tr>
<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
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<tr>
<td>BIOL 400</td>
<td>Teaching in Biology</td>
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<tr>
<td>BIOL 402W</td>
<td>Biological Experimental Design</td>
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<tr>
<td>BIOL 407</td>
<td>Plant Developmental Anatomy</td>
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<tr>
<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
<td></td>
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<tr>
<td>BIOL 417</td>
<td>Invertebrate Zoology</td>
<td></td>
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<tr>
<td>BIOL 419</td>
<td>Ecological and Environmental Problem Solving</td>
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<tr>
<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
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<td>BIOL 422</td>
<td>Advanced Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOL/PPEM 425</td>
<td>Biology of Fungi</td>
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<tr>
<td>BIOL 433</td>
<td>Evolution of Vertebrates</td>
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<td>BIOL 437</td>
<td>Histology</td>
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<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
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<tr>
<td>BIOL 444</td>
<td>Field Ecology</td>
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<tr>
<td>BIOL 450W</td>
<td>Experimental Field Biology</td>
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<tr>
<td>BIOL 461</td>
<td>Contemporary Issues in Science and Medicine</td>
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<tr>
<td>BIOL 473</td>
<td>Laboratory in Mammalian Physiology</td>
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<tr>
<td>BIOL 475N</td>
<td>Anatomy in Italy: Cadavers, Culture, and Science</td>
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<tr>
<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
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<td>BIOL 482</td>
<td>Coastal Biology</td>
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<tr>
<td>BIOL 494</td>
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<tr>
<td>BIOL 495</td>
<td>Internship in Biology</td>
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<tr>
<td>BIOL 496</td>
<td>Independent Studies</td>
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<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
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<tr>
<td>BIOTC 459</td>
<td>Plant Tissue Culture and Biotechnology</td>
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<tr>
<td>SC 295</td>
<td>Science Co-op Work Experience I</td>
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<tr>
<td>SC 395</td>
<td>Science Co-op Work Experience II</td>
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<tr>
<td>SC 495</td>
<td>Science Co-op Work Experience III</td>
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<td>CHEM 210</td>
<td>Organic Chemistry I</td>
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<td>&amp; CHEM 212</td>
<td>and Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 213</td>
<td>and Laboratory in Organic Chemistry</td>
<td></td>
</tr>
</tbody>
</table>

**Groups**

Select a minimum of 18 credits of 400-level biology courses, with at least 3 credits from each of the following groups (each course may be used to satisfy a requirement in only one group). Moreover, a maximum of 3 credits of BIOL 400, 494, 495, 496 and SC 295, 395, 495 may be used to fulfill the 18 credit minimum in the 400-level biology course requirements.

**Plant and Fungi Group:**
- BIOL 406 Symbiosis
- BIOL 407 Plant Developmental Anatomy
- BIOL 414 Taxonomy of Seed Plants
- BIOL 420 Paleobotany
- BIOL 424 Seeds of Change: The Uses of Plants
- BIOL/PPEM 425 Biology of Fungi

**Evolution Group:**
- BIOL 405 Molecular Evolution
- BIOL 406 Symbiosis
- BIOL 411 Medical Embryology
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 420 Paleobotany
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 427 Evolution
- BIOL 428 Population Genetics
- BIOL 429 Animal Behavior
- BIOL 432 Developmental Genetics
- BIOL 433 Evolution of Vertebrates
- BIOL 434 Pathobiology of Emerging Infectious Disease
- BIOL 436 Population Ecology and Global Climate Change
- BIOL 438 Theoretical Population Ecology
- BIOL 439 Practical Bioinformatics
- BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
- BIOL 446 Physiological Ecology
- BIOL 451 Biology of RNA
- BIOL 460 Human Genetics
- BIOL 463 General Ecology
- BIOL 464 Sociobiology

**Supporting Courses and Related Areas**

Select 17-24 credits from department list

**General Biology Option (46-51 credits)**

*Available at the following campuses: Abington, Altoona, Beaver, Berks, Brandywine, Harrisburg, Schuylkill, Scranton, University Park, York*
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BIOL 474</td>
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<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
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<tr>
<td>BIOL 404</td>
<td>Cellular Mechanisms in Vertebrate Physiology</td>
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<tr>
<td>BIOL 405</td>
<td>Molecular Evolution</td>
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<tr>
<td>BIOL 407</td>
<td>Plant Developmental Anatomy</td>
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<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
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<tr>
<td>BIOL 413</td>
<td>Cell Signaling and Regulation</td>
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<tr>
<td>BIOL 416</td>
<td>Biology of Cancer</td>
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<td>BIOL 422</td>
<td>Advanced Genetics</td>
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<td>Reproductive Biology</td>
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<td>BIOL 443</td>
<td>Evo-devo: Evolution of Developmental Mechanisms</td>
</tr>
<tr>
<td>BIOL 448</td>
<td>Ecology of Plant Reproduction</td>
</tr>
<tr>
<td>BIOL 451</td>
<td>Biology of RNA</td>
</tr>
<tr>
<td>BIOL 460</td>
<td>Human Genetics</td>
</tr>
<tr>
<td>BIOL 467</td>
<td>Molecular Basis of Neurological Diseases</td>
</tr>
<tr>
<td>BIOL 469</td>
<td>Neurobiology</td>
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<tr>
<td>MICRB 410</td>
<td>Principles of Immunology</td>
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</tbody>
</table>

**Genetics and Developmental Biology Group:**

**Ecology Group:**

- BIOL 406  | Symbiosis                                        |
- BIOL 412  | Ecology of Infectious Diseases                   |
- BIOL 415  | Ecotoxicology                                    |
- BIOL 417  | Invertebrate Zoology                             |
- BIOL 419  | Ecological and Environmental Problem Solving     |
- BIOL/PPEM 425 | Biology of Fungi               |
- BIOL 429  | Animal Behavior                                  |
- BIOL 435  | Ecology of Lakes and Streams                     |
- BIOL 436  | Population Ecology and Global Climate Change     |
- BIOL 438  | Theoretical Population Ecology                   |
- BIOL 444  | Field Ecology                                    |
- BIOL 446  | Physiological Ecology                            |
- BIOL 450W | Experimental Field Biology                       |
- BIOL 463  | General Ecology                                  |
- BIOL 464  | Sociobiology                                     |
- BIOL 474  | Astrobiology                                     |
- BIOL 482  | Coastal Biology                                  |
- BIOL 499A | Tropical Field Ecology                           |

**Physiology Group:**

- BIOL 404  | Cellular Mechanisms in Vertebrate Physiology     |
- BIOL 406  | Symbiosis                                        |
- BIOL 409  | Biology of Aging                                 |
- BIOL 411  | Medical Embryology                               |
- BIOL 412  | Ecology of Infectious Diseases                   |
- BIOL 413  | Cell Signaling and Regulation                    |
- BIOL 415  | Ecotoxicology                                    |
- BIOL 416  | Biology of Cancer                                |

**Practicum Group:**

- BIOL 400  | Teaching in Biology                              |
- BIOL 402W | Biological Experimental Design                   |
- BIOL 407  | Plant Developmental Anatomy                      |
- BIOL 414  | Taxonomy of Seed Plants                          |
- BIOL 417  | Invertebrate Zoology                             |
- BIOL 419  | Ecological and Environmental Problem Solving     |
- BIOL 421  | Comparative Anatomy of Vertebrates               |
- BIOL 422  | Advanced Genetics                                |
- BIOL/PPEM 425 | Biology of Fungi               |
- BIOL 433  | Evolution of Vertebrates                         |
- BIOL 437  | Histology                                        |
- BIOL 439  | Practical Bioinformatics                         |
- BIOL 444  | Field Ecology                                    |
- BIOL 450W | Experimental Field Biology                       |
- BIOL 461  | Contemporary Issues in Science and Medicine      |
- BIOL 473  | Laboratory in Mammalian Physiology               |
- BIOL 475N | Anatomy in Italy: Cadavers, Culture, and Science |
- BIOL 476  | Advanced Human Anatomy - cadaver based           |
- BIOL 478  | COMPARATIVE NEUROANATOMY                         |
- BIOL 482  | Coastal Biology                                  |
- BIOL 494  | Research Project                                 |
- BIOL 495  | Internship in Biology                            |
- BIOL 496  | Independent Studies                              |
- BIOL 499A | Tropical Field Ecology                           |
- BIOTC 459 | Plant Tissue Culture and Biotechnology           |
- SC 295   | Science Co-op Work Experience I                  |
- SC 395   | Science Co-op Work Experience II                 |
- SC 495   | Science Co-op Work Experience III                |

**Supporting Courses and Related Areas**

Select 20-27 credits from department list

---

**Genetics and Developmental Biology Option (46-51 credits)**

Available at the following campuses: Abington, Berks, Harrisburg, University Park, York
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<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
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</tbody>
</table>

### Additional Courses

Select 2-5 credits from the following:

- MATH 220 Matrices
- MATH 231 Calculus of Several Variables
- MICRB 201 Introductory Microbiology
- MICRB 202 Introductory Microbiology Laboratory

### Groups

Select a minimum of 12 credits of 400-level courses, with at least 6 credits from the Genetics and Developmental Biology group, 3 credits from Evolution, and 3 credits from the Practicum group. A maximum of 3 credits of BIOL 400, 494, 495, 496 and SC 295, 395, 495 may be used to fulfill the 12 credit minimum in the 400-level biology course requirements.

#### Genetics and Developmental Biology Group:

- BIOL 404 Cellular Mechanisms in Vertebrate Physiology
- BIOL 405 Molecular Evolution
- BIOL 407 Plant Developmental Anatomy
- BIOL 411 Medical Embryology
- BIOL 413 Cell Signaling and Regulation
- BIOL 416 Biology of Cancer
- BIOL 422 Advanced Genetics
- BIOL 426 Developmental Neurobiology
- BIOL 428 Population Genetics
- BIOL 431 Reproductive Biology
- BIOL 432 Developmental Genetics
- BIOL 439 Practical Bioinformatics
- BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
- BIOL 448 Ecology of Plant Reproduction
- BIOL 451 Biology of RNA
- BIOL 460 Human Genetics
- BIOL 467 Molecular Basis of Neurological Diseases
- BIOL 469 Neurobiology
- BMB 400 Molecular Biology of the Gene
  - or BMB 450 Microbial/Molecular Genetics
  - or BMB 464 Molecular Medicine
  - or BMB 484 Functional Genomics
  - or HORT 407 Plant Breeding
  - or MICRB 41 Principles of Immunology

#### Evolution Group:

- BIOL 405 Molecular Evolution
- BIOL 406 Symbiosis
- BIOL 411 Medical Embryology
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 427 Evolution
- BIOL 428 Population Genetics
- BIOL 429 Animal Behavior
- BIOL 432 Developmental Genetics
- BIOL 433 Evolution of Vertebrates
- BIOL 434 Pathobiology of Emerging Infectious Disease
- BIOL 436 Population Ecology and Global Climate Change
- BIOL 438 Theoretical Population Ecology
- BIOL 439 Practical Bioinformatics
- BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
- BIOL 446 Physiological Ecology
- BIOL 451 Biology of RNA
- BIOL 460 Human Genetics
- BIOL 463 General Ecology
- BIOL 464 Sociobiology
- BIOL 474 Astrobiology
- BIOL 478 COMPARATIVE NEUROANATOMY

#### Practicum Group:

- BIOL 400 Teaching in Biology
- BIOL 402W Biological Experimental Design
- BIOL 407 Plant Developmental Anatomy
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 419 Ecological and Environmental Problem Solving
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 433 Evolution of Vertebrates
- BIOL 437 Histology
- BIOL 439 Practical Bioinformatics
- BIOL 444 Field Ecology
- BIOL 450W Experimental Field Biology
- BIOL 461 Contemporary Issues in Science and Medicine
- BIOL 473 Laboratory in Mammalian Physiology
- BIOL 475N Anatomy in Italy: Cadavers, Culture, and Science
- BIOL 478 COMPARATIVE NEUROANATOMY
- BIOL 482 Coastal Biology
- BIOL 494 Research Project
- BIOL 495 Internship in Biology
- BIOL 496 Independent Studies
- BIOL 499A Tropical Field Ecology
- SC 295 Science Co-op Work Experience I
- SC 395 Science Co-op Work Experience II
- SC 495 Science Co-op Work Experience III

### Supporting Courses and Related Areas

Select 9-17 credits from department list

9-17
# Neuroscience Option (46-51 credits)

*Available at the following campuses: University Park*

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<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
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</table>

## Additional Courses

Select 3 credits from the following:

- BIOL 426 Developmental Neurobiology
- BIOL 470 Functional and Integrative Neuroscience
- BIOL 478 COMPARATIVE NEUROANATOMY

### Groups

Select a minimum of 12 credits of 400-level biology courses, with at least 6 credits from the Neuroscience group, 3 credits from the Evolution group, and 3 credits from the Practicum Group. A maximum of 3 credits of BIOL 400, 494, 495, 496 and SC 295, 395, 495 may be used to fulfill the 12 credit minimum in the 400-level biology course requirements.

#### Neuroscience Group:

- BIOL 404 Cellular Mechanisms in Vertebrate Physiology
- BIOL 413 Cell Signaling and Regulation
- BIOL 424 Seeds of Change: The Uses of Plants
- BIOL 426 Developmental Neurobiology
- BIOL 430 Developmental Biology
- BIOL 437 Histology
- BIOL 467 Molecular Basis of Neurological Diseases
- BIOL 470 Functional and Integrative Neuroscience
- BIOL 472 Mammalian Physiology
- BIOL 473 Laboratory in Mammalian Physiology
- BIOL 478 COMPARATIVE NEUROANATOMY
- BIOL 479 General Endocrinology
- BBH 432 Biobehavioral Aspects of Stress
- or BBH 451 Pharmacological Influences on Health
- or BBH 468 Neuroanatomical Bases for Disorders of Behavior and Health
- or HDFS 468
- or NUTR 445 Energy and Macronutrient Metabolism
- or PSYCH 45 Learning and Memory
- or PSYCH 46 Physiological Psychology
- or PSYCH 47 Clinical Neuropsychology

#### Evolution Group:

- BIOL 405 Molecular Evolution
- BIOL 406 Symbiosis
- BIOL 411 Medical Embryology
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 420 Paleobotany
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics

## Practicum Group:

- BIOL 400 Teaching in Biology
- BIOL 402W Biological Experimental Design
- BIOL 407 Plant Developmental Anatomy
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 419 Ecological and Environmental Problem Solving
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 433 Evolution of Vertebrates
- BIOL 437 Histology
- BIOL 439 Practical Bioinformatics
- BIOL 444 Field Ecology
- BIOL 450W Experimental Field Biology
- BIOL 461 Contemporary Issues in Science and Medicine
- BIOL 473 Laboratory in Mammalian Physiology
- BIOL 475N Anatomy in Italy: Cadavers, Culture, and Science
- BIOL 478 COMPARATIVE NEUROANATOMY
- BIOL 482 Coastal Biology
- BIOL 494 Research Project
- BIOL 495 Internship in Biology
- BIOL 496 Independent Studies
- BIOL 499A Tropical Field Ecology
- BIOTC 459 Plant Tissue Culture and Biotechnology
- SC 295 Science Co-op Work Experience I
- SC 395 Science Co-op Work Experience II
- SC 495 Science Co-op Work Experience III

## Supporting Courses and Related Areas

Select 14-19 credits from department list

### Plant Biology Option (46-51 credits)

*Available at the following campuses: University Park*
### Prescribed Courses

<table>
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<tr>
<td>BIOL 441</td>
<td>Plant Physiology</td>
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<td>BMB 402</td>
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</table>

### Additional Courses

#### Groups

Select a minimum of 12 credits of 400-level biology courses, with 12 credits from the Plant and Fungi group, 3 credits from the Evolution group, and 3 credits from the Practicum group. A maximum of 3 credits of BIOL 400, 494, 495, 496 and SC 295, 395, 495 may be used to fulfill the 12 credit minimum in the 400-level biology course requirements.

#### Plant and Fungi Group:
- BIOL 406  | Symbiosis                           |
- BIOL 414  | Taxonomy of Seed Plants             |
- BIOL 420  | Paleobotany                         |
- BIOL 424  | Seeds of Change: The Uses of Plants|
- BIOL/PPEM 425 | Biology of Fungi                  |
- BIOL 431  | Reproductive Biology                |
- BIOL 444  | Field Ecology                       |
- BIOL 446  | Physiological Ecology               |
- BIOL 448  | Ecology of Plant Reproduction       |
- BIOL 451  | Biology of RNA                      |
- BIOL 482  | Coastal Biology                     |
- BIOL 499A | Tropical Field Ecology              |

#### Evolution Group:
- BIOL 405  | Molecular Evolution                 |
- BIOL 406  | Symbiosis                           |
- BIOL 411  | Medical Embryology                  |
- BIOL 414  | Taxonomy of Seed Plants             |
- BIOL 417  | Invertebrate Zoology                |
- BIOL 420  | Paleobotany                         |
- BIOL 421  | Comparative Anatomy of Vertebrates  |
- BIOL 422  | Advanced Genetics                   |
- BIOL/PPEM 425 | Biology of Fungi                   |
- BIOL 427  | Evolution                           |
- BIOL 428  | Population Genetics                 |
- BIOL 429  | Animal Behavior                     |
- BIOL 432  | Developmental Genetics              |
- BIOL 433  | Evolution of Vertebrates            |
- BIOL 434  | Pathobiology of Emerging Infectious Disease |
- BIOL 436  | Population Ecology and Global Climate Change |
- BIOL 438  | Theoretical Population Ecology      |
- BIOL 439  | Practical Bioinformatics            |
- BIOL 443  | Evo-devo: Evolution of Developmental Mechanisms |
- BIOL 446  | Physiological Ecology               |

#### Supporting Courses and Related Areas
Select 14-19 credits from department list

### Vertebrate Physiology Option (46-51 credits)

**Available at the following campuses: Abington, Altoona, Brandywine, University Park**

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<tr>
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<th>Title</th>
<th>Credits</th>
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<tr>
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<td>Laboratory in Mammalian Physiology</td>
<td>2</td>
</tr>
<tr>
<td>BMB 401</td>
<td>General Biochemistry</td>
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</tr>
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<td>BMB 402</td>
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<tr>
<td>CHEM 210</td>
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</tr>
<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
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</tbody>
</table>

### Additional Courses

#### Groups
Select a minimum of 12 credits of 400-level courses, with at least 6
credits from the Physiology group, 3 credits from the Evolution group,
and 3 credits from the Practicum group. A maximum of 3 credits of
BIOL 400, 494, 495, 496 and SC 295, 395, 495 may be used to fulfill
the 12 credit minimum in the 400-level biology course requirements.

Physiology Group:
- BIOL 404 Cellular Mechanisms in Vertebrate Physiology
- BIOL 406 Symbiosis
- BIOL 409 Biology of Aging
- BIOL 411 Medical Embryology
- BIOL 412 Ecology of Infectious Diseases
- BIOL 413 Cell Signaling and Regulation
- BIOL 415 Ecotoxicology
- BIOL 416 Biology of Cancer
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 424 Seeds of Change: The Uses of Plants
- BIOL 426 Developmental Neurobiology
- BIOL 431 Reproductive Biology
- BIOL 432 Developmental Genetics
- BIOL 437 Histology
- BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
- BIOL 446 Physiological Ecology
- BIOL 460 Human Genetics
- BIOL 469 Neurobiology
- BIOL 470 Functional and Integrative Neuroscience
- BIOL 478 COMPARATIVE NEUROANATOMY
- BIOL 479 General Endocrinology
- BIOL 482 Coastal Biology
- ANSC 431 Physiology of Animal Reproduction
  or ANTH 466 The Skull
  or BMB 484 Functional Genomics
  or ENT 402 Biology of Animal Parasites
  or MICRB 40 Microbial Physiology and Structure
  or MICRB 41 Principles of Immunology
  or MICRB 43 Viral Pathogenesis
  or PSYCH 46 Physiological Psychology

Evolution Group:
- BIOL 405 Molecular Evolution
- BIOL 406 Symbiosis
- BIOL 411 Medical Embryology
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 420 Paleobotany
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 427 Evolution
- BIOL 428 Population Genetics
- BIOL 429 Animal Behavior
- BIOL 432 Developmental Genetics
- BIOL 433 Evolution of Vertebrates
- BIOL 434 Pathobiology of Emerging Infectious Disease
- BIOL 436 Population Ecology and Global Climate Change
- BIOL 438 Theoretical Population Ecology
- BIOL 439 Practical Bioinformatics
- BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
- BIOL 446 Physiological Ecology
- BIOL 451 Biology of RNA
- BIOL 460 Human Genetics
- BIOL 463 General Ecology
- BIOL 464 Sociobiology
- BIOL 474 Astrobiology
- BIOL 478 COMPARATIVE NEUROANATOMY

Practicum Group:
- BIOL 400 Teaching in Biology
- BIOL 402W Biological Experimental Design
- BIOL 407 Plant Developmental Anatomy
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 419 Ecological and Environmental Problem Solving
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 433 Evolution of Vertebrates
- BIOL 437 Histology
- BIOL 439 Practical Bioinformatics
- BIOL 444 Field Ecology
- BIOL 448 Ecology of Plant Reproduction
- BIOL 450W Experimental Field Biology
- BIOL 461 Contemporary Issues in Science and Medicine
- BIOL 473 Laboratory in Mammalian Physiology
- BIOL 475N Anatomy in Italy: Cadavers, Culture, and Science
- BIOL 476 Advanced Human Anatomy - cadaver based
- BIOL 478 COMPARATIVE NEUROANATOMY
- BIOL 482 Coastal Biology
- BIOL 494 Research Project
- BIOL 495 Internship in Biology
- BIOL 496 Independent Studies
- BIOL 499A Tropical Field Ecology
- BIOTC 459 Plant Tissue Culture and Biotechnology
- SC 295 Science Co-op Work Experience I
- SC 395 Science Co-op Work Experience II
- SC 495 Science Co-op Work Experience III

Supporting Courses and Related Areas
Select 15-20 credits from department list

Program Learning Objectives
1. Students should be able to explain the process of evolution and its
   underlying mechanisms.
2. Students should be able to explain the following core concepts,
   as discussed in Vision and Change: A Call to Action 2010 Report
   (American Association for the Advancement of Science):
a. Structure and function (the basic units of biological structure that define the functions of living things).

b. Information flow, exchange and storage (the influence of genetics on the growth and behavior of organisms).

c. Pathways and transformations of energy and matter (the ways in which chemical transformation pathways and the laws of thermodynamics govern the growth and change of biological systems).

d. Systems (the ways in which living things are interconnected and interact with one another).

e. Biodiversity at the genetic, organismal, community, and global scales

3. Students should be able to read and critically interpret primary scientific literature.

4. Students should be able to communicate results of biological research.

5. Students should be able to recognize and apply ethical principles to basic and applied practice, and recognize the roles of science and scientists in society.

6. Students should be able to demonstrate appropriate laboratory skills, including: scientific technique; maintenance of a laboratory notebook; writing laboratory reports; and adhering to all laboratory safety procedures.

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 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy)

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Anne Vardo-Zalik
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717-718-6705
Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2019-20 academic year. To access previous years’ suggested academic plans, please visit the archive (http://bulletins.psu.edu/undergraduate/archive) to view the appropriate Undergraduate Bulletin edition (Note: the archive only contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin).

General Biology Option at Berks 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

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<td>3 CHEM 112*</td>
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Second Year

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Third Year

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Fourth Year

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Department List Selection | 3 Department List Selection | 3
General Education Course | 3 General Education Course | 1.5

Total Credits 125-128

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

University Requirements and General Education Notes:

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

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of ‘C’ or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

The following courses fulfill the Writing Across The Curriculum requirement: BIOL 220W, 230W, and 240W. Students must complete all three (3) courses to fulfill this requirement.

The following courses are offered Fall Semester only: BIOL 220W, 230W, CHEM 202, 210, PHYS 250.

The following courses are offered Spring Semester only: BIOL 240W, CHEM 203, 212, 213, PHYS 251.

Students must complete one (1) of the following courses to satisfy Entrance-to-Major requirements: BIOL 220W, 230W, or 240W.

For PHYS 250 and 251, the following course sequence may be substituted: PHYS 211, 212, 213, 214. PHYS 213 and 214 are offered Spring Semester only.

Genetics & Developmental Biology Option at Berks 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

<table>
<thead>
<tr>
<th>Semester</th>
<th>Credits</th>
<th>Spring</th>
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<td>MATH 140**#</td>
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<td>BIOL 110**</td>
<td>4 BIOL 240W***</td>
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Total Credits 15-18

Course satisfies General Education and degree requirement
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<tr>
<th>Course</th>
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<tr>
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Total Credits 128

* 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

University Requirements and General Education Notes:

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

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3. The following courses are offered Spring Semester only: BIOL 240W, BMB 402, CHEM 212, 213, PHYS 251.
4. Students must complete one (1) of the following courses to satisfy Entrance-to-Major requirements: BIOL 220W, 230W, or 240W.
5. Students should take PHYS 213 and 214 only if they completed PHYS 211 and 212. Consult adviser for details.

Career Paths

A Biology BS degree provides an excellent foundation and the skills required for a wide range of technical careers. While many majors use a Biology degree to prepare for entrance into health professional schools, others follow career paths in research, education, and business. Students also pursue graduate study at universities both across the U.S. and internationally.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE BIOLOGY PROGRAM (http://bio.psu.edu/undergraduate-portal/after-graduation)

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (http://bio.psu.edu/graduate-portal)

Contact

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med18@psu.edu

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1600 Woodland Road
Abington, PA 19001
215-881-7300
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3000 Ivyside Park
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lkp3@psu.edu  
http://altoona.psu.edu/academics/bachelors-degrees/biology/request-information

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