Biology, B.S. (Berks)

Begin Campus: Any Penn State Campus

End Campus: Berks

Program Description
Not all options are available at every campus. Contact the campus you are interested in attending to determine which options are offered.

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 Department of Biology 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 the 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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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Prescribed Courses</strong></td>
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</tr>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
<td>1</td>
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<tr>
<td>CHEM 113</td>
<td>Experimental Chemistry II</td>
<td>1</td>
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<tr>
<td>MATH 141</td>
<td>Calculus with Analytic Geometry II</td>
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<td></td>
<td><em>Prescribed Courses: Require a grade of C or better</em></td>
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<tr>
<td>BIOL 110</td>
<td>Biology: Basic Concepts and Biodiversity</td>
<td>4</td>
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<tr>
<td>BIOL 220W</td>
<td>Biology: Populations and Communities</td>
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<td>BIOL 230W</td>
<td>Biology: Molecules and Cells</td>
<td>4</td>
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<td>BIOL 240W</td>
<td>Biology: Function and Development of Organisms</td>
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<td>CHEM 110</td>
<td>Chemical Principles I</td>
<td>3</td>
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<tr>
<td>CHEM 112</td>
<td>Chemical Principles II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
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<td></td>
<td><strong>Additional Courses</strong></td>
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<tr>
<td>Select one of the following:</td>
<td>8-12</td>
<td></td>
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<tr>
<td>PHYS 211 &amp; PHYS 212 &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>
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<tr>
<td>PHYS 250 &amp; PHYS 251</td>
<td>Introductory Physics I and 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>
<td></td>
</tr>
<tr>
<td>STAT 250</td>
<td>Introduction to Biostatistics</td>
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</table>

Requirements for the Option
Select an option 46-51

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Prescribed Courses</strong></td>
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<tr>
<td>BIOL 463</td>
<td>General Ecology</td>
<td>3</td>
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<tr>
<td></td>
<td><strong>Additional Courses</strong></td>
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<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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<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 and Organic Chemistry II and Laboratory in Organic Chemistry</td>
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</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:
- 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 464 Sociobiology
- BIOL 474 Astrobiology
- 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
<table>
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<tr>
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<th>Credits</th>
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<tr>
<td>BIOL 434</td>
<td>Pathobiology of Emerging Infectious Disease</td>
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<tr>
<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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<td>BIOL 446</td>
<td>Physiological Ecology</td>
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<tr>
<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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<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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**Practicum Group:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<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>
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<tr>
<td>BIOL 417</td>
<td>Invertebrate Zoology</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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<tr>
<td>BIOL 422</td>
<td>Advanced Genetics</td>
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<tr>
<td>BIOL/PPEM</td>
<td>Biology of Fungi</td>
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<tr>
<td>BIOL 433</td>
<td>Evolution of Vertebrates</td>
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<tr>
<td>BIOL 437</td>
<td>Histology</td>
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<tr>
<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
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<tr>
<td>BIOL 444</td>
<td>Field Ecology</td>
<td></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>
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<tr>
<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
<td></td>
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<tr>
<td>BIOL 482</td>
<td>Coastal Biology</td>
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<tr>
<td>BIOL 494</td>
<td>Research Project</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>
<td></td>
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<tr>
<td>SC 395</td>
<td>Science Co-op Work Experience II</td>
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</tr>
<tr>
<td>SC 495</td>
<td>Science Co-op Work Experience III</td>
<td></td>
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</tbody>
</table>

**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

**Code**

**Title**

**Credits**

**Additional Courses**

Select one of the following: 6-8

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 202</td>
<td>Fundamentals of Organic Chemistry I</td>
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<tr>
<td>&amp; CHEM 203</td>
<td>and Fundamentals of Organic Chemistry II</td>
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</tbody>
</table>
BIOL 474  Astrobiology
BIOL 478  COMPARATIVE NEUROANATOMY

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 430  Developmental Biology
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 469  Neurobiology
MICRB 410  Principles of Immunology

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
BIOL 421  Comparative Anatomy of Vertebrates
BIOL 424  Seeds of Change: The Uses of Plants
BIOL 426  Developmental Neurobiology
BIOL 430  Developmental Biology
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 472  Mammalian Physiology
BIOL 478  COMPARATIVE NEUROANATOMY
BIOL 479  General Endocrinology
BIOL 482  Coastal Biology

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  Plant Tissue Culture and Biotechnology
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, Schuylkill, University Park, York
<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>BIOL 322</td>
<td>Genetic Analysis</td>
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<td>BIOL 430</td>
<td>Developmental Biology</td>
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<td>BMB 401</td>
<td>General Biochemistry</td>
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<td>BMB 402</td>
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<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
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<td>CHEM 212</td>
<td>Organic Chemistry II</td>
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<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
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**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

**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

**Supporting Courses and Related Areas**

Select 9-17 credits from department list

<table>
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<tbody>
<tr>
<td>BIOL 420</td>
<td>Paleobotany</td>
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<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
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<td>BIOL 422</td>
<td>Advanced Genetics</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>
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<td>BIOL 428</td>
<td>Population Genetics</td>
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<td>BIOL 429</td>
<td>Animal Behavior</td>
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<td>BIOL 432</td>
<td>Developmental Genetics</td>
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<td>BIOL 433</td>
<td>Evolution of Vertebrates</td>
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<tr>
<td>BIOL 434</td>
<td>Pathobiology of Emerging Infectious Disease</td>
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<tr>
<td>BIOL 436</td>
<td>Population Ecology and Global Climate Change</td>
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<td>Theoretical Population 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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<td>BIOL 463</td>
<td>General Ecology</td>
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<td>BIOL 464</td>
<td>Sociobiology</td>
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<td>BIOL 474</td>
<td>Astrobiology</td>
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<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
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**Supporting Courses and Related Areas**

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</thead>
<tbody>
<tr>
<td>SC 295</td>
<td>Science Co-op Work Experience I</td>
</tr>
<tr>
<td>SC 395</td>
<td>Science Co-op Work Experience II</td>
</tr>
<tr>
<td>SC 495</td>
<td>Science Co-op Work Experience III</td>
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</table>
Neuroscience Option (46-51 credits)
Available at the following campuses: University Park

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>BIOL 469</td>
<td>Neurobiology</td>
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<tr>
<td>BMB 401</td>
<td>General Biochemistry</td>
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<tr>
<td>BMB 402</td>
<td>General Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 212</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
<td>2</td>
</tr>
</tbody>
</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

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

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<tr>
<td>BIOL/PPEM 425</td>
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<tr>
<td>BIOL 427</td>
<td>Evolution</td>
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<tr>
<td>BIOL 428</td>
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<td>BIOL 429</td>
<td>Animal Behavior</td>
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<td>BIOL 432</td>
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<td>BIOL 433</td>
<td>Evolution of Vertebrates</td>
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<tr>
<td>BIOL 434</td>
<td>Pathobiology of Emerging Infectious Disease</td>
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<tr>
<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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<tr>
<td>BIOL 451</td>
<td>Biology of RNA</td>
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<td>BIOL 460</td>
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<tr>
<td>BIOL 463</td>
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<td>BIOL 464</td>
<td>Sociobiology</td>
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<td>Astrobiology</td>
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<tr>
<td>BIOL 402W</td>
<td>Biological Experimental Design</td>
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<td>BIOL 407</td>
<td>Plant Developmental Anatomy</td>
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<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
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<tr>
<td>BIOL 417</td>
<td>Invertebrate Zoology</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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<tr>
<td>BIOL 422</td>
<td>Advanced Genetics</td>
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<tr>
<td>BIOL/PPEM 425</td>
<td>Biology of Fungi</td>
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<td>BIOL 433</td>
<td>Evolution of Vertebrates</td>
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<tr>
<td>BIOL 437</td>
<td>Histology</td>
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<tr>
<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
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<td>BIOL 444</td>
<td>Field Ecology</td>
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<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>
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<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
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<tr>
<td>BIOL 482</td>
<td>Coastal Biology</td>
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<tr>
<td>BIOL 494</td>
<td>Research Project</td>
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<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>
<tr>
<td>BIOTC 459</td>
<td>Plant Tissue Culture and Biotechnology</td>
<td></td>
</tr>
<tr>
<td>SC 295</td>
<td>Science Co-op Work Experience I</td>
<td></td>
</tr>
<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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Supporting Courses and Related Areas
Select 14-19 credits from department list
## Prescribed Courses

<table>
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<tr>
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<td>Plant Developmental Anatomy</td>
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<tr>
<td>BIOL 441</td>
<td>Plant Physiology</td>
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</tr>
<tr>
<td>BMB 401</td>
<td>General Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BMB 402</td>
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<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 212</td>
<td>Organic Chemistry II</td>
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</tr>
<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
<td>2</td>
</tr>
</tbody>
</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

### 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 and Environmental Problem Solving
- 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 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

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

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

<table>
<thead>
<tr>
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<th>Credits</th>
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</tr>
<tr>
<td>BMB 401</td>
<td>General Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>BMB 402</td>
<td>General Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td>3</td>
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<tr>
<td>CHEM 212</td>
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<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
<td>2</td>
</tr>
</tbody>
</table>

## Additional Courses

**Groups**

- BIOL 451 Biology of RNA
- BIOL 460 Human Genetics
- BIOL 463 General Ecology
- BIOL 464 Sociobiology
- BIOL 474 Astrobiology
- BIOL 478 COMPARATIVE NEUROANATOMY
Select a minimum of 12 credits of 400-level courses, with at least 12 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 430 Developmental Biology
- BIOL 431 Reproductive Biology
- BIOL 432 Developmental Genetics
- BIOL 437 Histology
- BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
- BIOL 446 Physiological Ecology
- ANSC 431 Physiology of Animal Reproduction
  - or ANTH 466 The Skull
  - or BMB 484 Functional Genomics
  - or ENT 402W Biology of Animal Parasites
  - or MICRB 40 Microbial Physiology and Structure
  - or MICRB 41 Principles of Immunology
  - or MICRB 41 Medical Microbiology
  - 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 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 15-20

**Program Learning Outcomes**
1. **KEY LITERACIES:** describe how heritable changes can lead to differences in populations over time that might result in speciation; trace energy/matter transformation, storage, and mobilization; explain how information is exchanged and stored; recognize how changes in biological structures can have varying effects on function;
and/or describe the interactions and interconnections among systems across biological scales and over evolutionary time scales.

2. **PROCESS OF SCIENCE**: apply the elements of the process of science such as posing questions, generating novel hypotheses based on the scientific literature; developing appropriate technical skills for research; designing/conducting experiments to test hypotheses in laboratory and/or field settings; summarizing/interpreting data; integrating/evaluating findings in the broader scientific field to construct new knowledge; and/or participating in the peer review/revision process.

3. **SCIENTIFIC EVIDENCE EVALUATION**: discriminate among scientific claims presented in a variety of sources based on the strength of evidence; find appropriate published scientific literature; and/or analyze and critically evaluate data/conclusions from the scientific peer-reviewed literature.

4. **QUANTITATIVE REASONING AND DATA SCIENCE**: apply basic quantitative competencies such as algebra, probability, statistics, unit conversions, and fundamental biological equations; organize, summarize, and interpret quantitative data; use modeling/simulation to approach problems from across various scales; and/or find and analyze large databases using statistical methods and/or other approaches.

5. **INTERDISCIPLINARY THINKING**: integrate knowledge among biological subfields and between biology and other disciplines.

6. **COLLABORATION AND COMMUNICATION**: engage with diverse communities and leverage the skills in the community to pose and solve biological questions; demonstrate the ability to work in teams to solve biological problems; and/or communicate in a variety of formal and informal ways in the discussion of biological research.

7. **SCIENCE AND SOCIETY**: explore the impacts of scientific research on society and the environment and how society influences/reliance on research to inform decision-making; evaluate the ethical implications of biological research; recognize ethical issues in a variety of settings; and/or describe how different perspectives and the resulting alternative approaches might be evaluated using ethical principles to identify a solution to an issue.

8. **PROFESSIONAL EXPERIENCES**: communicate in a professional manner and learn/use professional behaviors in all aspects of college and career building activities, including participation in opportunities such as research, internships, cooperative education, teaching and tutoring, study abroad, and/or volunteer work.

**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/)

**Berks**

Maureen Dunbar  
Program Coordinator, Associate Professor  
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Program Chair  
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Associate Professor of Biology  
Hawthorn Building 109  
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814-949-5205  
lkp3@psu.edu

**Beaver**

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100 University Drive  
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724-773-3527  
cmm48@psu.edu

**Brandywine**

Mark Boudreau  
Biology Coordinator  
25 Yearsley Mill Rd  
Media, PA 19063  
610-892-1268  
mab90@psu.edu

**Harrisburg**

Sairam V. Rudrabhatla, Ph.D.  
Program Chair  
Science and Technology Building, TL 174  
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717-948-6560  
svr11@psu.edu

**Schuylkill**

Lucas Redmond  
Program Coordinator, Biology  
C-001 200 University Drive  
Schuylkill Haven, PA 17972  
570-385-6167
Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2020-21 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.

<table>
<thead>
<tr>
<th>First Year</th>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
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<tr>
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<td>Credits</td>
<td>Spring</td>
<td>Credits</td>
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<td>STAT 200 or 250</td>
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General Education Course (GA or GH or GS) 3
General Education Course (GA or GH or GS) 3

Third Year

| Fall | Credits | Spring | Credits |
| PHYS 250 (GN)† | 4 | PHYS 251 | 4 |
| 400 Level BIOL Selection - Group 2: Evolutionary Biology | 3 | 400 Level BIOL Selection - Group 1: Plants and Fungi | 3 |
| Department List Selection | 3 | Department List Selection - Group 3: Genetics and Development | 3 |
| Department List Selection | 3 | Department List Selection | 3 |
| General Education Course (GA or GH or GS) | 3 | General Education Course (GA or GH or GS) | 3 |
| | | | 15 | 13.5 |

Fourth Year

| Fall | Credits | Spring | Credits |
| 400 Level BIOL Selection - Group 4: Ecology | 3 | 400 Level BIOL Selection - Group 6: Practicum | 3 |
| 400 Level BIOL Selection - Group 5: Animal Physiology | 3 | Department List Selection | 3 |
| Department List Selection | 3 | Department List Selection | 3 |
| General Education Course (GA or GH or GS) | 3 | General Education Course (GHW) | 1.5 |
| | | | 15 |

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).

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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.

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1 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.

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<thead>
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<th>First Year</th>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
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<td>CAS 100A or 100B (GWS)‡</td>
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<td>MATH 140 or 140B (GQ)§*‡</td>
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<td>MATH 141 or 141B (GQ)§</td>
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<td>BIOL 240W§</td>
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<td>CHEM 110 (GN)§‡</td>
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<td>ENGL 202C (GWS)‡</td>
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<td>BIOL 230W§</td>
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<th>Spring</th>
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<td>PHYS 211 or 250 (GN)‡</td>
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<td>PHYS 212 or 251</td>
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<td>BMB 401</td>
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<td>General Education Course (GA or GH or GS)</td>
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<th>Spring</th>
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<td>400 Level BIOL Selection - Group 3: Practicum</td>
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2. The following courses are offered Fall Semester only: BIOL 220W, 230W, 430, BMB 401, CHEM 210, PHYS 250.
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/)

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