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 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 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>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
<td>1</td>
</tr>
<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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</table>

Prescribed Courses: Require a grade of C or better

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 110</td>
<td>Biology: Basic Concepts and Biodiversity</td>
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</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>
<td>3</td>
</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
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</tbody>
</table>

Additional Courses
Select one of the following: 8-12

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<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>
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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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</table>

Select one of the following: 3-4

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<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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</table>

Requirements for the Option
Select an option 46-51

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
<td></td>
</tr>
<tr>
<td>BIOL 412</td>
<td>Ecology of Infectious Diseases</td>
<td></td>
</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>
<td></td>
</tr>
<tr>
<td>BIOL 436</td>
<td>Population Ecology and Global Climate Change</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>
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<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>
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<tr>
<td>BIOL 474</td>
<td>Astrobiology</td>
<td></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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<tr>
<td>BIOL 505</td>
<td>Molecular Evolution</td>
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<tr>
<td>BIOL 506</td>
<td>Symbiosis</td>
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<tr>
<td>BIOL 411</td>
<td>Medical Embryology</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>
<td></td>
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<tr>
<td>BIOL 420</td>
<td>Paleobotany</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>
<td></td>
</tr>
<tr>
<td>BIOL/PPEM 425</td>
<td>Biology of Fungi</td>
<td></td>
</tr>
<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>
<td></td>
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<tr>
<td>BIOL 432</td>
<td>Developmental Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOL 433</td>
<td>Evolution of Vertebrates</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
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</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
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</tr>
<tr>
<td>BIOL 434</td>
<td>Pathobiology of Emerging Infectious Disease</td>
<td></td>
</tr>
<tr>
<td>BIOL 436</td>
<td>Population Ecology and Global Climate Change</td>
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</tr>
<tr>
<td>BIOL 438</td>
<td>Theoretical Population Ecology</td>
<td></td>
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<tr>
<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
<td></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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<tr>
<td>BIOL 460</td>
<td>Human Genetics</td>
<td></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>
<td></td>
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<tr>
<td>BIOL 474</td>
<td>Astrobiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
<td></td>
</tr>
</tbody>
</table>

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 17-24 credits from department list

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
</table>

Additional Courses
Select one of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
</tr>
</thead>
</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
- BIOL 431: Reproductive Biology
- BIOL 441: Plant Physiology
- 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
- PPEM 427: Mycotoxins: Effects of Fungal Toxins on Human and Animal Health

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

General Biology Option (46-51 credits)
Available at the following campuses: Abington, Altoona, Beaver, Berks, Brandywine, Harrisburg, Schuylkill, Scranton, University Park, York

Code    | Title
---------|---------------------------------------------------------------
CHEM 210 | Organic Chemistry I
& CHEM 212 & Organic Chemistry II
& CHEM 213 & Laboratory in Organic Chemistry
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 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
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 322</td>
<td>Genetic Analysis</td>
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</tr>
<tr>
<td>BIOL 430</td>
<td>Developmental Biology</td>
<td>3</td>
</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>
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<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
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<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

Select 2-5 credits from the following: 2-5

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

### Groups

#### 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
- BMB 450 Microbial/Molecular Genetics
- BMB 464 Molecular Medicine
- BMB 484 Functional Genomics
- HORT 407 Plant Breeding
- 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

### 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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 469</td>
<td>Neurobiology</td>
<td>3</td>
</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>
</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>
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Additional Courses
Select 3 credits from the following:

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<tr>
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<th>Title</th>
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<tbody>
<tr>
<td>BIOL 426</td>
<td>Developmental Neurobiology</td>
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</tr>
<tr>
<td>BIOL 470</td>
<td>Functional and Integrative Neuroscience</td>
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</tr>
<tr>
<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
<td></td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 404</td>
<td>Cellular Mechanisms in Vertebrate Physiology</td>
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<td>BIOL 413</td>
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<td>Seeds of Change: The Uses of Plants</td>
<td></td>
</tr>
<tr>
<td>BIOL 426</td>
<td>Developmental Neurobiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 430</td>
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Evolution Group:

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<td>Evo-devo: Evolution of Developmental Mechanisms</td>
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<td>Physiological Ecology</td>
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Practicum Group:

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<td>BIOTC 459</td>
<td>Plant Tissue Culture and Biotechnology</td>
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<tr>
<td>SC 295</td>
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<tr>
<td>SC 395</td>
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<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

Plant Biology Option (46-51 credits)
Available at the following campuses: University Park
### Prescribed Courses

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<td>CHEM 212</td>
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<td>CHEM 213</td>
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### Additional Courses

**Groups**

Select a minimum of 12 credits of 400-level biology courses, with at least 6 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

**Biology of RNA**
- BIOL 451

**Human Genetics**
- BIOL 460

**General Ecology**
- BIOL 463

**Sociobiology**
- BIOL 464

**Astrobiology**
- BIOL 474

**COMPARATIVE NEUROANATOMY**
- BIOL 478

**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

**Evolution of Vertebrates**
- BIOL 433

**Histology**
- BIOL 437

**Practical Bioinformatics**
- BIOL 439

**Field Ecology**
- BIOL 444

**Experimental Field Biology**
- BIOL 450W

**Contemporary Issues in Science and Medicine**
- BIOL 461

**Laboratory in Mammalian Physiology**
- BIOL 473

**Anatomy in Italy: Cadavers, Culture, and Science**
- BIOL 475N

**COMPARATIVE NEUROANATOMY**
- BIOL 478

**Coastal Biology**
- BIOL 482

**Research Project**
- BIOL 494

**Internship in Biology**
- BIOL 495

**Independent Studies**
- BIOL 496

**Plant Tissue Culture and Biotechnology**
- BIOTC 459

**Science Co-op Work Experience I**
- SC 295

**Science Co-op Work Experience II**
- SC 395

**Science Co-op Work Experience III**
- SC 495

### 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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### Additional Courses

**Groups**

Select 14-19 credits from department list

**Vertebrate Physiology**
- 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

**Mammalian Physiology**
- BIOL 472

**Laboratory in Mammalian Physiology**
- BIOL 473

**General Biochemistry**
- BMB 401

**General Biochemistry**
- BMB 402

**Organic Chemistry I**
- CHEM 210

**Organic Chemistry II**
- CHEM 212

**Laboratory in Organic Chemistry**
- CHEM 213
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 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 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 41 Medical Microbiology  
  or MICRB 43 Viral Pathogenesis  
  or PSYCH 466 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
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- BIOL 436  Population Ecology and Global Climate Change
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- 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  15-20

**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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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 plan or a 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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Second Year

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<td>CHEM 203 or 212 and 213</td>
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Third Year

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<th>Fall</th>
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<td>PHYS 250</td>
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<td>PHYS 251</td>
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<td>400 Level BIOL Selection - Group 2: Evolutionary Biology</td>
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<td>400 Level BIOL Selection - Group 1: Plants and Fungi</td>
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<td>400 Level BIOL Selection - Group 3: Genetics and Development</td>
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Fourth Year

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<tr>
<td>400 Level BIOL Selection - Group 4: Ecology</td>
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<td>400 Level BIOL Selection - Group 6: Practicum</td>
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<td>400 Level BIOL Selection - Group 5: Animal Physiology</td>
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<td>CHEM 110</td>
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<td>CHEM 111†</td>
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<td>First-Year Seminar</td>
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**Second Year**

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<td>BIOL 220W*#</td>
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<td>BIOL 230W*#</td>
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<td>STAT 250</td>
<td>CHEM 213</td>
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<td>PHYS 211 or 250</td>
<td>PHYS 212 or 251</td>
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<td>BMB 401</td>
<td>BMB 402</td>
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<th>Semester</th>
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<th>Fall</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
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<td>400 Level BIOL Selection - Group 1: Genetics and Developmental Biology</td>
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<td>General Education Course (GHW)</td>
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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.

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.

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.
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)

**Contact**

**Berks**
DIVISION OF SCIENCE
Luehrssen Science Building
Reading, PA 19610
610-396-6328
med18@psu.edu

http://berks.psu.edu/bs-biology

**Abington**
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1600 Woodland Road
Abington, PA 19001
215-881-7300
epi1@psu.edu

http://abington.psu.edu/biology

**Altoona**
DIVISION OF MATHEMATICS AND NATURAL SCIENCES
Hawthorn Building 109
3000 Ivyside Park
Altoona, PA 16601
814-949-5205
lkp3@psu.edu

http://altoona.psu.edu/academics/bachelors-degrees/biology/request-information

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100 University Drive
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724-773-3527
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25 Yearsley Mill Rd
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610-285-1268
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https://brandywine.psu.edu/academics/bachelors-degrees/biology

Harrisburg
SCHOOL OF SCIENCE, ENGINEERING, AND TECHNOLOGY
Science & Tech Building, TL 177
Middletown, PA 17057
717-948-4387
mrr53@psu.edu

https://harrisburg.psu.edu/science-engineering-technology/biology-science/bachelor-science-biology

Schuylkill
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C-001 200 University Drive
Schuylkill Haven, PA 17972
570-385-6167
ljr5322@psu.edu

https://schuylkill.psu.edu/academics/degrees/bacc-degrees/biology

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Dawson 207
Dunmore, PA 18512
570-963-2579
dxb14@psu.edu

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228 Ritenour Building
University Park, PA 16802
814-865-2329
psubioadvising@psu.edu

http://bio.psu.edu/about-us/contact-us

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1 Elias Science Building
York, PA 17403
717-718-6705

amv12@psu.edu

http://york.psu.edu/academics/baccalaureate/biology