BIOLOGY, B.S. (UNIVERSITY COLLEGE)

Begin Campus: Any Penn State Campus

End Campus: Beaver, Brandywine, Schuylkill, Scranton, York

Program Description

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

The curriculum in Biology is planned for preparation for professions requiring competence in biological science or for gaining an understanding of the world of living things. The professional group includes students who intend to secure advanced degrees through graduate study, students who are interested in work with various governmental agencies or industries having biological responsibilities, and students who want to prepare for careers in medicine or other health-related professions. Students whose interests are not professional select the curriculum because its broad approach can result in an educated view of the structure and function of living things. Achievement of these goals, including a special interest in a particular area of biology, can be met by selecting one of five options offered by the Department of Biology that will lead to the B.S. degree in Biology. The options and their key areas are:

- **Ecology Option**
  Available at the following campuses: Altoona, University Park
  Behavior, and population and community biology of plants and animals.

- **General Biology Option**
  Available at the following campuses: Abington, Altoona, Beaver, Berks, Brandywine, Harrisburg, Schuylkill, Scranton, University Park, York
  All aspects of modern biology.

- **Genetics and Developmental Biology Option**
  Available at the following campuses: Abington, Berks, Harrisburg, University Park, York
  Genetics, genetic engineering, and plant and animal development.

- **Neuroscience Option**
  Available at the following campuses: University Park
  Development, biochemistry, physiology and aging of the central and peripheral nervous system.

- **Plant Biology Option**
  Available at the following campuses: University Park
  Morphology, systematics, and physiology of plants and fungi.

- **Vertebrate Physiology Option**
  Available at the following campuses: Abington, Altoona, Brandywine, University Park
  Pre-medicine, pre-dentistry, pharmacology, and animal physiology.

What is Biology?

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 different procedures and instruments play an important role in gaining biological knowledge. Biologists explore ways to cure neurological diseases, conserve coral populations in tropical oceans, discover more efficient ways to use plants for food and bioenergy, develop vaccines for infectious diseases, and investigate many other facets of Biology.

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>Prescribed Courses</td>
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</tr>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Experimental Chemistry II</td>
<td>1</td>
</tr>
<tr>
<td>MATH 141</td>
<td>Calculus with Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>Prescribed Courses: Require a grade of C or better</td>
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<tr>
<td>BIOI 110</td>
<td>Biology: Basic Concepts and Biodiversity</td>
<td>4</td>
</tr>
<tr>
<td>BIOI 220W</td>
<td>Biology: Populations and Communities</td>
<td>4</td>
</tr>
<tr>
<td>BIOI 230W</td>
<td>Biology: Molecules and Cells</td>
<td>4</td>
</tr>
<tr>
<td>BIOI 240W</td>
<td>Biology: Function and Development of Organisms</td>
<td>4</td>
</tr>
<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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<tr>
<td>Additional Courses</td>
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<tr>
<td>Select one of the following:</td>
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<td>8-12</td>
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<tr>
<td>PHYS 211</td>
<td>General Physics: Mechanics</td>
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<tr>
<td>&amp; PHYS 212</td>
<td>and General Physics: Electricity and Magnetism</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 213</td>
<td>and General Physics: Fluids and Thermal Physics</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 214</td>
<td>and General Physics: Wave Motion and Quantum Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 250</td>
<td>Introductory Physics I</td>
<td></td>
</tr>
<tr>
<td>&amp; PHYS 251</td>
<td>and Introductory Physics II</td>
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</tbody>
</table>

**Requirements for the Option**
Select an option 50-54

**Requirements for the Option**

**Ecology Option (50-54 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>Additional Courses</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>
<td></td>
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<tr>
<td>Select one of the following:</td>
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<td>6-8</td>
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<tr>
<td>CHEM 202</td>
<td>Fundamentals of Organic Chemistry I</td>
<td></td>
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<tr>
<td>&amp; CHEM 203</td>
<td>and Fundamentals of Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 212</td>
<td>and Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 213</td>
<td>and Laboratory in Organic Chemistry</td>
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<tr>
<td>Select 3-4 credits of the following:</td>
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<td>3-4</td>
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<tr>
<td>STAT 200</td>
<td>Elementary Statistics</td>
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<tr>
<td>STAT 240</td>
<td>Introduction to Biometry</td>
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</tr>
<tr>
<td>STAT 250</td>
<td>Introduction to Biostatistics</td>
<td></td>
</tr>
</tbody>
</table>

Groups

Select a minimum of 18 credits of 400-level biology courses, with at least 3 credits from each of the following groups:
Group I:
- BIOL 412 Ecology of Infectious Diseases
- BIOL 419 Ecological and Environmental Problem Solving
- BIOL 435 Ecology of Lakes and Streams
- BIOL 436 Population Ecology and Global Climate Change
- BIOL 444 Field Ecology
- BIOL 450W Experimental Field Biology
- BIOL 463 General Ecology
- BIOL 482 Coastal Biology
- BIOL 499A Tropical Field Ecology

Group II:
- BIOL 414 Taxonomy of Seed Plants
- BIOL 427 Evolution
- BIOL 428 Population Genetics
- BIOL 429 Animal Behavior
- BIOL 448 Ecology of Plant Reproduction
- BIOL 464 Sociobiology
- BIOL 474 Astrobiology

Group III:
- BIOL 406 Symbiosis
- BIOL 415 Ecotoxicology
- BIOL 417 Invertebrate Zoology
- BIOL 446 Physiological Ecology
- PPEM 425 Biology of Fungi

Group IV:
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 419 Ecological and Environmental Problem Solving
- BIOL 444 Field Ecology
- BIOL 446 Evolution
- BIOL 448 Ecology of Plant Reproduction
- BIOL 449A Tropical Field Ecology
- HORT 407 Plant Breeding
- PPEM 416 Plant Virology: Molecules to Populations
- PPEM 425 Biology of Fungi

Supporting Courses and Related Areas
Select 17-24 credits from department list

General Biology Option (50-54 credits)
Available at the following campuses: Abington, Altoona, Beaver, Berks, Brandywine, Harrisburg, Schuylkill, Scranton, University Park, York

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select 3-4 credits of the following:</td>
<td>STAT 200</td>
<td>Elementary Statistics</td>
</tr>
<tr>
<td></td>
<td>STAT 240</td>
<td>Introduction to Biometry</td>
</tr>
<tr>
<td></td>
<td>STAT 250</td>
<td>Introduction to Biostatistics</td>
</tr>
</tbody>
</table>
| Groups | Select a minimum of 18 credits of 400-level biology courses, with at least 3 credits from each of the following groups: 1
| Group I: | BIOL 407 | Plant Developmental Anatomy |
| | BIOL 414 | Taxonomy of Seed Plants |
| | BIOL 441 | Plant Physiology |
| | BIOL 443 | Evo-devo: Evolution of Developmental Mechanisms |
| | BIOL 444 | Field Ecology |
| | BIOL 446 | Physiological Ecology |
| | BIOL 448 | Ecology of Plant Reproduction |
| | BIOL 499A | Tropical Field Ecology |
| | HORT 407 | Plant Breeding |
| | PPEM 416 | Plant Virology: Molecules to Populations |
| | PPEM 425 | Biology of Fungi |
| Group II: | BIOL 405 | Molecular Evolution |
| | BIOL 411 | Medical Embryology |
| | BIOL 414 | Taxonomy of Seed Plants |
| | BIOL 417 | Invertebrate Zoology |
| | BIOL 420 | Paleobotany |
| | BIOL 421 | Comparative Anatomy of Vertebrates |
| | BIOL 425 | Biology of Fungi |
| | BIOL 427 | Evolution |
| | BIOL 428 | Population Genetics |
| | BIOL 438 | Theoretical Population Ecology |
| | BIOL 443 | Evo-devo: Evolution of Developmental Mechanisms |
| | BIOL 460 | Human Genetics |
| | BIOL 474 | Astrobiology |
| Group III: | BIOL 404 | Cellular Mechanisms in Vertebrate Physiology |
| | BIOL 405 | Molecular Evolution |
| | BIOL 407 | Plant Developmental Anatomy |
| | BIOL 411 | Medical Embryology |
| | BIOL 416 | Biology of Cancer |
| | BIOL 422 | Advanced Genetics |
| | BIOL 426 | Developmental Neurobiology |
| | BIOL 428 | Population Genetics |
| | BIOL 430 | Developmental Biology |
| | BIOL 432 | Developmental Genetics |
| | BIOL 439 | Practical Bioinformatics |
| | BIOL 443 | Evo-devo: Evolution of Developmental Mechanisms |
| | BIOL 448 | Ecology of Plant Reproduction |
| | BIOL 460 | Human Genetics |

1 Courses in Group IV except BIOL 496, SC 295, SC 395, SC 495 may be used to satisfy requirements in other groups.
2 A maximum of 3 credits of BIOL 496 or 4 credits of SC 295, SC 395, SC 495 may be used to fulfill the 18-credit minimum in the 400-level biology course requirement.
<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
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<tr>
<td>BMB 400</td>
<td>Molecular Biology of the Gene</td>
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<tr>
<td>BMB 450</td>
<td>Microbial/Molecular Genetics</td>
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<tr>
<td>HORT 407</td>
<td>Plant Breeding</td>
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</table>

**Group IV:**

<table>
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<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 414</td>
<td>Taxonomy of Seed Plants</td>
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<tr>
<td>BIOL 415</td>
<td>Ecotoxicology</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 428</td>
<td>Population Genetics</td>
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<tr>
<td>BIOL 429</td>
<td>Animal Behavior</td>
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<tr>
<td>BIOL 435</td>
<td>Ecology of Lakes and Streams</td>
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<tr>
<td>BIOL 436</td>
<td>Population Ecology and Global Climate Change</td>
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<tr>
<td>BIOL 444</td>
<td>Field Ecology</td>
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<tr>
<td>BIOL 446</td>
<td>Physiological Ecology</td>
<td></td>
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<tr>
<td>BIOL 448</td>
<td>Ecology of Plant Reproduction</td>
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<tr>
<td>BIOL 450W</td>
<td>Experimental Field Biology</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 499A</td>
<td>Tropical Field Ecology</td>
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**Group V:**

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<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 404</td>
<td>Cellular Mechanisms in Vertebrate Physiology</td>
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<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
<td></td>
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<tr>
<td>BIOL 409</td>
<td>Biology of Aging</td>
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<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
<td></td>
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<tr>
<td>BIOL 413</td>
<td>Cell Signaling and Regulation</td>
<td></td>
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<tr>
<td>BIOL 416</td>
<td>Biology of Cancer</td>
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<tr>
<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
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<tr>
<td>BIOL 426</td>
<td>Developmental Neurobiology</td>
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<td>BIOL 430</td>
<td>Developmental Biology</td>
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<tr>
<td>BIOL 432</td>
<td>Developmental Genetics</td>
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<tr>
<td>BIOL 437</td>
<td>Histology</td>
<td></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 460</td>
<td>Human Genetics</td>
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<tr>
<td>BIOL 469</td>
<td>Neurobiology</td>
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<td>BIOL 470</td>
<td>Functional and Integrative Neuroscience</td>
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<td>BIOL 472</td>
<td>Mammalian Physiology</td>
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<tr>
<td>BIOL 479</td>
<td>General Endocrinology</td>
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**Group VI:**

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>BIOL 400</td>
<td>Teaching in Biology</td>
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<tr>
<td>BIOL 407</td>
<td>Plant Developmental Anatomy</td>
<td></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 419</td>
<td>Ecological and Environmental Problem Solving</td>
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<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
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<tr>
<td>BIOL 437</td>
<td>Histology</td>
<td></td>
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<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 448</td>
<td>Ecology of Plant Reproduction</td>
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<td>BIOL 450</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 496</td>
<td>Independent Studies (1-3 credits)</td>
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<td>PPEM 425</td>
<td>Biology of Fungi</td>
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<tr>
<td>SC 295</td>
<td>Science Co-op Work Experience I</td>
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<tr>
<td>SC 395</td>
<td>Science Co-op Work Experience II</td>
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<tr>
<td>SC 495</td>
<td>Science Co-op Work Experience III</td>
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**Supporting Courses and Related Areas**

Select 20-27 credits from department list

**Genetics and Developmental Biology Option (50-54 credits)**

*Available at the following campuses: Abington, Berks, Harrisburg, University Park, York*

**Code** | **Title**                                               | **Credits** |
<table>
<thead>
<tr>
<th></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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<tr>
<td>BMB 402</td>
<td>General Biochemistry</td>
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<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 of the following:

<table>
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<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>MATH 220</td>
<td>Matrices</td>
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<tr>
<td>MATH 231</td>
<td>Calculus of Several Variables</td>
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<tr>
<td>MIRC 201</td>
<td>Introductory Microbiology</td>
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<tr>
<td>MIRC 202</td>
<td>Introductory Microbiology Laboratory</td>
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Select 3-4 credits of the following:

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<td>STAT 250</td>
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<tr>
<td>STAT 319</td>
<td>Applied Statistics in Science</td>
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**Groups**

Select a minimum of 12 credits of 400-level courses, with at least 6 credits from Group I, 3 credits from Group II, and 3 credits from Group III:

**Group I:**

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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>BIOL 404</td>
<td>Cellular Mechanisms in Vertebrate Physiology</td>
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<tr>
<td>BIOL 405</td>
<td>Molecular Evolution</td>
<td></td>
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<tr>
<td>BIOL 407</td>
<td>Plant Developmental Anatomy</td>
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<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
<td></td>
</tr>
<tr>
<td>BIOL 413</td>
<td>Cell Signaling and Regulation</td>
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<tr>
<td>BIOL 416</td>
<td>Biology of Cancer</td>
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<tr>
<td>BIOL 422</td>
<td>Advanced Genetics</td>
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<td>BIOL 426</td>
<td>Developmental Neurobiology</td>
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<tr>
<td>BIOL 427</td>
<td>Evolution</td>
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<tr>
<td>BIOL 428</td>
<td>Population Genetics</td>
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Biology, B.S. (University College)

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<td>Practical Bioinformatics</td>
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<td>BIOL 443</td>
<td>Evo-devo: Evolution of Developmental Mechanisms</td>
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<tr>
<td>BIOL 448</td>
<td>Ecology of Plant Reproduction</td>
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<tr>
<td>BIOL 460</td>
<td>Human Genetics</td>
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<tr>
<td>BIOL 469</td>
<td>Neurobiology</td>
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<tr>
<td>BMB 400</td>
<td>Molecular Biology of the Gene</td>
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<tr>
<td>BMB 450</td>
<td>Microbial/Molecular Genetics</td>
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<td>HORT 407</td>
<td>Plant Breeding</td>
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<td>MICRB 410</td>
<td>Principles of Immunology</td>
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Group II:

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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>
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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>
<td></td>
</tr>
<tr>
<td>BIOL 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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<td>BIOL 438</td>
<td>Theoretical Population Ecology</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 460</td>
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Group III:

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<tr>
<td>BIOL 407</td>
<td>Plant Developmental Anatomy</td>
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</tr>
<tr>
<td>BIOL 437</td>
<td>Histology</td>
<td></td>
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<tr>
<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
<td></td>
</tr>
<tr>
<td>BIOL 448</td>
<td>Ecology of Plant Reproduction</td>
<td></td>
</tr>
<tr>
<td>BIOL 461</td>
<td>Contemporary Issues in Science and Medicine</td>
<td></td>
</tr>
<tr>
<td>BIOL 473</td>
<td>Laboratory in Mammalian Physiology</td>
<td></td>
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<tr>
<td>BIOL 496</td>
<td>Independent Studies (1-3 credits)</td>
<td></td>
</tr>
<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
<td></td>
</tr>
<tr>
<td>BMB 442</td>
<td>Laboratory in Proteins, Nucleic Acids, and Molecular Cloning</td>
<td></td>
</tr>
<tr>
<td>PPEM 425</td>
<td>Biology of Fungi</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>
<tr>
<td>SC 495</td>
<td>Science Co-op Work Experience III</td>
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Supporting Courses and Related Areas

Select 9-17 credits from department list

9-17

Neuroscience Option (50-54 credits)

Available at the following campuses: University Park

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<tr>
<th>Code</th>
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<th>Credits</th>
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<td>Neurobiology</td>
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<td>BIOL 470</td>
<td>Functional and Integrative Neuroscience</td>
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<tr>
<td>BMB 401</td>
<td>General Biochemistry</td>
<td></td>
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<tr>
<td>BMB 402</td>
<td>General Biochemistry</td>
<td></td>
</tr>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td></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>
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Additional Courses

Select 3-4 credits of the following:

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<th>Code</th>
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<tbody>
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<tr>
<td>STAT 240</td>
<td>Introduction to Biometry</td>
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<td>STAT 250</td>
<td>Introduction to Biostatistics</td>
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Groups

Select a minimum of 12 credits of 400-level biology courses, with at least 6 credits from Group I, 3 credits from Group II, and 3 credits from Group III:

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<tr>
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<tbody>
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<td>Cellular Mechanisms in Vertebrate Physiology</td>
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<tr>
<td>BIOL 409</td>
<td>Biology of Aging</td>
<td></td>
</tr>
<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
<td></td>
</tr>
<tr>
<td>BIOL 413</td>
<td>Cell Signaling and Regulation</td>
<td></td>
</tr>
<tr>
<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
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<tr>
<td>BIOL 426</td>
<td>Developmental Neurobiology</td>
<td></td>
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<tr>
<td>BIOL 430</td>
<td>Developmental Biology</td>
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</tr>
<tr>
<td>BIOL 437</td>
<td>Histology</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 460</td>
<td>Human Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOL 472</td>
<td>Mammalian Physiology</td>
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<tr>
<td>BIOL 473</td>
<td>Laboratory in Mammalian Physiology</td>
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<tr>
<td>BIOL 479</td>
<td>General Endocrinology</td>
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<tr>
<td>BMB 400</td>
<td>Molecular Biology of the Gene</td>
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Neuroscience Option (50-54 credits)

Available at the following campuses: University Park

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>BIOL 400</td>
<td>Teaching in Biology</td>
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<tr>
<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
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<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>
<td></td>
</tr>
<tr>
<td>BIOL 437</td>
<td>Histology</td>
<td></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 448</td>
<td>Ecology of Plant Reproduction</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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**Biology, B.S. (University College)**

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<tr>
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<td>BIOL 496</td>
<td>Independent Studies (1-3 credits)</td>
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<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
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<tr>
<td>SC 295</td>
<td>Science Co-op Work Experience I</td>
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<td>SC 395</td>
<td>Science Co-op Work Experience II</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  

1 May select up to 6 credits from department list

**Plant Biology Option (50-54 credits)**  
Available at the following campuses: University Park

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<td>Plant Developmental Anatomy</td>
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<tr>
<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
<td>3</td>
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<tr>
<td>BIOL 441</td>
<td>Plant Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BMB 401</td>
<td>General Biochemistry</td>
<td>3</td>
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<td>BMB 402</td>
<td>General Biochemistry</td>
<td>3</td>
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<td>Organic Chemistry I</td>
<td>3</td>
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<td>CHEM 212</td>
<td>Organic Chemistry II</td>
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<td>Laboratory in Organic Chemistry</td>
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**Additional Courses**
Select 3-4 credits of the following:  

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<th>Code</th>
<th>Title</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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<td>STAT 250</td>
<td>Introduction to Biostatistics</td>
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**Groups**
Select a minimum of 9 credits of 400-level biology courses, with at least 6 credits from Group I and 3 credits from Group II:

**Group I:**

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<td>BIOL 427</td>
<td>Evolution</td>
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<td>BIOL 430</td>
<td>Developmental Biology</td>
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<tr>
<td>BIOL 443</td>
<td>Evo-devo: Evolution of Developmental Mechanisms</td>
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<td>BIOL 444</td>
<td>Field Ecology</td>
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<td>BIOL 446</td>
<td>Physiological Ecology</td>
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<tr>
<td>BIOL 448</td>
<td>Ecology of Plant Reproduction</td>
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</tr>
<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
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<td>BIOTC 459</td>
<td>Plant Tissue Culture and Biotechnology</td>
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<td>HORT 407</td>
<td>Plant Breeding</td>
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<td>PPEM 416</td>
<td>Plant Virology: Molecules to Populations</td>
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<td>PPEM 425</td>
<td>Biology of Fungi</td>
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**Group II:**

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<td>Taxonomy of Seed Plants</td>
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<td>BIOL 419</td>
<td>Ecological and Environmental Problem Solving</td>
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<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
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<td>BIOL 448</td>
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<tr>
<td>BIOL 450W</td>
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**Additional Courses**
Select a minimum of 12 credits of 400-level courses, with at least 6 credits from Group I, 3 credits from Group II, and 3 credits from Group III:

**Group I:**

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<tr>
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<td>Cellular Mechanisms in Vertebrate Physiology</td>
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<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
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<tr>
<td>BIOL 409</td>
<td>Biology of Aging</td>
<td></td>
</tr>
<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
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<td>BIOL 412</td>
<td>Ecology of Infectious Diseases</td>
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<tr>
<td>BIOL 413</td>
<td>Cell Signaling and Regulation</td>
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<td>BIOL 416</td>
<td>Biology of Cancer</td>
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<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
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<td>BIOL 426</td>
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<tr>
<td>BIOL 430</td>
<td>Developmental Biology</td>
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<tr>
<td>BIOL 432</td>
<td>Developmental Genetics</td>
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<tr>
<td>BIOL 437</td>
<td>Histology</td>
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<td>BIOL 443</td>
<td>Evo-devo: Evolution of Developmental Mechanisms</td>
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<td>Neurobiology</td>
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<td>BIOL 470</td>
<td>Functional and Integrative Neuroscience</td>
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<td>General Endocrinology</td>
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**Group II:**

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<tbody>
<tr>
<td>BIOL 405</td>
<td>Molecular Evolution</td>
<td></td>
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<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
<td></td>
</tr>
<tr>
<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
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**Vertebrate Physiology Option (50-54 credits)**
Available at the following campuses: Abington, Altoona, Brandywine, University Park

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<td>Mammalian Physiology</td>
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<td>BIOL 473</td>
<td>Laboratory in Mammalian Physiology</td>
<td>2</td>
</tr>
<tr>
<td>BMB 401</td>
<td>General Biochemistry</td>
<td>3</td>
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<td>BMB 402</td>
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<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>
<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
<td>2</td>
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**Additional Courses**
Select 3-4 credits of the following:  

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<td>Introduction to Biostatistics</td>
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**Groups**
Select a minimum of 12 credits of 400-level courses, with at least 6 credits from Group I, 3 credits from Group II, and 3 credits from Group III:

**Group I:**

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<td>BIOL 406</td>
<td>Symbiosis</td>
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Program Learning Objectives

Beaver Campus

1. **Evolution**: Understand and give examples of the evolutionary processes that have generated the extinct and extant diversity of life.

2. **Structure and Function**: Compare and contrast how the physical structures of organisms determine biological function from the molecular to ecosystem levels.

3. **Information Flow, Exchange, and Storage**: Identify how the growth and behavior of organisms are regulated by the transmission, expression, and interactions of genetic information.

4. **Pathways and Transformations of Energy and Matter**: Analyze how the pathways and transformations of energy and matter enable living organisms to carry out essential life processes.

5. **Systems**: Living systems are interconnected and interacting; assess complex biological processes by quantifying dynamic interactions at multiple functional scales.

Brandywine Campus

1. Students will be able to explain the process of evolution and its underlying principles and mechanism.

2. Students will be able to explain the fundamental biological processes including (but not limited to) cell structure and function, ecological diversity, animal and plant physiology and genetic analysis of prokaryotes and eukaryotes.

3. Students will be able to discuss the relationships between form and function of biological structures at the molecular, cellular, organismal, population, and ecosystem levels of the biological hierarchy.

4. Students will be able to read, understand, and critically interpret the primary biological literature.

5. The student will be able to design, conduct, analyze, and communicate (in writing and orally) biological research.

6. The student will recognize and be able to apply basic ethical principles to basic and applied biological/biomedical practice and will understand the role of biological/biomedical science, scientists, and practitioners in society.

Scranton and York Campuses

1. Students will demonstrate the ability to think critically, analyze, and use information to solve problems.

2. Students will be expected to demonstrate a level of proficiency with biological concepts.

3. Students will become familiar with the physical, chemical, and mathematical foundations necessary to understand biological systems.

4. Students will be able to clearly state a scientific hypothesis; design a controlled experiment to test this hypothesis, analyze and clearly present data; and justify the conclusions of an experiment.

5. Students will be expected to become proficient in reading, understanding, and reviewing scientific information and communicating that information, while simultaneously building vocabulary reflecting contemporary terminology.

6. Students will be expected to work successfully as team members, while simultaneously building upon their abilities to become self-directed learners.

7. Students will be expected to show mastery of fundamental laboratory techniques.

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)

Beaver

Cassandra Miller-Butterworth
Associate Professor of Biology
100 University Drive
Monaca, PA 15061
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).

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### Brandywine Campus

#### General Option

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#### Total Credits 128.5

1 *BIOL course groupings: Group I = Plants & fungi; Group II = Evolutionary biology; Group III = Genetics; Group IV = Ecology; Group V = Animal physiology; Group VI = Practicum

* 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

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**Vertebrate Physiology Option**
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### General Education course (GWH)
- * Course requires a grade of C or better for the major
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<td>MICRB 201 (or Biology Option)</td>
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<td>Biology Option</td>
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<td>BIOL 4 XX Group I</td>
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<tr>
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<td>15</td>
<td><strong>16.5</strong></td>
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</table>
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.

### Integrative Studies (either Inter-domain or Linked Courses)

Integrative Studies may be completed within the 30 Knowledge Domain credits and must be completed with either Inter-domain or Linked courses, not a combination of both. For Inter-domain courses, credit may apply to both Knowledge Domain designations but does not reduce the total number of credits within the Knowledge Domains and at least 3 credits of single-domain coursework are required in each of the 5 Knowledge Domains. Linked courses used for the Integrative Studies requirement must represent two different Knowledge Domains.

### Scranton Campus

#### General Option

The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an Academic Requirements or What If report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

### First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 110†</td>
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<td>BIOL 230W*</td>
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<tr>
<td>CHEM 110#†</td>
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<td>CHEM 112†</td>
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<tr>
<td>MATH 140#†</td>
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Total Credits 125-126

### Second Year

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Total Credits 16.5

### Third Year

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<td>BIOL 4 XX Group VI</td>
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Total Credits 15

### Fourth Year

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<tr>
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<td>BIOL 4 XX Group I - Evolutionary Biology</td>
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Total Credits 15

### Scranton Campus

#### General Option

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.
Basis to develop and refine an academic plan that is appropriate for you.

York Campus
General Biology Option
The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an Academic Requirements or What If report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

### First Year

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<tr>
<th>Fall</th>
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<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 110*</td>
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<td>BOL 240W*</td>
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<tr>
<td>CHEM 110*</td>
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<td>MATH 140*</td>
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<td>General Education Course (GHW)</td>
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### Second Year

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<td>PHYS 251 or 212</td>
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<td>PHYS 214 (or Elective)</td>
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<td>CHEM 210</td>
<td>3</td>
<td>CHEM 212</td>
<td>3</td>
</tr>
<tr>
<td>CAS 100†</td>
<td>3</td>
<td>CHEM 213</td>
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### Third Year

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<th>Spring</th>
<th>Credits</th>
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<td>ENGL 202C†</td>
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### Fourth Year

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<th>Fall</th>
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<td>BIOL 4XX Group V</td>
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<td>BIOL 4XX Group IV</td>
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<td>16.5</td>
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</table>

Total Credits 127-128

* Course requires a grade of C or better for the major
† Course requires a grade of C or better for General Education

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### 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, GWH, 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.

### Genetics and Developmental Biology Option

The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an Academic Requirements or What If report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

### First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 110*</td>
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<td>BOL 240W*</td>
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<td>CHEM 110*</td>
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<td>ENGL 15 or 30†</td>
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<td>PHYS 250 or 211</td>
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<td>MATH 140*</td>
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<td>MATH 141</td>
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### Second Year

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<td>CHEM 212</td>
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</tr>
<tr>
<td>CAS 100†</td>
<td>3</td>
<td>CHEM 213</td>
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<td>Biology Option</td>
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### Third Year

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<td>ENGL 202C†</td>
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<td>STAT 200 or 250</td>
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<tr>
<td>General Education Course</td>
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### Fourth Year

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Total Credits 127-128

* Course is an Entrance to Major requirement
† Course satisfies General Education and degree requirement

---

Physiology); Group VI (Practicum). Courses offered to complete these major requirements may be offered on a rotating basis.
<table>
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Total Credits 134

* 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:**

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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.

**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**

**Beaver**

100 University Drive  
Monaca, PA 15061  
724-773-3527  
cmm48@psu.edu

**Brandywine**

ACADEMIC AFFAIRS  
25 Yearsley Mill Rd  
Media, PA 19063  
610-285-1268  
mab90@psu.edu

https://brandywine.psu.edu/academics/bachelors-degrees/biology

**Schuylkill**

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

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

**Scranton**

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

https://scranton.psu.edu/biology-degree

**York**

1 Elias Science Building  
York, PA 17403  
717-718-6705  
amv12@psu.edu

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

**Abington**

DIVISION OF SCIENCE AND ENGINEERING  
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

**Berks**

DIVISION OF SCIENCE  
Luerssen Science Building  
Reading, PA 19610  
610-396-6328

http://beaver.psu.edu/biology
med18@psu.edu
http://berks.psu.edu/bs-biology

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

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

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

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