BIOLOGY, B.S. (SCIENCE)

Begin Campus: Any Penn State Campus

End Campus: University Park

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.

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 (https://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>
<td>1</td>
</tr>
<tr>
<td>MATH 141</td>
<td>Calculus with Analytic Geometry II</td>
<td>4</td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 110</td>
<td>Biology: Basic Concepts and Biodiversity</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 220W</td>
<td>Biology: Populations and Communities</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 230W</td>
<td>Biology: Molecules and Cells</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 240W</td>
<td>Biology: Function and Development of Organisms</td>
<td>4</td>
</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>
<td>4</td>
</tr>
</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</td>
<td>General Physics: Mechanics</td>
<td></td>
</tr>
<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>
<td></td>
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</tbody>
</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>
<td></td>
</tr>
<tr>
<td>STAT 240</td>
<td>Introduction to Biometry</td>
<td></td>
</tr>
<tr>
<td>STAT 250</td>
<td>Introduction to Biostatistics</td>
<td></td>
</tr>
</tbody>
</table>

Requirements for the Option
Select an option 46-51

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 463</td>
<td>General Ecology</td>
<td>3</td>
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</table>

Additional Courses
Select one of the following: 6-8

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CHEM 202</td>
<td>Fundamentals of Organic Chemistry I</td>
<td></td>
</tr>
<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 211</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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</tbody>
</table>

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

Ecology Group:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</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>
<td></td>
</tr>
<tr>
<td>BIOL 438</td>
<td>Theoretical Population Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 444</td>
<td>Field Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 446</td>
<td>Physiological Ecology</td>
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</tr>
<tr>
<td>BIOL 450W</td>
<td>Experimental Field Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 464</td>
<td>Sociobiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 474</td>
<td>Astrobiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 482</td>
<td>Coastal Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
<td></td>
</tr>
</tbody>
</table>

Evolution Group:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 405</td>
<td>Molecular Evolution</td>
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</tr>
<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
<td></td>
</tr>
<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
<td></td>
</tr>
<tr>
<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
<td></td>
</tr>
<tr>
<td>BIOL 417</td>
<td>Invertebrate Zoology</td>
<td></td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Paleobotany</td>
<td></td>
</tr>
<tr>
<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
<td></td>
</tr>
<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>
</tr>
<tr>
<td>BIOL 428</td>
<td>Population Genetics</td>
<td></td>
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</tbody>
</table>
Biology, B.S. (Science)

BIOLOGICAL SCIENCES MAJORS

BIOL 429 Animal Behavior
BIOL 432 Developmental Genetics
BIOL 433 Evolution of Vertebrates
BIOL 434 Pathobiology of Emerging Infectious Disease
BIOL 436 Population Ecology and Global Climate Change
BIOL 438 Theoretical Population Ecology
BIOL 439 Practical Bioinformatics
BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
BIOL 446 Physiological Ecology
BIOL 451 Biology of RNA
BIOL 460 Human Genetics
BIOL 463 General Ecology
BIOL 464 Sociobiology
BIOL 474 Astrobiology
BIOL 478 COMPARATIVE NEUROANATOMY

Practicum Group:
BIOL 400 Teaching in Biology
BIOL 402W Biological Experimental Design
BIOL 407 Plant Developmental Anatomy
BIOL 414 Taxonomy of Seed Plants
BIOL 417 Invertebrate Zoology
BIOL 419 Ecological and Environmental Problem Solving
BIOL 421 Comparative Anatomy of Vertebrates
BIOL 422 Advanced Genetics
BIOL/PPEM 425 Biology of Fungi
BIOL 433 Evolution of Vertebrates
BIOL 437 Histology
BIOL 439 Practical Bioinformatics
BIOL 444 Field Ecology
BIOL 450W Experimental Field Biology
BIOL 461 Contemporary Issues in Science and Medicine
BIOL 473 Laboratory in Mammalian Physiology
BIOL 475N
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

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

<table>
<thead>
<tr>
<th>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 407</td>
<td>Plant Developmental Anatomy</td>
<td></td>
</tr>
<tr>
<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
<td></td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Paleobotany</td>
<td></td>
</tr>
<tr>
<td>BIOL 424</td>
<td>Seeds of Change: The Uses of Plants</td>
<td></td>
</tr>
<tr>
<td>BIOL/PPEM 425</td>
<td>Biology of Fungi</td>
<td></td>
</tr>
<tr>
<td>BIOL 431</td>
<td>Reproductive Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 441</td>
<td>Plant Physiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 444</td>
<td>Field Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 446</td>
<td>Physiological Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 448</td>
<td>Ecology of Plant Reproduction</td>
<td></td>
</tr>
<tr>
<td>BIOL 451</td>
<td>Biology of RNA</td>
<td></td>
</tr>
<tr>
<td>BIOL 482</td>
<td>Coastal Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
<td></td>
</tr>
<tr>
<td>PPEM 427</td>
<td>Mycotoxins: Effects of Fungal Toxins on Human and Animal Health</td>
<td></td>
</tr>
<tr>
<td>BIOL 405</td>
<td>Molecular Evolution</td>
<td></td>
</tr>
<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
<td></td>
</tr>
<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
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<td>Invertebrate Zoology</td>
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<tr>
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<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>
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<tr>
<td>BIOL/PPEM 425</td>
<td>Biology of Fungi</td>
<td></td>
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<tr>
<td>BIOL 427</td>
<td>Evolution</td>
<td></td>
</tr>
<tr>
<td>BIOL 428</td>
<td>Population Genetics</td>
<td></td>
</tr>
<tr>
<td>BIOL 429</td>
<td>Animal Behavior</td>
<td></td>
</tr>
<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>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>
<td></td>
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<tr>
<td>BIOL 438</td>
<td>Theoretical Population Ecology</td>
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<tr>
<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
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</tr>
<tr>
<td>BIOL 443</td>
<td>Evo-devo: Evolution of Developmental Mechanisms</td>
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</tr>
<tr>
<td>BIOL 446</td>
<td>Physiological Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 451</td>
<td>Biology of RNA</td>
<td></td>
</tr>
<tr>
<td>BIOL 460</td>
<td>Human Genetics</td>
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</tr>
</tbody>
</table>

Select one of the following: 6-8

CHEM 202 Fundamentals of Organic Chemistry I
& CHEM 203 and Fundamentals of Organic Chemistry II
CHEM 210 Organic Chemistry I
& CHEM 212 and Organic Chemistry II
& CHEM 213 and Laboratory in Organic Chemistry

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

Chemistry Group:
CHEM 202 Fundamentals of Organic Chemistry I
& CHEM 203 and Fundamentals of Organic Chemistry II

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

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

Code       Title                                      Credits
Addition
al Courses
Select one of the following: 6-8
### Biology, B.S. (Science)

**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 467: Molecular Basis of Neurological Diseases
- 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 430: Developmental Biology
- BIOL 431: Reproductive Biology
- BIOL 432: Developmental Genetics
- BIOL 437: Histology
- BIOL 444: Field Ecology
- BIOL 450W: Experimental Field Biology
- BIOL 451: Biology of RNA
- BIOL 452: Developmental Neurobiology
- BIOL 454: Neuroscience
- BIOL 456: Physiological Ecology
- BIOL 459: Histology
- BIOL 460: Human Genetics
- BIOL 467: Molecular Basis of Neurological Diseases
- BIOL 468: Comparative Neuroanatomy
- BIOL 469: Neurobiology
- BIOL 470: Functional and Integrative Neuroscience
- BIOL 471: Invertebrate Zoology
- BIOL 472: Human 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 451: Contemporary Issues in Science and Medicine
- BIOL 473: Laboratory in Mammalian Physiology
- BIOL 475N: Advanced Human Anatomy - cadaver based
- 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

- 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 444: 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: Human Physiology
- BIOL 478: Comparative Neuroanatomy
- BIOL 479: General Endocrinology
- BIOL 482: Coastal Biology

- 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 451: Contemporary Issues in Science and Medicine
- BIOL 473: Laboratory in Mammalian Physiology
- BIOL 475N: Advanced Human Anatomy - cadaver based
- 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
### Genetics and Developmental Biology Option (46-51 credits)

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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</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>
</tr>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 212</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Additional Courses

Select 2-5 credits from the following:

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

#### Groups

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

#### Genetics and Developmental Biology Group:

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

#### Evolution Group:

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

#### Practicum Group:

- BIOL 400 Teaching in Biology
- BIOL 402W Biological Experimental Design
- BIOL 407 Plant Developmental Anatomy
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 419 Ecological and Environmental Problem Solving
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 433 Evolution of Vertebrates
- BIOL 437 Histology
- BIOL 439 Practical Bioinformatics
- BIOL 444 Field Ecology
- BIOL 450W Experimental Field Biology
- BIOL 461 Contemporary Issues in Science and Medicine
- BIOL 473 Laboratory in Mammalian Physiology
- BIOL 475N
- BIOL 478 COMPARATIVE NEUROANATOMY
- BIOL 482 Coastal Biology
- BIOL 494 Research Project
- BIOL 495 Internship in Biology
- BIOL 496 Independent Studies
- BIOL 499A Tropical Field Ecology
- SC 295 Science Co-op Work Experience I
- SC 395 Science Co-op Work Experience II
### Neuroscience Option (46-51 credits)

*Available at the following campuses: University Park*

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

- **Additional Courses**
  - Select 3 credits from the following:
    - BIOL 426 Developmental Neurobiology
    - BIOL 470 Functional and Integrative Neuroscience
    - BIOL 478 COMPARATIVE NEUROANATOMY

- **Groups**
  - **Neuroscience Group:** 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.

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

- **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
- BIOL 478 COMPARATIVE NEUROANATOMY
- BIOL 482 Coastal Biology
- BIOL 494 Research Project
- BIOL 495 Internship in Biology
- BIOL 496 Independent Studies
- BIOL 499A Tropical Field Ecology
- BIOTC 459 Plant Tissue Culture and Biotechnology
- SC 295 Science Co-op Work Experience I
- SC 395 Science Co-op Work Experience II
- SC 495 Science Co-op Work Experience III
**Supporting Courses and Related Areas**
Select 14-19 credits from department list 14-19

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

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>BIOL 407</td>
<td>Plant Developmental Anatomy</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>
</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>
<td>2</td>
</tr>
</tbody>
</table>

**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
- 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 425
- BIOL 433 Evolution of Vertebrates
- BIOL 437 Histology
- BIOL 439 Practical Bioinformatics
- BIOL 444 Field Ecology
- BIOL 450W Experimental Field Biology
- BIOL 461 Contemporary Issues in Science and Medicine
- BIOL 473 Laboratory in Mammalian Physiology
- BIOL 475N COMPARATIVE NEUROANATOMY
- BIOL 482 Coastal Biology
- BIOL 494 Research Project
- BIOL 495 Internship in Biology
- BIOL 496 Independent Studies
- BIOL 499A Tropical Field Ecology
- BIOTC 459 Plant Tissue Culture and Biotechnology
- SC 295 Science Co-op Work Experience I
- SC 395 Science Co-op Work Experience II
- SC 495 Science Co-op Work Experience III

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

**Vertebrate Physiology Option (46-51 credits)**
*Available at the following campuses: Abington, Altoona, Brandywine, Schuylkill, University Park*

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<td>BIOL 472</td>
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<tr>
<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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<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>
</tbody>
</table>

**Vertebrate Physiology Option (46-51 credits)**
*Available at the following campuses: Abington, Altoona, Brandywine, Schuylkill, University Park*

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIOL 472</td>
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<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
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</table>
### Additional Courses

#### Groups

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

**Physiology Group:**
- BIOL 404 Cellular Mechanisms in Vertebrate Physiology
- BIOL 406 Symbiosis
- BIOL 409 Biology of Aging
- BIOL 411 Medical Embryology
- BIOL 412 Ecology of Infectious Diseases
- BIOL 413 Cell Signaling and Regulation
- BIOL 415 Ecotoxicology
- BIOL 416 Biology of Cancer
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 424 Seeds of Change: The Uses of Plants
- BIOL 426 Developmental Neurobiology
- BIOL 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

**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

**Supporting Courses and Related Areas**

Select 15-20 credits from department list

<table>
<thead>
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<tbody>
<tr>
<td>BIOL 427</td>
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<td>BIOL 428</td>
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<td>BIOL 429</td>
<td>Animal Behavior</td>
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<td>Developmental Genetics</td>
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<td>BIOL 433</td>
<td>Evolution of Vertebrates</td>
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<td>BIOL 434</td>
<td>Pathobiology of Emerging Infectious Disease</td>
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<td>BIOL 436</td>
<td>Population Ecology and Global Climate Change</td>
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<td>Evo-devo: Evolution of Developmental Mechanisms</td>
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<td>General Ecology</td>
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<td>Sociobiology</td>
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<td>Astrobiology</td>
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<td>BIOL 400</td>
<td>Teaching in Biology</td>
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<td>BIOL 402W</td>
<td>Biological Experimental Design</td>
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<td>BIOL 407</td>
<td>Plant Developmental Anatomy</td>
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<tr>
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<td>Ecological and Environmental Problem Solving</td>
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<tr>
<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
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<td>BIOL 422</td>
<td>Advanced Genetics</td>
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<td>BIOL/PPEM</td>
<td>425 Biology of Fungi</td>
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<td>BIOL 437</td>
<td>Histology</td>
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<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
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<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 450W</td>
<td>Experimental Field Biology</td>
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<td>BIOL 461</td>
<td>Contemporary Issues in Science and Medicine</td>
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<td>BIOL 473</td>
<td>Laboratory in Mammalian Physiology</td>
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<tr>
<td>BIOL 475N</td>
<td>Advanced Human Anatomy - cadaver based</td>
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<td>COMPARATIVE NEUROANATOMY</td>
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<td>Coastal Biology</td>
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<td>BIOL 494</td>
<td>Research Project</td>
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<td>Internship in Biology</td>
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<td>Independent Studies</td>
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<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>SC 295</td>
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<td>SC 395</td>
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<td>SC 495</td>
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Select 15-20 credits from department list

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<th>Title</th>
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<tbody>
<tr>
<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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<tr>
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<td></td>
</tr>
</tbody>
</table>
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 (https://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 and Inter-Domain courses do not meet this requirement.)
- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

Breadth in the Knowledge Domains (Inter-Domain courses do not meet this requirement.)
- Arts (GA): 3 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 3 credits
- Social and Behavioral Sciences (GS): 3 credits
- Natural Sciences (GN): 3 credits

Integrative Studies
- Inter-Domain Courses (Inter-Domain): 6 credits

Exploration
- GN, may be completed with Inter-Domain courses: 3 credits
- GA, GH, GN, GS, Inter-Domain courses. This may include 3 credits of World Language course work beyond the 12th credit level or the requirements for the student's degree program, whichever is higher: 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 (https://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.