BIOLOGY, B.S. (UNIVERSITY COLLEGE)

Begin Campus: Any Penn State Campus
End Campus: Beaver, Brandywine, Schuylkill, Scranton, York

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>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

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>
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<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
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</tr>
<tr>
<td>CHEM 113</td>
<td>Experimental Chemistry II</td>
<td>1</td>
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<tr>
<td>MATH 141</td>
<td>Calculus with Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 110</td>
<td>Biology: Basic Concepts and Biodiversity</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 220W</td>
<td>Biology: Populations and Communities</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 230W</td>
<td>Biology: Molecules and Cells</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 240W</td>
<td>Biology: Function and Development of Organisms</td>
<td>4</td>
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<tr>
<td>CHEM 110</td>
<td>Chemical Principles I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 112</td>
<td>Chemical Principles II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
<td>4</td>
</tr>
</tbody>
</table>

Prescribed Courses: Require a grade of C or better

Select one of the following: 8-12

- PHYS 211 | General Physics: Mechanics
- & PHYS 212 | and General Physics: Electricity and Magnetism
- & PHYS 213 | and General Physics: Fluids and Thermal Physics
- & PHYS 214 | and General Physics: Wave Motion and Quantum Physics

Select one of the following: 3-4

- STAT 200 | Elementary Statistics
- STAT 240 | Introduction to Biometry
- STAT 250 | Introduction to Biostatistics

Requirements for the Option

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

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

Additional Courses

Select one of the following: 6-8

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>STAT 462</td>
<td>Applied Regression Analysis</td>
<td>3</td>
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<tr>
<td>or STAT 464</td>
<td>Applied Nonparametric Statistics</td>
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</table>

Select one of the following: 6-8

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

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

Ecology Group:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
<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>
<td></td>
</tr>
<tr>
<td>BIOL 450W</td>
<td>Experimental Field Biology</td>
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<tr>
<td>BIOL 464</td>
<td>Sociobiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 474</td>
<td>Astrobiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 482</td>
<td>Coastal Ecology</td>
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</tr>
<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
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Evolution Group:

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<tr>
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<tr>
<td>BIOL 406</td>
<td>Symbiosis</td>
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<tr>
<td>BIOL 411</td>
<td>Medical Embryology</td>
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<tr>
<td>BIOL 414</td>
<td>Taxonomy of Seed Plants</td>
<td></td>
</tr>
<tr>
<td>BIOL 417</td>
<td>Invertebrate Zoology</td>
<td></td>
</tr>
<tr>
<td>BIOL 420</td>
<td>Paleobotany</td>
<td></td>
</tr>
<tr>
<td>BIOL 421</td>
<td>Comparative Anatomy of Vertebrates</td>
<td></td>
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<tr>
<td>BIOL 422</td>
<td>Advanced Genetics</td>
<td></td>
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<tr>
<td>BIOL/PPEM 425</td>
<td>Biology of Fungi</td>
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<tr>
<td>BIOL 427</td>
<td>Evolution</td>
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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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<tr>
<td>BIOL 429</td>
<td>Animal Behavior</td>
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<tr>
<td>BIOL 432</td>
<td>Developmental Genetics</td>
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<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>
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<tr>
<td>BIOL 436</td>
<td>Population Ecology and Global Climate Change</td>
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<tr>
<td>BIOL 439</td>
<td>Practical Bioinformatics</td>
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<tr>
<td>BIOL 443</td>
<td>Evo-devo: Evolution of Developmental Mechanisms</td>
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<tr>
<td>BIOL 446</td>
<td>Physiological Ecology</td>
<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>
<td></td>
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<tr>
<td>BIOL 463</td>
<td>General Ecology</td>
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<tr>
<td>BIOL 464</td>
<td>Sociobiology</td>
<td></td>
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<tr>
<td>BIOL 474</td>
<td>Astrobiology</td>
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<tr>
<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
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<tr>
<td>BIOL 400</td>
<td>Teaching in Biology</td>
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<td>BIOL 402W</td>
<td>Biological Experimental Design</td>
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<td>BIOL 407</td>
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<td>Paleobotany</td>
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<tr>
<td>BIOL 424</td>
<td>Seeds of Change: The Uses of Plants</td>
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<td>BIOL/PPEM</td>
<td>Biology of Fungi 425</td>
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<td>BIOL 431</td>
<td>Reproductive Biology</td>
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<td>Plant Physiology</td>
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<td>Coastal Biology</td>
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<td>Tropical Field Ecology</td>
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<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
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<tr>
<td>BIOL 500</td>
<td>Environmental Field Biology</td>
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<tr>
<td>BIOL 500W</td>
<td>Environmental Field Biology</td>
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<tr>
<td>BIOL 501</td>
<td>Contemporary Issues in Science and Medicine</td>
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<tr>
<td>BIOL 502</td>
<td>Laboratory in Mammalian Physiology</td>
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<tr>
<td>BIOL 475N</td>
<td>COMPARATIVE NEUROANATOMY</td>
<td></td>
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<td>BIOL 482</td>
<td>Coastal Biology</td>
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<tr>
<td>BIOL 494</td>
<td>Research Project</td>
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<tr>
<td>BIOL 495</td>
<td>Internship in Biology</td>
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<tr>
<td>BIOL 496</td>
<td>Independent Studies</td>
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<tr>
<td>BIOL 499A</td>
<td>Tropical Field Ecology</td>
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</tr>
<tr>
<td>BIOTC 459</td>
<td>Plant Tissue Culture and Biotechnology</td>
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</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 17-24 credits from department list

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 460</td>
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<td>General Ecology</td>
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<td>BIOL 464</td>
<td>Sociobiology</td>
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<td>BIOL 474</td>
<td>Astrobiology</td>
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</tr>
<tr>
<td>BIOL 478</td>
<td>COMPARATIVE NEUROANATOMY</td>
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</tbody>
</table>

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

Available at the following campuses: Abington, Altoona, Beaver, Berks, Brandywine, Harrisburg, Schuylkill, Scranton, University Park, York

Select one of the following: 6-8

### Groups

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

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

#### Evolution Group:
- BIOL 405 Molecular Evolution
- BIOL 406 Symbiosis
- BIOL 411 Medical Embryology
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 420 Paleobotany
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi

#### Additional Courses
- BIOL 451 Biology of RNA
- BIOL 473 Laboratory in Mammalian Physiology
- BIOL 494 Research Project
- BIOL 495 Internship in Biology
- BIOL 496 Independent Studies
- BIOL 499A Tropical Field Ecology
- BIOTC 459 Plant Tissue Culture and Biotechnology
- SC 295 Science Co-op Work Experience I
- SC 395 Science Co-op Work Experience II
- SC 495 Science Co-op Work Experience III

### Supporting Courses and Related Areas

Select 17-24 credits from department list

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>CHEM 202</td>
<td>Fundamentals of Organic Chemistry I</td>
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</tr>
<tr>
<td>&amp; CHEM 203</td>
<td>Fundamentals of Organic Chemistry II</td>
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</tr>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 212</td>
<td>Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>&amp; CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
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</table>

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

Available at the following campuses: Abington, Altoona, Beaver, Berks, Brandywine, Harrisburg, Schuylkill, Scranton, University Park, York
BIOL 463  General Ecology  
BIOL 464  Sociobiology  
BIOL 474  Astrobiology  
BIOL 478  COMPARATIVE NEUROANATOMY  

Genetics and Developmental Biology Group:  
BIOL 404  Cellular Mechanisms in Vertebrate Physiology  
BIOL 405  Molecular Evolution  
BIOL 407  Plant Developmental Anatomy  
BIOL 411  Medical Embryology  
BIOL 413  Cell Signaling and Regulation  
BIOL 416  Biology of Cancer  
BIOL 422  Advanced Genetics  
BIOL 426  Developmental Neurobiology  
BIOL 428  Population Genetics  
BIOL 430  Developmental Biology  
BIOL 431  Reproductive Biology  
BIOL 432  Developmental Genetics  
BIOL 439  Practical Bioinformatics  
BIOL 443  Evo-devo: Evolution of Developmental Mechanisms  
BIOL 448  Ecology of Plant Reproduction  
BIOL 451  Biology of RNA  
BIOL 460  Human Genetics  
BIOL 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 416  Biology of Cancer  
BIOL 421  Comparative Anatomy of Vertebrates  
BIOL 424  Seeds of Change: The Uses of Plants  
BIOL 426  Developmental Neurobiology  
BIOL 430  Developmental Biology  
BIOL 431  Reproductive Biology  
BIOL 432  Developmental Genetics  
BIOL 437  Histology  
BIOL 443  Evo-devo: Evolution of Developmental Mechanisms  
BIOL 446  Physiological Ecology  
BIOL 460  Human Genetics  
BIOL 469  Neurobiology  
BIOL 470  Functional and Integrative Neuroscience  
BIOL 472  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 461  Contemporary Issues in Science and Medicine  
BIOL 473  Laboratory in Mammalian Physiology  
BIOL 475N  BIOL 476  Advanced Human Anatomy - cadaver based  
BIOL 478  COMPARATIVE NEUROANATOMY  
BIOL 482  Coastal Biology  
BIOL 494  Research Project  
BIOL 495  Internship in Biology  
BIOL 496  Independent Studies  
BIOL 499A  Tropical Field Ecology  
BIOTC 459  Plant Tissue Culture and Biotechnology  
SC 295  Science Co-op Work Experience I  
SC 395  Science Co-op Work Experience II  
SC 495  Science Co-op Work Experience III  

**Supporting Courses and Related Areas**  
Select 20-27 credits from department list  

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Sciences and Mathematics Group:  
SC 295  Science Co-op Work Experience I  
SC 395  Science Co-op Work Experience II  
SC 495  Science Co-op Work Experience III  

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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  
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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  

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  
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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  

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Sciences and Mathematics Group:  
SC 295  Science Co-op Work Experience I  
SC 395  Science Co-op Work Experience II  
SC 495  Science Co-op Work Experience III  

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

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

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<tr>
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<th>Credits</th>
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<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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<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 Microbial/Molecular Genetics
  or BMB 464 Molecular Medicine
  or BMB 484 Functional Genomics
  or HORT 407 Plant Breeding
  or MICRB 41 Principles of Immunology

**Evolution Group:**

- BIOL 405 Molecular Evolution
- BIOL 406 Symbiosis

- BIOL 411 Medical Embryology
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 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
- BIOL 482 Coastal Biology
- BIOL 492 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
### Supporting Courses and Related Areas

Select 9-17 credits from department list

### 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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<tbody>
<tr>
<td>BIOL 469</td>
<td>Neurobiology</td>
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<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>
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</tr>
<tr>
<td>CHEM 210</td>
<td>Organic Chemistry I</td>
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</tr>
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<td>CHEM 212</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
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<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:**
  - 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

- **Evolution Group:**
  - BIOL 405 Molecular Evolution
  - BIOL 406 Symbiosis
  - BIOL 411 Medical Embryology
  - BIOL 414 Taxonomy of Seed Plants

- **Additional Courses:**
  - BIOL 420 Paleobotany
  - BIOL 421 Comparative Anatomy of Vertebrates
  - BIOL 422 Advanced Genetics
  - 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 423 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>
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<tr>
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<td>BIOL 407</td>
<td>Plant Developmental Anatomy</td>
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<td>BIOL 441</td>
<td>Plant Physiology</td>
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<td>BMB 401</td>
<td>General Biochemistry</td>
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<tr>
<td>BMB 402</td>
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<tr>
<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
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</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
- BIOL 432 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
- BIOLTC 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>
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<th>Title</th>
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<tr>
<td>BIOL 472</td>
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<tr>
<td>BIOL 473</td>
<td>Laboratory in Mammalian Physiology</td>
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<tr>
<td>BMB 401</td>
<td>General Biochemistry</td>
<td>3</td>
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<td>CHEM 210</td>
<td>Organic Chemistry I</td>
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<td>CHEM 213</td>
<td>Laboratory in Organic Chemistry</td>
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</tbody>
</table>

**Additional Courses**

**Groups**

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

**Physiology Group:**
- BIOL 404 Cellular Mechanisms in Vertebrate Physiology
- BIOL 406 Symbiosis
- BIOL 409 Biology of Aging
- BIOL 411 Medical Embryology
- BIOL 412 Ecology of Infectious Diseases
- BIOL 413 Cell Signaling and Regulation
- BIOL 415 Ecotoxicology
- BIOL 416 Biology of Cancer
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 424 Seeds of Change: The Uses of Plants
- BIOL 426 Developmental Neurobiology
- BIOL 430 Developmental Biology
- BIOL 431 Reproductive Biology
- BIOL 432 Developmental Genetics
- BIOL 437 Histology
- BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
- BIOL 446 Physiological Ecology
- BIOL 460 Human Genetics
- BIOL 469 Neurobiology
- BIOL 470 Functional and Integrative Neuroscience
- BIOL 478 COMPARATIVE NEUROANATOMY
- BIOL 479 General Endocrinology
- BIOL 482 Coastal Biology
- ANSC 431 Physiology of Animal Reproduction
  or ANTH 466 The Skull
  or BMB 484 Functional Genomics
  or ENT 402W Biology of Animal Parasites
  or MICRB 40 Microbial Physiology and Structure
  or MICRB 41 Principles of Immunology
  or MICRB 41 Medical Microbiology
  or MICRB 43 Viral Pathogenesis
  or PSYCH 46 Physiological Psychology

**Evolution Group:**
- BIOL 405 Molecular Evolution
- BIOL 406 Symbiosis
- BIOL 411 Medical Embryology
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 420 Paleobotany
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 427 Evolution
- BIOL 428 Population Genetics
- BIOL 429 Animal Behavior
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- BIOL 443 Evo-devo: Evolution of Developmental Mechanisms
- BIOL 446 Physiological Ecology
- BIOL 451 Biology of RNA
- BIOL 460 Human Genetics
- BIOL 463 General Ecology
- BIOL 464 Sociobiology
- BIOL 474 Astrobiology
- BIOL 478 COMPARATIVE NEUROANATOMY

**Practicum Group:**
- BIOL 400 Teaching in Biology
- BIOL 402W Biological Experimental Design
- BIOL 407 Plant Developmental Anatomy
- BIOL 414 Taxonomy of Seed Plants
- BIOL 417 Invertebrate Zoology
- BIOL 419 Ecological and Environmental Problem Solving
- BIOL 421 Comparative Anatomy of Vertebrates
- BIOL 422 Advanced Genetics
- BIOL/PPEM 425 Biology of Fungi
- BIOL 433 Evolution of Vertebrates
- BIOL 437 Histology
- BIOL 439 Practical Bioinformatics
- BIOL 444 Field Ecology
- BIOL 448 Ecology of Plant Reproduction
- BIOL 450W Experimental Field Biology
- BIOL 461 Contemporary Issues in Science and Medicine
- BIOL 473 Laboratory in Mammalian Physiology
- BIOL 475N 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
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- SC 295 Science Co-op Work Experience I
- SC 395 Science Co-op Work Experience II
- SC 495 Science Co-op Work Experience III

**Supporting Courses and Related Areas**

Select 15-20 credits from department list

15-20
**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.