# PENNSYLVANIA STATEWIDE PROGRAM-TO-PROGRAM ARTICULATION AGREEMENT IN ENVIRONMENTAL SCIENCE

## I. INTRODUCTION

In accordance with Article XX-C of the Public School Code of 1949, institutions participating in Pennsylvania's statewide college credit transfer system agree to the following policies governing the transfer of credits from a participating associate degree-granting institution into a participating bachelor degree-granting institution. This agreement specifically ensures that a student who successfully completes an Associate of Arts (AA) or Associate of Science (AS) degree in Environmental Science or any AA or AS degree that incorporates the required competencies at a participating institution can transfer the full degree into a parallel bachelor degree program in Environmental Science, Environmental Studies or Biology at a participating four-year institution.

In order for students to transfer the full associate degree into a parallel bachelor degree program at a participating bachelor-degree granting institution, all of the following criteria must be met:

- Successful completion of an associate's degree that includes at least 60 credits.
- Successful completion of an associate's degree that includes all of the required major-specific content area competencies from **ONE** of the **TWO** study-tracks identified in this Agreement:
    1. Study Track I: Biology-Related Programs
    2. Study Track II: Geoscience-Related Programs

See Appendices A and B: Program-to-Program Articulation Models for Environmental Science.

References to courses in all agreements designate competencies and are not to be construed as making a reference to a specific course at a specific institution. Course titles in the agreements are presented for guidance in advising students as to which coursework they should take even though the course at the student's college may not have the specific title mentioned in the agreement.[1]

It is therefore understood that students meeting these requirements will be considered by both the associate degree granting institution and the receiving bachelor degree-granting institution to possess the knowledge, skills and abilities necessary for entry as a junior into a parallel bachelor degree program in Environmental Science.

Under this agreement, the receiving bachelor degree institution will recognize all competencies attained within the AA or AS degree and accept a transfer student who has earned the associate degree with full junior standing into a parallel baccalaureate degree program. All decisions made with respect to the transfer process shall be based on the principle of equivalence of expectations and requirements for native and transfer students. A transfer student's admission into the parallel baccalaureate degree will be subject to the bachelor degree institution's specific requirements for admission to that major and be consistent with such requirements for native students. See Addendum*: General Statewide Program-to-Program Articulation Agreement in Pennsylvania*.

## II. OVERVIEW

Environmental Science is a broad and dynamic field of interest that unites a number of disciplines in order to understand the biologic, hydrologic, geologic, and atmospheric components of the Earth and the role of human beings on the Earth. In addition, an information explosion has occurred in Environmental

[1] Adopted by TAOC and added to the agreement on April 11, 2012.

Science that creates a challenge for the student to understand fully any of the facets of the field. As a result, programs of study in Environmental Science are as varied and dynamic as global systems.

Because of the complex nature of the field of study, Environmental Science degree programs vary widely, allowing students to focus on specific approaches to understanding physical and biological aspects of the planet. Most programs have identified either a *biological approach* or a *physical approach* that provides students with the competencies necessary to succeed in Environmental Science. By completing one of the two tracks identified in this agreement, students will be able to enter a parallel bachelor degree program as a junior at a participating institution.

This Agreement specifies content in the form of competencies *not courses* that will transfer into the parallel bachelor degree. Institutions are at liberty to embed competencies however they choose. For example, one institution may embed competencies in a 3-credit course, while another may embed those same competencies in a 4-credit course. The specific course structures are not as important as making sure that upon completion of the associate's degree, a student has achieved the competencies listed below and is prepared to enter junior-level coursework in a parallel bachelor degree program. The Bachelor Degree Institution will recognize all competencies attained within the AA or AS degree and accept a transfer student who has earned the associate degree with full junior standing into a parallel baccalaureate degree program.

Students should work with an academic advisor to select the best options for their major and their transfer institution. Students will not be penalized for not completing recommended coursework prior to transferring.

## III. STUDY TRACK I: BIOLOGY-RELATED PROGRAMS

An associate degree that includes the following major-specific content and competencies will allow a student to transfer into a parallel bachelor degree in Environmental Studies with a *biological approach*.

### A. REQUIRED Major-Specific Content Areas

Under this Agreement, a fully-transferable associate degree in the field of Environmental Science with a *biology emphasis* must include competencies from the following content areas:

1. **Biology (min. 16 credits)**
   a. **Principles of Biology (8 credits)**
   b. **Biology Program-Specific Content (8-12 credits) from at least TWO, but no more than three, of the following areas:**
      1) **Botany**
      2) **Genetics**
      3) **Microbiology**
      4) **Ecology**
      5) **Research Methods**
      6) **Environmental Biology**
      7) **Zoology**
2. **General Chemistry (8 credits)**
3. **Mathematics (6-8 credits, including 3-4 credits in Calculus or Statistics)**

See Appendix A: Program-to-Program Articulation Model for Environmental Science: STUDY-TRACK I: BIOLOGY-RELATED PROGRAMS.

#### 1. Biology - 16 credits minimum

**a. Principles of Biology - 8 credits**

Biology as a science is involved in a course of change that is quite remarkable. An information explosion has occurred that has created a challenge for the student who must fully understand universal concepts and principles. Thus, the growing

complexity in the biological sciences makes it essential that the student be provided with fundamental principles and basic information that will serve as the basis for an understanding and appreciation of the many and varied sub-disciplines of biology. It is necessary that the student have an understanding of processes and interactions that occur at the molecular, cellular, organismal and population levels of organization. Students must also be prepared to appreciate the different aspects of plant and animal diversity, as well as the special adaptations and evolutionary relationships of these organisms.

Competencies in the following content areas within the Principles of Biology have been identified as essential for comparable preparation toward a parallel bachelor's degree in Environmental Science:

Competency Area 1: Scientific Investigation
Competency Area 2: Scientific literature
Competency Area 3: Cell structure and function
Competency Area 4: Energy transfer within biological systems
Competency Area 5: Introduction to molecular genetics
Competency Area 6: Basic principles of inheritance
Competency Area 7: Evolution and natural selection
Competency Area 8: Hierarchical organization of life
Competency Area 9: Basic biochemistry
Competency Area 10: Laboratory experiences
Competency Area 11: Organismal Biology

See Appendix C: Competencies for Preparation in the Principles of Biology.

**b. Biology Program-Specific Content Areas – 8-12 credits**

Students must meet competencies, acquired through both lecture and rigorous laboratory/field experiences, in at least two but not more than three, of the following areas:

1) **Botany**
2) **Genetics**
3) **Microbiology**
4) **Ecology**
5) **Research Methods**
6) **Environmental Biology**
7) **Zoology**

**1) Botany Competencies**

An introductory understanding of botany is necessary for all students majoring in Environmental Science. These competencies provide students with the basic concepts of plant biology and a survey of the major groups of plants and plant-like organisms. It expands on many of the biological concepts introduced in Principles of Biology within the context of plants. These competencies, acquired through both lecture and rigorous laboratory/field experiences, also are intended to provide students with the fundamentals necessary to support upper level courses with a botanical content and provide a broad survey of form and function of the major plant groups as well as the bacteria, algae, water molds, slime molds and fungi within the overall framework of a modern phylogenetic system of classification. Laboratory study of representative members of the major phyla will be included.

See Appendix D: Competencies for Preparation in Botany.

**2) Genetics Competencies**

Organisms can be fully understood only by knowing how the hereditary material orchestrates the organism's development and behavior. Moreover, populations and species can be fully understood only by knowing how the hereditary material is recombined and transmitted through the generations. Thus genetics, the study of the hereditary material, is fundamental to all of the life sciences, and few biologists, regardless of the scales of time and size at which they work, can do their work without knowing and applying genetics. These competencies, acquired through both lecture and rigorous laboratory/field experiences, are intended to provide students majoring in the life sciences with the thorough introduction to genetics that they will need for more advanced work in the field.

See Appendix E: Competencies for Preparation in Genetics.

**3) Microbiology Competencies**

An introduction to microbiology is essential to provide knowledge about prokaryotic and other single celled organisms to students in the Environmental Science major. These competencies, acquired through both lecture and rigorous laboratory/field experiences, examine the structure and metabolism of microbes and emphasize the strategies employed by these organisms in their evolutionary successes.

See Appendix F: Competencies for Preparation in Microbiology.

**4) Ecology Competencies**

Ecology is the study of the interaction of organisms with their environment. An introduction to ecology will provide students with a sense of how organisms respond to both living and non-living aspects of their environments. Knowledge of ecological principles, acquired through both lecture and rigorous laboratory/field experiences, will be useful to students by broadening their awareness of the richness and diversity by which organisms interact with and respond to natural environments.

See Appendix G: Competencies for Preparation in Ecology.

**5) Research Methods Competencies**

A hands-on introduction to scientific research is absolutely essential for the education of Environmental Science majors. Students must learn about the process by which scientific knowledge is acquired while conducting their own research projects. Through both lecture and rigorous laboratory/field experiences, they must acquire the skills that are essential to the successful design and execution of scientific research.

See Appendix H: Competencies for Preparation in Research Methods.

**6) Environmental Biology Competencies**

Exposure to content areas concerning human population growth, soil, land and energy use, water and air pollution and how the global climate (both environmental and human) impact these resources are essential to Environmental Science majors. Students should gain an understanding of how humans impact their world, how technology can allow more responsible use of non-renewable resources, and how corrective measures today could significantly improve our future environment.

See Appendix I: Competencies for Preparation in Environmental Biology

**7) Zoology Competencies**
A hands-on survey of the animal kingdom, with emphasis on evolutionary relationships and the interactions of animals with their environments is necessary for students majoring in the Environmental Sciences. Laboratory study of representative members of the major phyla will include dissection, field experiences, and experimentation.

See Appendix J: Competencies for Preparation in Zoology.

**2. General Chemistry – 8 credits**
An understanding of General Chemistry is essential for forming the foundation of knowledge for pursuing a major in Environmental Science. Students must meet competencies, acquired through both lecture and rigorous laboratory/field experiences, in 8 credits of General Chemistry *for science majors*.

**3. Mathematics – 6-8 credits**
Students must complete 6-8 credits in mathematics, with at least 3-4 credits being taken in Calculus or Statistics.

Students may fulfill this requirement by taking two approved math courses from Category 3 of the Transfer Credit Framework, provided that at least one is an approved Statistics or Calculus course.

See Appendix T: Transfer Credit Framework. Credit requirements are presented as a range since actual credit number may vary by institution.

## B. RECOMMENDED Major-Specific Content Areas

In addition to the required major content and competencies listed above, students transferring into a bachelor degree program in Environmental Science with a biological approach would also benefit from acquiring competencies in the following content areas:

1. **General Physics (8 credits)**
2. **Introductory Environmental Science (3-4 credits)**
3. **Geology (3-6 credits)**
4. **Geographic Information Systems (3-4 credits)**
5. **Organic Chemistry (8 credits)**

Students will not be penalized for not completing competencies in these areas of study, though exposure to these areas of study at the foundation level would greatly benefit an Environmental Science major transferring at the junior level.

**1. General Physics – 8 credits**
Students are advised to complete 8 credits of coursework in General Physics as part of the articulated associate degree. Students may fulfill this requirement by taking the following approved coursework from Category 4 of the Transfer Credit Framework:

- General Physics I – 3-4 credits
- General Physics II – 3-4 credits

**2. Introductory Environmental Science – 3-4 credits**
Students are advised to complete 3-4 credits of coursework in Introductory Environmental science as part of the articulated associate degree.

See Appendix K: Competencies for Preparation in Introductory Environmental Science.

3. **Geology – 3-6 credits**
   Students are advised to complete 3-6 credits of coursework in Geology as part of the articulated associate degree.

   See Appendix L: Competencies for Preparation in Geology.

4. **Geographic Information Systems (GIS) – 3-4 credits**
   Students are advised to complete 3-4 credits of coursework in GIS as part of the articulated associate degree.

   See Appendix M: Competencies for Preparation in Geographic Information Systems.

5. **Organic Chemistry – 8 credits**
   An understanding of organic chemistry is essential for a thorough education in life science fields. Living things are carbon-based and their biochemistry as well as their physiology and environmental interactions all rely at least in part on the chemistry of organic molecules. Organic Chemistry is the study and application of reactions involving carbon-based molecules. The American Chemical Society (ACS) classifies the first semester of Organic Chemistry as a foundation course and the second semester as an in-depth course. As such, Organic chemistry should include the fundamentals of nomenclature, reactions, mechanisms, and related concepts.

   The following competencies have been identified as essential for a background in Organic Chemistry:
   - Competency Area 1: Bonding
   - Competency Area 2: Structure and Function
   - Competency Area 3: Acid-Base Reactions
   - Competency Area 4: Stereochemistry
   - Competency Area 5: Nomenclature
   - Competency Area 6: Spectroscopy
   - Competency Area 7: Organic Reactions
   - Competency Area 8: Organic Synthesis
   - Competency Area 9: Macromolecules

   See Appendix N: Competencies for Preparation in Organic Chemistry.

   Organic Chemistry Laboratories involve specialty glassware, equipment, and instrumentation that is different from many fields in Chemistry and Biology. Emphasis in the Organic Laboratory is on the synthesis and purification of compounds followed by the application of instrumentation in the analysis and identification of the products. Like all laboratories, safety practices, the keeping of a laboratory notebook, and report writing should also be incorporated.

   The following competencies are based on the guidelines recommended by the ACS and are essential for a background in Organic Chemistry Laboratory:
   - Competency Area 1: Laboratory Safety and Laboratory Notebook
   - Competency Area 2: Purification Techniques
   - Competency Area 3: Spectroscopy
   - Competency Area 4: Functional Group Interconversion
   - Competency Area 5: Chromatography
   - Competency Area 6: Statistical Analysis
   - Competency Area 7: Computational

   See Appendix O: Competencies for Preparation in Organic Chemistry Laboratory.

# IV. STUDY TRACK II: GEOSCIENCE-RELATED PROGRAMS

An associate degree that includes the following major-specific content and competencies will allow a student to transfer into a parallel bachelor degree in Environmental Studies with a *physical approach* (i.e., emphasis in Earth/Space Science or Geosciences).

## A. REQUIRED Major-Specific Content Areas

Under this Agreement, a fully-transferable associate degree in the field of Environmental Science with a *physical emphasis* must include competencies from the following content areas:

1. **Principles of Biology (8 credits)**
2. **Introductory Environmental Science (3-4 credits)**
3. **Geology & Environmental Systems Science (6-9 credits)**
4. **Geography (9-12 credits)**
   a. **Geography as a Discipline (3 credits)**
   b. **Geographic Information Systems (3 credits)**
   c. **Geography Program-Specific Content (3-6 credits) from at least ONE, but no more than two, of the following areas:**
      1) **Physical Geography**
      2) **Cultural Geography**
      3) **World Regional Geography**
5. **Mathematics (6-8 credits)**

See Appendix B: Program-to-Program Articulation Model for Environmental Science: STUDY-TRACK I: GEOSCIENCE-RELATED PROGRAMS.

### 1. Principles of Biology – 8 credits

Biology as a science is involved in a course of change that is quite remarkable. An information explosion has occurred that has created a challenge for the student who must fully understand universal concepts and principles. Thus, the growing complexity in the biological sciences makes it essential that the student be provided with fundamental principles and basic information that will serve as the basis for an understanding and appreciation of the many and varied sub-disciplines of biology. It is necessary that the student have an understanding of processes and interactions that occur at the molecular, cellular, organismal and population levels of organization. Students must also be prepared to appreciate the different aspects of plant and animal diversity, as well as the special adaptations and evolutionary relationships of these organisms.

Competencies in the following content areas within the Principles of Biology have been identified as essential for comparable preparation toward a Bachelor's Degree in Environmental Science:

Competency Area 1: Scientific Investigation
Competency Area 2: Scientific literature
Competency Area 3: Cell structure and function
Competency Area 4: Energy transfer within biological systems
Competency Area 5: Introduction to molecular genetics
Competency Area 6: Basic principles of inheritance
Competency Area 7: Evolution and natural selection
Competency Area 8: Hierarchical organization of life
Competency Area 9: Basic biochemistry
Competency Area 10: Laboratory experiences
Competency Area 11: Organismal Biology

See Appendix C: Competencies for Preparation in the Principles of Biology.

**2. Introductory Environmental Science – 3-4 credits**

Introductory Environmental Science will demonstrate how natural systems function and how humans influence these systems. The environmental scientist must have the ability to integrate varied disciplines in order to begin to understand the interaction of man with the biotic and abiotic components of the environment.

See Appendix K: Competencies for Preparation in Introductory Environmental Science.

**3. Geology & Environmental Systems Science – 6-9 credits**

An environmental scientist needs an excellent understanding of the materials from which the Earth is made, the processes acting on and within the Earth, and Earth structures. The student should also have learned the history of the changing Earth through time, and how the rock record can be interpreted to provide evidence of these changes.

The following competency areas will allow majors to identify and solve problems in the geosciences:

Competency Area 1: Formation of the Solar System and Earth
Competency Area 2: Plate Tectonics and Earthquakes
Competency Area 3: Minerals
Competency Area 4: Igneous Rocks and Environments
Competency Area 5: Weathering, Soil, and Mass Wasting
Competency Area 6: Sedimentary Rocks and Environments
Competency Area 7: Metamorphic Rocks and Environments
Competency Area 8: Deformation and the Continents
Competency Area 9: Surface Water and Groundwater
Competency Area 10: Climate, Glaciers, Wind, and Coastal Processes
Competency Area 11: Geologic Time and Rock Correlation
Competency Area 12: Crystalline and Chemical Structure of Sedimentary Particles and Water
Competency Area 13: Soil Chemistry and Nutrient Cycling
Competency Area 14: Soil Microbes & Pathogens
Competency Area 15: Soil Classification and Evaluation Methods
Competency Area 16: Soils in Agriculture and Engineering
Competency Area 17: Soil Contamination and Erosion
Competency Area 18: Soil Conservation and Soil Management
Competency Area 19: Hydrologic Cycle and Water Resource Cycle
Competency Area 20: Precipitation and Infiltration
Competency Area 21: Runoff and Stream Flow Processes
Competency Area 22: Subsurface Drainage and Redistribution Processes
Competency Area 23: Watershed Delineation and Human Land Use Impact
Competency Area 24: Water Resource Management in Planning and Engineering
Competency Area 25: Hydrologic Field Methods

See Appendix L: Competencies for Preparation in Geology.

**4. Geography (9-12 credits)**

**a. Geography as a Discipline (3 credits)**

Any student majoring in Environmental Science should not only have a solid foundation in chemical, biological, and geological science, but also a fundamental understanding of the geographic sciences. To this end, students should understand the major concepts and theoretical perspectives of geography by demonstrating knowledge of both Human and Physical Geography. This requires knowledge of cultural, political, economic, and environmental factors that shape the character of cities, regions, countries, and the global system as well as a comprehensive

understanding of how human and physical environments change through time and space.

See Appendix P: Competencies for Preparation in Geography as a Discipline.

**b. Geographic Information Systems (GIS) (3 credits)**
GIS is one of a set of geographical techniques that is central to the study of environmental phenomena.

See Appendix M: Competencies for Preparation in GIS.

**c. Geography Program-Specific Content Areas (3-6 credits)**
Students must meet competencies, acquired through both lecture and laboratory/field experiences, in at least one, but not more than the two, of the following areas:

**1) Physical Geography**
**2) Cultural Geography**
**3) World Regional Geography**

***1) Physical Geography***
Students should demonstrate an understanding of the natural processes that have created patterns on the earth's surface and how they affect and are affected by humans.

See Appendix Q: Competencies for Preparation in Physical Geography.

***2) Cultural Geography***
Students beginning their junior year of study in Geography should have demonstrated understanding of the cultural processes that have created patterns on the earth's surface and how this affect and are affected by their landscapes.

See Appendix R: Competencies for Preparation in Cultural Geography.

***3) World Regional Geography***
Students beginning their junior year of study in Geography should have demonstrated knowledge of the spatial patterns of physical & cultural landscapes and regionalization; the major landforms, climates, biomes, cultures, cities and land uses.

See Appendix S: Competencies for Preparation in World Regional Geography.

**5. Mathematics – 6-8 Credits**
Students must complete 6-8 credits in mathematics, with at least 3-4 credit being taken in Calculus or Statistics.

Students may fulfill this requirement by taking two approved math courses from Category 3 of the Transfer Credit Framework, provided that at least one of the courses is Statistics or Calculus.

See Appendix T: Transfer Credit Framework. Credit requirements are presented as a range since actual credit number may vary by institution.

## B. RECOMMENDED Major-Specific Content Areas

In addition to the required major content and competencies listed above, students transferring into a bachelor degree program in Environmental Science with a physical approach would also benefit from acquiring competencies in the following content areas:

1. **General Physics (8 credits)**
2. **Ecology (3-4 credits)**
3. **General Chemistry (8 credits)**

Students will not be penalized for not completing competencies in these areas of study, though exposure to these areas of study at the foundation level would greatly benefit an Environmental Science major transferring at the junior level.

See Appendix B: Program-to-Program Articulation Model for Environmental Science: STUDY-TRACK II: GEOSCIENCE-RELATED PROGRAMS

1. **General Physics – 8 credits**
   Students are advised to complete 8 credits of coursework in General Physics as part of the articulated associate degree. Students may fulfill this requirement by taking the following approved coursework from Category 4 of the Transfer Credit Framework:
   - General Physics I – 3-4 credits
   - General Physics II – 3-4 credits

2. **Ecology – 3-4 credits**
   Students are advised to complete 3-4 credits of coursework in Ecology as part of the articulated associate degree.

   See Appendix G: Competencies for Preparation in Ecology.

3. **General Chemistry – 8 credits**
   An understanding of General Chemistry is essential for forming the foundation of knowledge for pursuing a major in Environmental Science. Students are advised to complete 8 credits of coursework in General Chemistry *for science majors*, acquired through both lecture and rigorous laboratory/field experiences.

## Appendix A: Program-to-Program Articulation Model for Environmental Science: STUDY TRACK I: BIOLOGY-RELATED PROGRAMS

| **REQUIRED Major-Specific Content Areas** | **Notes** |
|---|---|
| **Principles of Biology – 8 credits** | See Appendix C: Competencies for Preparation in the Principles of Biology |
| **Biology Program-Specific Content Areas – 8-12 credits from at least TWO*, but no more than three*, of the following:**<br>**1) Botany**<br>**2) Genetics**<br>**3) Microbiology**<br>**4) Ecology**<br>**5) Research Methods**<br>**6) Environmental Biology**<br>**7) Zoology** | 1) See Appendix D: Competencies for Preparation in Botany<br>2) See Appendix E: Competencies for Preparation in Genetics<br>3) See Appendix F: Competencies for Preparation in Microbiology<br>4) See Appendix G: Competencies for Preparation in Ecology<br>5) See Appendix H: Competencies for Preparation in Research Methods<br>6) See Appendix I: Competencies for Preparation in Environmental Biology<br>7) See Appendix J: Competencies for Preparation in Zoology |
| **General Chemistry *for science majors* – 8 credits** | Students must meet competencies, acquired through both lecture and rigorous laboratory/field experiences, in 8 credits of General Chemistry *for science majors*. |
| **Mathematics (6-8 credits), *including 3-4 credits in Calculus or Statistics*** | Students may fulfill this requirement by taking two approved math courses from Category 3 of the Transfer Credit Framework, provided that at least one of the courses is Statistics or Calculus. See Appendix T: Transfer Credit Framework |
| **RECOMMENDED Major-Specific Content Areas** | **Notes** |
| **General Physics – 8 credits** | Students may fulfill this requirement by taking the following approved coursework from Category 4 of the Transfer Credit Framework:<br>• General Physics I – 3-4 credits<br>• General Physics II – 3-4 credits |
| **Introductory Environmental Science – 3-4 credits** | See Appendix K: Competencies for Preparation in Introductory Environmental Science |
| **Geology – 3-6 credits** | See Appendix L: Competencies for Preparation in Geology |
| **Geographic Information Systems – 3-4 credits** | See Appendix M: Competencies for Preparation in Geographic Information Systems |
| **Organic Chemistry – 8 credits** | See Appendices N & O: Competencies for Preparation in Organic Chemistry and Lab |

## Appendix B: Program-to-Program Articulation Model for Environmental Science: STUDY TRACK II: GEOSCIENCE-RELATED PROGRAMS

| REQUIRED<br>Major-Specific Content Areas | Notes |
|---|---|
| **Principles of Biology – 8 credits** | See Appendix C: Competencies for Preparation in the Principles of Biology |
| **Introductory Environmental Science – 3-4 credits** | See Appendix K: Competencies for Preparation in Introductory Environmental Science |
| **Geology & Environmental Systems Science – 6-9 credits** | See Appendix L: Competencies for Preparation in Geology |
| **Geography as a Discipline – 3 credits** | See Appendix P: Competencies for Preparation in Geography as a Discipline |
| **Geographic Information Systems – 3 credits** | See Appendix M: Competencies for Preparation in Geographic Information Systems |
| **Geography Program-Specific Content Areas – 3-6 credits**<br>Students must meet competencies in two, but not more than three, of the following areas:<br>**1) Physical Geography**<br>**2) Cultural Geography**<br>**3) World Regional Geography** | 1) See Appendix Q: Competencies for Preparation in Physical Geography<br>2) See Appendix R: Competencies for Preparation in Cultural Geography<br>3) See Appendix S: Competencies for Preparation in World Regional Geography |
| **Mathematics – 6-8 credits, *including 3-4 credits in Calculus or Statistics*** | Students may fulfill this requirement by taking two approved math courses from Category 3 of the Transfer Credit Framework, provided that at least one of the courses is Statistics or Calculus. See Appendix T: Transfer Credit Framework |
| **RECOMMENDED<br>Major-Specific Content Areas** | **Notes** |
| **General Physics – 8 credits** | Students may fulfill this requirement by taking the following approved coursework from Category 4 of the Transfer Credit Framework:<br>• General Physics I – 3-4 credits<br>• General Physics II – 3-4 credits |
| **Ecology – 3-4 credits** | See Appendix G: Competencies for Preparation in Ecology |
| **General Chemistry *for science majors* – 8 credits** | Students must meet competencies, acquired through both lecture and rigorous laboratory/field experiences, in 8 credits of General Chemistry *for science majors*. |

## Appendix C: Competencies for Preparation in the Principles of Biology

**Competency Area 1:** Scientific Investigation
To obtain competency in this area, students should be able to:
1) Define, describe, and implement the scientific method.
2) Describe implications of scientific or technological developments on ethical questions in biology.

**Competency Area 2:** Scientific literature
To obtain competency in this area, students should be able to:
1) Locate and critically evaluate scientific information.
2) Write literature reviews and lab reports.

**Competency Area 3:** Cell structure and function
To obtain competency in this area, students should be able to:
1) Describe the basic structure of a cell and define the functions of the organelles.
2) Describe the fluid mosaic model structure of biological membranes and the relationships between the membranes, the cytoskeleton, and the extracellular matrix.
3) Describe the functions of biological membranes, including transport, signal transduction, cell-cell recognition, enzymatic activity, and intercellular joining.
4) Explain the biochemistry of and factors involved in membrane transport.
5) Describe the transfer of information within a cell and between cells.
6) Describe the difference between prokaryotic and eukaryotic cell structure.
7) Describe the structure and function of chromosomes and their role in cell division.
8) Explain the concept of the cell cycle, how it is controlled, and how it relates to cell division.
9) Describe and differentiate between the mechanisms of mitosis and meiosis.
10) Explain the concepts of independent assortment, crossing over, and random fertilization, and relate these to the production of genetic variation within a population.

**Competency Area 4:** Energy transfer within biological systems
To obtain competency in this area, students should be able to:
1) Explain the first and second laws of thermodynamics.
2) Explain the concept of free energy.
3) Define chemical reaction and contrast exergonic and endergonic reactions.
4) Explain the concepts of oxidation and reduction.
5) Describe the structure of ATP and explain how it powers cellular work.
6) Describe the process of photosynthesis.
7) Describe the processes of glycolysis, the citric acid cycle, and electron transport.
8) Describe the processes of anaerobic respiration/fermentation.

**Competency Area 5:** Introduction to molecular genetics
To obtain competency in this area, students should be able to:
1) Explain the processes controlling gene expression: gene regulation, transcription, and translation.
2) Describe the process of DNA replication in eukaryotes and bacteria.
3) Describe the concept of mutation and explain the various kinds of mutations.

**Competency Area 6:** Basic principles of inheritance
To obtain competency in this area, students should be able to
1) Explain Mendelian genetics and the expression of traits through the solution of simple monohybrid and dihybrid genetics problems.
2) Explain the concepts of complete dominance, incomplete dominance, and codominance, multiple alleles, pleiotropy, epistasis, and polygenic inheritance.

**Competency Area 7:** Evolution and natural selection
To obtain competency in this area, students should be able to:

1) Describe the sources of genetic variation within a population and explain why variation is essential for evolution.
2) Define evolution and natural selection, mutation, sexual selection, gene flow and genetic drift.
3) Explain the basic principles of population genetics.
4) Discuss the biological species concept, reproductive isolation mechanisms, and the process of speciation.
5) Explain some of the mechanisms behind different scientific hypotheses concerning the origin of life forms.
6) Explain endosymbiosis and the origin of eukaryotic cells.
7) Discuss the advantages and disadvantages of multicellularity.
8) Describe the various lines of evidence for evolution including DNA and other molecular data, morphology and anatomy, developmental biology, biogeography, fossils, and radiometric dating.

**Competency Area 8:** Hierarchical organization of life
To obtain competency in this area, students should be able to:

1) Describe the methods used in the classification of organisms.
2) Explain how phylogenetic trees are constructed.
3) Describe the principal characteristics of the major taxa such as Domains/Kingdoms.
4) Describe basic ecological concepts in regards to the hierarchical organization of life.

**Competency Area 9:** Basic biochemistry
To obtain competency in this area, students should be able to:

1) Describe the fundamental properties of water in biological systems.
2) Describe the four major biomolecules: carbohydrate, lipid, nucleic acid, and protein; and explain their functions and importance in biological systems.
3) Draw and describe basic synthesis and degradation reactions of the four major biomolecules.
4) Describe basic enzyme structure and function.
5) Describe how biological systems are constrained by chemical and physical processes.

**Competency Area 10:** Laboratory experiences
To obtain competency in this area, students should be able to:

1) Develop, implement and evaluate an experimental problem through data collection and analysis.
2) Properly use a microscope, balance, pipette, micropipettes, and other basic laboratory equipment.
3) Demonstrate the use of basic computer applications such as excel for creating graphs and running simple statistical analyses.
4) Demonstrate the proper technique for weighing and measuring materials using the metric system.
5) Calculate concentrations and convert units.
6) Demonstrate familiarity with basic biochemical analysis for organic molecule identification.
7) Demonstrate the use of spectrophotometric assay for various applications.

**Competency Area 11:** Organismal Biology
To obtain competency in this area, students should be able to:

1) Relate taxonomic classification to biological evolution.
2) Describe patterns and processes of embryological development in animals.
3) Relate structure to function in animal organ systems.
4) Relate reproductive patterns to classification of the major phyla of plants.
5) Characterize the features of selected organisms in the Kingdom Fungi.
6) Demonstrate the polyphyletic nature of the Kingdom Protista.
7) Characterize the evolutionary and ecological significance of bacteria.
8) Discuss the impact of viruses on organisms.
9) Interpret the ecological significance of organisms within various taxa.
10) Access, interpret, and evaluate peer-reviewed primary scientific literature.

## Appendix D: Competencies for Preparation in Botany

To obtain competency in this area, students should be able to:

1) Explain the importance of botany as a past, present, and future science.
2) Describe and recognize plant cellular and subcellular structures.
3) Describe basic comparative plant anatomy and morphology.
4) Describe and recognize the distinguishing characteristics of simple and complex tissues. Describe the characteristics and roles of primary and secondary meristems.
5) Describe and recognize distinguishing characteristics of typical monocot and dicot roots, stems, and leaves, and flowers.
6) Describe and recognize major types of fleshy and dry fruits.
7) Demonstrate the skills required for microscopic examination of plant cells, subcellular structures, and tissues.
8) Identify representative trees and shrubs of Pennsylvania.
9) Describe the mechanism and pathways involved in the transport of water, minerals, and nutrients in plants.
10) Describe basic soil characteristics and plant mineral nutrition.
11) Explain the basics of plant metabolism with an emphasis on photosynthesis.
12) Describe the differences in structure and function of photosynthetic pigments.
13) Describe the roles of photosystems I and II in the light reactions of photosynthesis.
14) Describe and understand the process of chemiosmosis and ATP synthesis in chloroplasts.
15) Describe the role and importance of the Calvin cycle.
16) Describe the impacts of photorespiration on productivity.
17) Describe C4 and CAM photosynthesis.
18) Review the process of aerobic cellular respiration as it relates to plant metabolism.
19) Describe the basic developmental processes in plants and the roles of plant hormones in growth and development
20) Describe the roles of phytochrome in plants, photoperiodism, representative plant movements, and the effect of temperature on developmental processes
21) Explain the basic concepts of plant biotechnology and plant genetic engineering.
22) Describe and recognize the distinguishing characteristics of diverse groups within the Plant Kingdom including bryophytes, ferns and fern allies, gymnosperms, and angiosperms.
23) Describe and recognize the distinguishing characteristics of non-plant but plant-like organisms such as some members of the Domain Bacteria, some protists, and some members of the Kingdom Fungi.
24) Discuss the major evolutionary advances in plant form and function.
25) Describe life cycles of representative algae, fungi, bryophytes, ferns and fern allies, gymnosperms, and angiosperms and relate to major evolutionary advances in plants and related organisms.
26) Discuss various anatomical and physiological adaptations of plants to diverse environments.
27) Explain the basic concepts of economic and medical botany.
28) Describe the distinguishing characteristics of representative plant families.
29) Explain concepts of plant ecology including pollination ecology, various symbioses, primary and secondary succession, biomes, nutrient cycling in ecosystems, human impacts on ecosystems, impacts of invasive species, and interactions between plants and other organisms.
30) Apply investigatory skills to develop, implement and evaluate experimental problems through data collection, analysis, and report writing.

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## Appendix E: Competencies for Preparation in Genetics

To obtain competency in this area, students should be able to:

1) Explain the most important genetic principles, including those related to Mendelian genetics, chromosomal genetics, gene interactions, mutation, microbial genetics, molecular genetics, and evolutionary genetics.
2) Use current terminology to explain the modern understanding of eukaryotic chromosome structure.
3) Apply an understanding of genetic principles to the analysis of genetic problems and systems.
4) Apply basic probability theory and statistical hypothesis testing techniques to the analysis of genetic problems including linkage analysis.
5) Explain and discuss the importance of genetics to Biology as a whole and to certain human concerns such as medical and technological innovations including recombinant DNA technology, genetic engineering, and genetic testing.
6) Discuss how genes and the environment interact to produce a specific phenotype.
7) Explain the cellular activities of mitosis and meiosis as they relate to genetics.
8) Apply investigative laboratory skills relevant to basic genetics, including the production and analysis of genetic crosses, the microscopic study of chromosomes, electrophoresis, DNA isolation, the handling and genetic analysis of microbes, basic recombinant DNA techniques such as restriction digests and bacterial transformation, and the use of computers to access information from online databases, in data analysis and in the simulation of biological systems.
9) Design, conduct, statistically evaluate, and interpret the results of a genetic experiment, expanding on one, or more, of the laboratory techniques listed in the previous objective.
10) Explain evolution in terms of molecular genetics and population genetics.
11) Demonstrate understanding of population statistics, including Hardy-Weinberg equilibrium.
12) Explain perturbations to and deviations from Hardy-Weinberg equilibria and what they mean for the evolution of species.
13) Demonstrate an understanding of current applications in biotechnology, such as recombinant and transgenic methods in plants, animals, and microorganisms.
14) Demonstrate an understanding of genomics, including genome mapping strategies such as cytogenic, linkage, and physical mapping. Describe possible applications for data gained through genome projects.

# Appendix F: Competencies for Preparation in Microbiology

**Microbe classification**

To obtain competency in this area, students should be able to:

1) Describe the characteristics of the various groups of microbes including bacteria, archaea, fungi, protozoa, helminthes, viruses, prions and viroids.
2) Describe the criteria and techniques used to classify microbes and the challenges involved.
3) Describe the function of the cellular structures found in prokaryotes.
4) Draw a typical growth curve and discuss factors that influence the growth of microorganisms.
5) Describe methods of microbial reproduction including binary fission and budding.
6) Describe metabolic pathways used by prokaryotes including the glycolytic pathway, the pentose-phosphate shunt, the Entner-Douderoff pathway, fermentations, and alternative strategies to electron transport and photosynthesis.

**Bacterial genetics**

To obtain competency in this area, students should be able to:

1) Describe gene regulation and expression using the lac operon.
2) Differentiate the strategies used for genetic exchange by prokaryotes.
3) Describe DNA structure, organization and replication in prokaryotes.
4) Describe the interactions microbes have with other organisms including mutualistic, parasitic, and commensal interactions.

**Evolution**

To obtain competency in this area, students should be able to:

1) Describe and explain the major steps in the evolution of life on Earth, including symbioses that involved both prokaryotic and eukaryotic organisms and discuss an approximate time line for these events using ultra structural, biochemical, molecular and fossil evidence as examples.
2) Describe how several factors, including: mutation, horizontal gene transfer mechanisms, large population sizes, short generation times—cause rapid evolution of microbial populations.

**Importance of microbes**

To obtain competency in this area, students should be able to:

1) Describe the principles involved in common types of applied microbiology.
2) Describe in general terms, microbial roles in each of the following: decomposition/nutrient cycling, O2 production, production of industrial, commercial, and medical products.
3) Discuss the principles of antimicrobial chemotherapy.
4) Demonstrate familiarity with different types of media (selective, differential, etc.) and their uses.
5) Use standard methods to enumerate and identify bacteria.
6) Use laboratory techniques to successfully identify an “unknown” organism.
7) Demonstrate safe laboratory practices and know how to aseptically handle and dispose of live microbes.
8) Demonstrate the basic principles of microscopy and the use of stains to enhance contrast in cells.

## Appendix G: Competencies for Preparation in Ecology

To obtain competency in this area, students should be able to:

1) Explain the historical importance of ecology and technology to human society.
2) Explain how speciation occurs.
3) Explain how coevolution occurs and what its effects are.
4) Explain and describe the importance of the environment to evolution, natural selection and the maintenance of biodiversity.
5) Describe the physical, biological, and behavioral factors that influence an organism's ability to grow and reproduce in its habitat.
6) Explain and apply principles of population growth, population regulation, and population dynamics.
7) Describe the principles of community ecology.
8) Compare and contrast intraspecific and interspecific competition.
9) Explain the principle of character displacement and its relationship to competition.
10) Explain what predation and herbivory are and how they influence populations.
11) Explain the concepts of parasitism, mutualism, and commensalism.
12) Describe ecological succession.
13) Recognize similarities among ecological communities inhabiting similar types of environments, and the diverse evolutionary adaptations that influence a species' range, dispersal, and ability to survive in its environment.
14) Describe the major biotic and abiotic ecological characteristics that identify a given ecosystem.
15) Describe the biogeochemistry of an ecosystem and explain the cycles of nitrogen, carbon, phosphorous, and water.
16) Explain energy flow in ecosystems, photosynthesis, trophic levels, and biomass pyramids from an ecological perspective.
17) Discuss diverse adaptations for nutrient acquisition in ecosystems, the conversion of these nutrients into biologically useful forms, cycling of nutrients, and the indispensable roles of producers and decomposers.
18) Evaluate the impact of human behavior on earth's ecosystems, particularly as it relates to biological diversity, global climate change, and the ability of ecosystems to sustain life.
19) Recognize the continually changing nature of ecosystems, and discuss factors that impact ecosystems and the evolution of resident species through natural selection.
20) Describe and explain the causes and consequences of pollution on the biosphere and the survival of all organisms.
21) Analyze a variety of timely environmental issues in light of their ecological, social, economic, ethical, or cultural implications.
22) Collect data and formulate valid scientific conclusions of an ecological nature.
23) Work as part of a team in field and laboratory investigations of ecological phenomena.
24) Collect ecological data and apply basic statistical skills for analyzing quantitative and qualitative data to formulate conclusions.

## Appendix H: Competencies for Preparation in Research Methods

To obtain competency in this area, students should be able to:

1) Describe the steps of the scientific method and discuss how the scientific method is used.
2) Distinguish between non-manipulative studies and experiments.
3) Identify flaws in experimental design.
4) Explain basic statistical concepts including Type I error, p-value, test statistic, null hypothesis.
5) Distinguish between descriptive and inferential statistics.
6) Distinguish between parametric and nonparametric statistics and explain the advantages and disadvantages of each.
7) Conduct effective and comprehensive scientific literature searches.
8) Read, understand and critique primary scientific journal articles.
9) Explain the process involved in getting scientific research published in a journal
10) Identify an original scientific research project to work on.
11) Write a scientific research project proposal.
12) Design and conduct a research project that will test a hypothesis or answer a given biological question
13) Determine which statistical test is appropriate for a given situation or set of data.
14) Draw a graph that clearly summarizes a particular data set.
15) Write a scientific paper, similar in scope and style to papers published in the scientific literature, based on original scientific research.
16) Present results of a scientific study in the form of an oral presentation and/or a poster presentation.

# Appendix I: Competencies for Preparation in Environmental Biology

**Fundamental science**

To obtain competency in this area, students should be able to:

1) Discuss the importance of biological science and research in modern society.
2) Define the scientific method and discuss the steps involved in carrying out a sound scientific inquiry.
3) Distinguish between theory and hypothesis from the view of the scientist and the layperson.
4) Distinguish between science and non-science and give examples of each.
5) Describe the difference between "basic science" and "applied science."
6) List and describe the "levels of organization" (from least to most complex) in biological systems.
7) Briefly describe the 3 domains and important kingdoms and phyla of life, and their important subdivisions. List examples of each, and discuss their importance in ecosystems.

**Chemistry and energetics**

To obtain competency in this area, students should be able to:

1) Distinguish between potential and kinetic energy. Give biological and non-biological examples. How are these energy forms used and stored by organisms?
2) State the first and second “laws of energy” and describe their importance.
3) Understand both the matter and energy conversions of photosynthesis and cellular respiration
4) Describe the structure of the atom, and the meanings of atomic number, atomic mass and isotope. Describe the atomic nucleus and electron orbitals, and the importance of the electrons in determining bonding between atoms. Be able to diagram an atom given its atomic number and mass.
5) Understand the causes of radioactivity, and differentiate radioactivity from chemical reactions.
6) Distinguish between inorganic and organic compounds. Describe the characteristics of the carbon atom; include the type of bonds C forms and the types of chemical structures C can form.
7) Understand and differentiate between ionic, covalent (polar and nonpolar) and hydrogen bonds.
8) Relate the polarity of the water molecule to important properties of water such as evaporative cooling, its ability to act as a solvent and to dissociate ionic compounds, and its ability to stick to (wet) molecules with polar covalent bonds.
9) Define pH and describe the pH scale, including the terms acid, base (alkali) and why pH is important.
10) Understand the basic chemical makeup of the 4 major biological molecule types, including the atoms each is composed of, and general importance or each to organisms.

**Population and community ecology and dynamics**

To obtain competency in this area, students should be able to:

1) Describe how populations may be distributed in space, and give examples of populations that appear to be distributed. Understand the importance of distribution in terms of local population size and density.
2) Differentiate between a species’ habitat and its ecological niche.
3) Discuss the various factors that can influence a population’s intrinsic rate of increase, r, leading to exponential (J-shaped) growth.
4) Discuss the various factors that can provide “environmental resistance” that limits a population’s growth, including various density-dependent and density-independent regulators of population growth, leading to logistic (S-shaped) growth. Be able to apply the logistic equation to an understanding of natural population growth dynamics (e.g., deer in suburbia, introduced wolves in Yellowstone, etc.).
5) Define carrying capacity, and note under what circumstances a population might exceed its carrying capacity.
6) Understand the concept of “critical limiting resource”, and list the critical resources needed to sustain the populations of various sorts of organisms.

7) Relate the above both to natural populations and to the past, present and possible futures of the human populations, and contrast different regions' populations trajectories and the reason for those differences (e.g., the "demographic transition" model).
8) Contrast traditional agriculture with Green Revolution-style "industrialized" agricultural practices with regard to energy (and other) inputs and outputs, biodiversity in the landscape, and cultural implications, with particular attention to the longer-term sustainability of agricultural production (including animal production and fisheries). Include specific examples such as the Ogallala and North China aquifers, pesticides and the pros and cons of their uses, ways of maintaining soil fertility, and the impacts of centralized animal production and aquaculture.
9) Understand the basic structure of soils, the roles of the parent materials and detritus deposition in determining soil structure and composition. Define humus, and understand its role in determining soil fertility. Contrast the advantages/disadvantages of different soil textures (sand, silt, clay, loam) in soils.
10) Define/describe community interactions such as symbiosis, predation, parasitism, commensalism, mutualism and competition. Give examples of each.
11) Contrast the underlying individual and societal considerations, and the values and ethical considerations, of various policies that either promote or restrict the bearing of children.

**Ecosystem, regional, biome and biosphere dynamics**

To obtain competency in this area, students should be able to:

1) Describe and discuss the function of the various abiotic and biotic components of an ecosystem.
1) Discuss the inputs and outputs, and the flow of energy through ecosystems.
2) Explain the trophic structure of food chains and food webs; explain the roles of primary producers, primary & secondary consumers, detritivores and decomposers.
3) Define productivity (net and gross), and describe the major pathways of energy flow in ecosystems. Be able to predict which ecosystems will have high productivities, and ecosystem responses to the overhunting of higher-level carnivores.
4) Relate the "10% rule" to the laws of thermodynamics, and to the inherent difficulties of feeding the human population with a meat-based diet.
5) Understand the terms photoautotroph, chemoautotroph, heterotroph, herbivore, carnivore, and omnivore.
6) Discuss why biomass measurements are not a good indicator of ecosystem productivity.
7) Explain how biological magnification (bioaccumulation) works, and list some important chemicals that can undergo this process. Discuss the societal implications, past and current, of this process.
8) Describe the cycling of carbon in an ecosystem, and how human activities may alter the carbon cycle and lead to other problems such as climate change.
9) Describe the various contributors to, and conclusions of, global climate change theory, including an understanding of the sources of the various greenhouse gases, the role of albedo and land use changes, and other influences on global climate.
10) Discuss the importance of the movement of nutrients via biogeochemical cycles; including biological, geological, and chemical processes.
11) Define watershed and comment on the importance of plants in stabilizing biogeochemical cycles within watersheds.
12) Describe the nitrogen cycle; include the term nitrogen fixation and (to a lesser extent), nitrification, assimilation, decomposition & ammonification, and denitrification.
13) Describe the phosphorus cycle.
14) Describe how human activities, e.g. sewage, fertilizer usage, and industrial animal farming, may alter the nitrogen and phosphorus cycles, and discuss the societal and ecological implications of such alterations.
15) Describe the eutrophication process, and various proposals to minimize it in aquatic ecosystems.
16) Define natural succession, distinguish between primary and secondary succession, and discuss the various types and scales of disturbance that initiate it.
17) Discuss the typical characteristics of pioneer, successional, and climax communities.

18) Briefly summarize the water (hydrologic) cycle. Show how human activities such as land development, agriculture, and forestry, can alter water flows, including percolation and runoff rates, evapotranspiration rates, soil moisture levels, erosion and sediment rates.
19) Explain the important sources, effects, and potentials for reduction, of acid deposition.
20) Cite examples of "environmental justice" concerns, including the connection between environmental degradation and areas of poverty and powerlessness.
21) Define and describe the important characteristics of major terrestrial and aquatic biomes, including dominant vegetation types, relative productivities, and important natural and anthropogenic disturbances.
22) Discuss the meanings of the term "biodiversity". Explain how species diversity is more than just a count of the species present in an area.
23) Explain how extinction rates have not been constant over time, and the role of human land uses as an influence on current extinction rates. Discuss the lessons from history as to expected recovery time following mass extinctions, and the societal implications of lower biodiversity.
24) Be able to explain species-area curves, and relate the conclusions to human impacts on natural ecosystems and the sizes of parks and preserves.
25) Discuss the current controversies over the Endangered Species Act, including a discussion of its unique ethical underpinnings. Summarize the goals and limitations of CITES, the IWC, and other international agreements for the protection of threatened and endangered species.

## Appendix J: Competencies for Preparation in Zoology

To obtain competency in this area, students should be able to:

1) Integrate the theory of evolution by natural selection into the phylogeny of the protists and the Kingdom Animalia.
2) Distinguish, by comparative biology, the following:
3) the protists from the metazoa;
4) the radiate animals from the bilateral animals;
5) acoelomate, pseudocoelomate and coelomate animals;
6) the invertebrates from the vertebrates.
7) List the distinguishing characteristics of selected groups of protists, and explain why protists are no longer recognized as a valid kingdom.
8) List the distinguishing characteristics of the Kingdom Animalia and be able to compare the phyla Porifera, Cnidaria, Platyhelminthes, Nematoda, Mollusca, Annelida, Arthropoda, Echinodermata, and Chordata.
9) Describe the basic characteristics and comparative biology of the major vertebrate classes.
10) Describe the physiology of organisms in each of the major phyletic groups.
11) Demonstrate the skills required of microscopic examination of animal tissues and gross animal dissection.
12) Identify and discuss issues relating to evolutionary events surrounding the rise of gross animal architecture.
13) Identify and discuss issues relating to the evolution of the main lines of animal phylogeny.

## Appendix K: Competencies for Preparation in Introductory Environmental Science

To obtain competency in this area, students should be able to:

1) Demonstrate the interdisciplinary aspects of environmental science.
2) Explain the concepts of ethics and economics and their application to the environmental policy process.
3) Explain how environmental chemistry, in particular the characteristics of the water molecule, help support life.
4) Distinguish how photosynthesis, cellular respiration and chemosynthesis relate to biotic systems.
5) Demonstrate an understanding of nutrient and biogeochemical cycles.
6) Evaluate the effects of human population growth on the environment and environmental policy decisions.
7) Identify the principles, goals and approaches of land development, land use and resource management.
8) Analyze risk assessment and risk management as applied to environmental toxicology.
9) Analyze the problems of freshwater supply and water quality. Address solutions to conserve freshwater supplies and reduce water pollution.
10) Identify the physical, geographical, chemical and biological aspects of, and assess the human impact on, the marine environment.
11) Identify the basic concepts of atmospheric science and the sources and major constituents of air pollution.
12) Identify and analyze conventional fossil fuels, conventional energy alternatives, and new renewable energy alternatives.
13) Demonstrate how bioremediation is utilized to treat wastewater and reduce the contamination in selected sites.

## Appendix L: Competencies for Preparation in Geology

**Competency Area 1:** Formation of the solar system and Earth
Students will demonstrate competency by:

1) Describing current hypotheses for the formation of the solar system, Earth, and moon
2) Explaining the internal structure and composition of the Earth

**Competency Area 2:** Plate tectonics and earthquakes
Students will demonstrate competency by:

1) Explaining the evidence for continental drift
2) Explaining the evidence for plate tectonics
3) Describing the energy sources and forces driving plate tectonics
4) Describing the theory of plate tectonics
5) Defining convergent, divergent, and transform plate boundaries and discussing geologic features associated with each.
6) Describing the process by which energy is stored as strain and released as seismic waves to create an earthquake.
7) Describing and explaining the distribution of earthquake epicenters
8) Listing the types of seismic waves and describing how they travel through/around the earth.
9) Being able to locate the epicenter of an earthquake
10) Discussing the methods and effectiveness of both short-term and long-term earthquake prediction

**Competency Area 3:** Minerals
Students will demonstrate competency by:

1) Defining mineral
2) Discussing the basic building blocks of minerals, and the types of bonds that hold minerals together
3) Identifying common rock-forming minerals based on characteristic physical properties
4) Listing the major mineral families and providing examples of each.

**Competency Area 4:** Igneous rocks and environments
Students will demonstrate competency by:

1) Identifying and classifying common intrusive and extrusive igneous rocks based on composition and texture
2) Describing common intrusive and extrusive igneous environments, processes, and landforms
3) Discussing magma evolution
4) Explaining Bowen's reaction series

**Competency Area 5:** Weathering, soil, and mass wasting
Students will demonstrate competency by:

1) Explaining the difference between physical and chemical weathering
2) Describing physical and chemical weathering processes
3) Defining soil and explaining the formation of an idealized soil profile.
4) Explaining the development of common broad soil classes
5) Discussing the primary controls and triggers of mass wasting and subsidence
6) Listing and describing the different types of mass wasting

**Competency Area 6:** Sedimentary rocks and environments
Students will demonstrate competency by:

1) Describing common sedimentary environments, processes, and structures
2) Identifying and classifying common clastic and chemical sedimentary rocks based on composition and texture

**Competency Area 7:** Metamorphic rocks and environments

Students will demonstrate competency by:

1) Describing common metamorphic environments and processes
2) Identifying and classifying common foliated and non-foliated metamorphic rocks based on composition and texture
3) Explaining the processes by which one rock can be changed into another in the Rock Cycle.

**Competency Area 8:** Deformation and the continents
Students will demonstrate competency by:

1) Explaining the difference between stress and strain
2) Discussing environments in which rocks experience strain
3) Defining and being able to identify different types of faults and folds
4) Explaining how the attitude of rocks can be described with strike and dip.
5) Identifying a wide variety of structures such as folds, faults, and unconformities on block diagrams.
6) Explaining how mountain building events connect with the Wilson Cycle
7) Defining isostasy
8) Discussing the patterns of continental development through time

**Competency Area 9:** Surface water and groundwater
Students will demonstrate competency by:

1) Identifying the reservoirs in which water is stored, and describing both the processes that move water from one reservoir to another and the sources of energy driving water's movement through the hydrologic cycle.
2) Discussing the most important factors influencing work (erosion, transport, deposition) done by streams
3) Describing erosional and depositional stream-shaped landforms
4) Identifying drainage patterns and relating patterns to geologic setting
5) Explaining the occurrence and movement of groundwater
6) Discussing issues of groundwater availability and contamination
7) Explaining the development of karst

**Competency Area 10:** Climate, glaciers, wind, and coastal processes
Students will demonstrate competency by:

1) Differentiate between weather and climate
2) Discussing the distribution of heat by air and water
3) Explaining the main controls on climate, including possible causes of ice ages
4) Explaining the greenhouse effect, and discus anthropogenic influence on climate
5) Discussing use of temperature proxies
6) Describing the location and movement of glaciers
7) Identifying and explaining the origin of erosional and depositional glacial landforms
8) Discussing the role of water and weathering in arid climates
9) Identifying landforms common in arid climates
10) Describing wave erosion and the landforms produced by wave erosion.
11) Discussing shoreline erosional problems and solutions.

**Competency Area 11:** Geologic time and rock correlation
Students will demonstrate competency by:

1) Explaining the key principles of relative age dating
2) Listing the three types of unconformities and Describing how each forms
3) Determining the order of events in a cross section or landscape based on principles of relative age dating.
4) Explaining the principles underlying radiometric dating.
5) Explaining at least one line of evidence for the age of the Earth
6) Knowing the names and age ranges of the major eons and eras of the geologic time scale

7) Using the principle of faunal succession to determine relative age and correlate rock units.

**Competency Area 12:** Crystalline and Chemical Structure of Sedimentary Particles and Soil Water
Students will demonstrate competency by:

1) Describing the crystalline and chemical structures of various sedimentary particles (as solids and in solution)
2) Explaining how the physical structure of sedimentary particles influences their behavior in soil development

**Competency 13.** Soil Chemistry and Nutrient Cycling

3) Students will demonstrate competency by:
4) Describing the chemical properties of various soils and soil horizons and how they change as a result of climate, temperature, etc.
5) Explaining how nutrients are developed and formed in soils and soil horizons and how they cycle through time
6) Explaining how nutrients enhance or limit soil productivity and increase or decrease biomass

**Competency 14.** Soil Microbes & Pathogens
Students will demonstrate competency by:

1) Describing the types of soil microbes and their relative function and impact on soil
2) development and nutrient cycling
3) Explaining the functioning of soil pathogens and how their transmission vectors

**Competency 15.** Soil Classification and Evaluation Methods
Students will demonstrate competency by:

1) Describing multiple methods for soil characterization and classification based on compositions, textures, etc.
2) Explaining how soils and their properties can be evaluated and tested for inclusion in classification schemes

**Competency 16.** Soils in Agriculture & Engineering
Students will demonstrate competency by:

1) Describing the roles of diverse soil types in agriculture, and how soil types are modified/altered for agricultural purposes
2) Explaining how soil science can inform engineering practices for buildings and infrastructure development.

**Competency 17.** Soil Contamination and Erosion
Students will demonstrate competency by:

1) Describing common sources of contamination (point source and non-point source) and how contamination is transmitted through soils
2) Explaining how erosion can be both vital to and detrimental to soil development

**Competency 18.** Soil Conservation and Soil Management
Students will demonstrate competency by:

1) Describing traditional and more contemporary methods for preserving and enhancing soils around the world
2) Explaining how soil best management practices contribute to ecosystem health, human health, and enhanced soil productivity

**Competency 19.** Hydrologic Cycle and Water Resource Cycle
Students will demonstrate competency by:

1) Describing the hydrologic cycle and its components
2) Describing the concepts of reservoirs, fluxes, residence times, water resource management

3) Explaining how water resources are cycled through environments, and human landscapes through human and non-human time-scales

**Competency 20.** Precipitation and Infiltration
Students will demonstrate competency by:
1) Describing global and regional patterns of precipitation and the causes of precipitation in all its forms.
2) Explaining how rates of precipitation and soil/sediment characteristics of the ground surface impact infiltration processes and rates
3) Explaining how mathematical models can help quantify and predict patterns and rates of infiltration and precipitation

**Competency 21.** Runoff and Stream Flow Processes
Students will demonstrate competency by:
1) Describing global and regional patterns of runoff and surface drainage associated with diverse human and natural landscapes
2) Explaining how stream flow processes work, and how they vary by climate, topography, slope, flow volume, sediment/soil loads, etc.
3) Explaining how runoff and stream flow processes impact human infrastructure and pose geohazards for human and natural landscapes.
4) Explaining how mathematical models can help quantify and predict patterns and rates of runoff during droughts and floods

**Competency 22.** Subsurface Drainage and Redistribution Processes
Students will demonstrate competency by:
1) Describing the processes and patterns of subsurface flow networks and how natural and polluted waters are transmitted from place to place underground.
2) Explaining how subsurface geology can impact and be impacted by groundwater flow rates and volumes.
3) Explaining how mathematical models and field instrumentation can help quantify and predict patterns and rates of subsurface transmission of water and pollutants.

**Competency 23.** Watershed Delineation and Human Land Use Impact
Students will demonstrate competency by:
1) Describing how a watershed is delineated and how watershed components including stream orders are established and defined.
2) Explaining how human land use patterns both impact and are impacted by surface water, subsurface water, and their processes through time

**Competency 24.** Water Resource Management, Planning, and Engineering
Students will demonstrate competency by:
1) Describing common water resource management practices, policies, and how they relate to responsible planning and engineering plans
2) Explaining how water resource science draws from the fields of hydrology, hydraulics, biology/ecology, chemistry, geology, etc.
3) Describing urban water systems and their associated processes.
4) Describing catchment management issues and strategies for both surface water and groundwater systems and their associated processes
5) Explaining the theoretical and applied management practices associated with environmental management as they relate to environmental policy and development

**Competency 25.** Hydrologic Field Methods
Students will demonstrate competency by:

1) Describing common field methods and equipment used for qualitative and quantitative assessments of groundwater and surface water processes, rates, and changes through time.
2) Explaining how stream flow gauging stations work, how to measure stream and flow velocities, how to measure and calculate discharge, how to assess water quality parameters in the subsurface and at the surface
3) Explaining how biological and what chemical assessments can be used to monitor water quality parameters

## Appendix M: Competencies for Preparation in Geographic Information Systems (GIS)

To obtain competency in this area, students should be able to:

1) Understand the history and components of GIS.
2) Interpret geographic and attribute data types, formats, and dimensions.
3) Recognize common sources of data and their reliability and uses.
4) Incorporate remote sensed with GPS data.
5) Know geographic coordinate systems and geo-coding methods.
6) Understand basic map layout and selection by attribute and location.
7) Explain vector and raster analysis methods.
8) Produce maps and text reports.

## Appendix N: Competencies for Preparation in Organic Chemistry

**Competency Area 1**: Bonding.
In order to attain this competency, students should be able to:

1) Understand topics in chemical bonding and the relationship between chemical structures and their reactivity.
2) Understand the concept of resonance.
3) Understand the concept of hybridization.

**Competency Area 2**: Structure and Function.
In order to attain this competency, students should be able to:

1) Identify functional groups.
2) Correlate chemical structure with reactivity and function.
3) Understand how the behavior and properties of molecules depend on electronic, orbital and steric interactions.
4) Understand the importance of environmental context (solution phase, pure gas, liquid or solid) on predicting the structure and reactivity of organic molecules.

**Competency Area 3**: Acid-Base Reactions.
In order to attain this competency, students should be able to:

1) Make predictions of behavior attributable to Lewis acid-base principles, and Bronsted-Lowry acid-base principles.
2) Understand the concept of pKa.

**Competency Area 4**: Stereochemistry.
In order to attain this competency, students should be able to:

1) Understand all stereochemical principles (cis, trans, R, S, exo, endo) and their identification/ relationships.
2) Make predictions regarding stability and reactivity of stereochemical molecules from conformational analysis.
3) Understand the importance of stereochemistry in specific reactions.

**Competency Area 5**: Nomenclature.
In order to attain this competency, students should be able to:

1) Name alkanes, alkenes, alkynes, aromatics, alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amides, halides and amines.
2) Incorporate stereochemistry in nomenclature.

**Competency Area 6**: Spectroscopy.
In order to attain this competency, students should be able to:

1) Analyze and interpret structural data obtained from laboratory experiments, spectroscopic analysis, and computational methods.
2) Understand the theory and analysis of Infrared Spectroscopy (IR) and Nuclear Magnetic Resonance Spectroscopy (NMR).

**Competency Area 7**: Organic Reactions.
In order to attain this competency, students should be able to:

1) Understand the concept of “reaction mechanism” in organic chemistry.
2) Predict reaction outcomes based on mechanistic principles, in the areas of addition, substitution, elimination and rearrangement chemistry.
3) Recognize and understand the significance of reactive intermediates such as carbocations, radicals, carbanions and carbenes.
4) Understand how reaction rate, kinetics, and energy diagrams apply to organic reactions.

**Competency Area 8**: Organic Synthesis.
In order to attain this competency, students should be able to:

1) Understand the design of organic syntheses.
2) Understand the synthesis and reactions of the major classes of organic molecules: alkanes, alkenes, alkynes, aromatics, alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amides, halides and amines.
3) Plan organic syntheses through the application of retrosynthetic analysis principles.

**Competency Area 9**: Macromolecules.
In order to attain this competency, students should be able to:

1) Recognize the organic functionality of macromolecules.
2) Understand the synthesis of, and the structure-based behavior of, macromolecular species such as proteins, lipids, (mono- and) polysaccharides, and synthetic polymers.

## Appendix O: Competencies for Preparation in Organic Chemistry Laboratory

**Competency Area 1**: Laboratory Safety and Laboratory Notebook. This competency applies to all laboratory competencies In order to attain this competency, students should know:

1) Safe laboratory practices at the institutional level
2) Safety protocols mandated by OSHA
3) Proper use of equipment
4 ) Proper practices in the acquisition of reagents for all experiments and proper disposal of waste.

**Competency Area 2**: Purification Techniques.
In order to attain this competency, students should be able to:

1) Isolate and purify organic materials.
2) Master methods such as simple and fractional distillation of liquids, recrystallization of solids, column chromatography, and extraction of solutes in immiscible solvents.
3) Identification of purified products by melting point, boiling point, refractive index (or polarimetry), or by spectroscopy.

**Competency Area 3**: Spectroscopy.
In order to attain this competency, students should be able to:

1) Develop competence in the spectroscopic analysis of organic starting materials and synthetic products.
2 ) Methods should include interpretation of IR and NMR spectra.
3 ) GC/MS should also be included.
4) Students should develop facility in deducing structures from spectra and be able to provide answers to questions involving data provided from ‘unavailable’ spectroscopic or computational sources.

**Competency Area 4**: Functional Group Interconversion.
In order to attain this competency, students should be able to correctly plan and carry out a broad variety of organic reactions based on functional group interconversions.

**Competency Area 5**: Chromatography.
In order to attain this competency, students should be able to perform an experiment that utilizes thin layer chromatography (TLC) and/or gas chromatography (GC). Examples include monitoring a reaction by observing both reactants and products and/or comparison of standards to unknowns.

**Competency Area 6**: Statistical Analysis.
In order to attain this competency, students should be able to perform a laboratory that applies statistical methods to the analysis of experimental data, real or simulated (this competency is recommended by the ACS).

**Competency Area 7**: Computational.
In order to attain this competency, students should be able to understand the value of, and the limitations associated with, computational methods.

## Appendix P: Competencies for Preparation in Geography as a Discipline

To obtain competency in this area, students should be able to:

1) Understand concepts of scale, region, location, and distance.
2) Know how make decisions regarding spatial analysis.
3) Demonstrate the ability to imagine and visualize geographic concepts.
4) Interpret thematic and locational maps.
5) Understand the history of geography as a discipline.

## Appendix Q: Competencies for Preparation in Physical Geography

To obtain competency in this area, students should be able to:

1) Interpret topographic maps.
2) Understand tectonic and gradational geomorphological processes.
3) Demonstrate knowledge of spatial patterns of hydrological processes.
4) Interpret spatial patterns of atmospheric and climatological processes.
5) Understand patterns of ecological processes, natural resources, and limitations for sustainability.

## Appendix R: Competencies for Preparation in Cultural Geography

To obtain competency in this area, students should be able to:

1) Understand spatial patterns of cultural identity.
2) Appreciate folk, linguistic, and religious building of landscapes.
3) Recognize the types of political boundaries.
4) Interpret effects of and effects on regional accessibility.
5) Know spatial patterns of economic development and demography.
6) Understand spatial patterns of economic activities and land uses.
7) Explain examples of human-environment interactions.

## Appendix S: Competencies for Preparation in World Regional Geography

To obtain competency in this area, students should be able to:

1) Understand regional patterns of mineral and biological resources.
2) Interpret regional patterns of human impacts on the environment.
3) Recognize regional patterns of agriculture and other economic activities.
4) Interpret effects of and effects on regional accessibility.
5) Understand patterns of human population growth and migration.
6) Understand regional patterns of economic and urban development.
7) Recognize patterns of religious, linguistic, and ethnic identity.

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Amended April 11, 2012

## Appendix T: 30-Credit Transfer Framework

Students who successfully complete courses from the categories below may transfer those credits toward the graduation requirements of nearly any major offered by the participating institutions. Please be aware that certain majors may have specific requirements prescribed by external agencies. Students should work with an advisor to select appropriate courses as they relate to the major.

| Category 1 (3-4 credits total) | Category 2 (3-4 credits total) | Category 3 (min. 3-4 credits; max. 6-8 credits) | Category 4 Must include lab (min. 3-4 credits; max. 6-8 credits) | Category 5 (min. 3-4 credits; max. 6-8 credits) | Category 6 (min. 3-4 credits; max. 6-8 credits) |
|---|---|---|---|---|---|
| English Composition | Public Speaking | Foundations of Mathematics | General Chemistry I (majors & non-majors courses) | General Psychology | Introduction to Music |
| | | College Algebra | General Chemistry II (majors & non-majors courses) | Introduction to Sociology | Introduction to Philosophy |
| | | Elementary Statistics | General Biology I (majors & non-majors courses) | American National Government | Elementary Spanish I |
| | | Precalculus | General Biology II (majors & non-majors courses) | Educational Psychology | Elementary Spanish II |
| | | Calculus I | General Physics I (non-calculus) | History of Western Civilization II | Painting I |
| | | | General Physics II (non-calculus) | Principles of Macroeconomics | Elementary French I |
| | | | Anatomy & Physiology I | Principles of Microeconomics | Elementary French II |
| | | | Anatomy & Physiology II | U.S. History I | Drawing I |
| | | | Introduction to Astronomy | U.S. History II | Ethics |
| | | | | History of Western Civilization I | Introduction to Art |
| | | | | Contemporary Social Problems | German I |
| | | | | Introduction to Anthropology | German II |
| | | | | Human Growth & Development | Introduction to Literature (may also be known as Introduction to Poetry, Interpreting Literature, Reading Literature, Theses in Literature, Topics in Literature, Current Themes in Literature) |
| | | | | Child Psychology | Survey of American Literature |
| | | | | | Literature of the Western World |
| | | | | | World Literature |
| | | | | | American Literature |
| | | | | | Survey of English Literature |
| | | | | | Introduction to Theatre |

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Amended April 11, 2012

# ADDENDUM
# GENERAL STATEWIDE PROGRAM-TO-PROGRAM ARTICULATION in PENNSYLVANIA
## *(Revised April 11, 2012)*

WHEREAS, the General Assembly of the Commonwealth of Pennsylvania enacted Act 114 of 2006, which added to the Public School Code of 1949, Article XX-C entitled "Transfers of Credits Between Institutions of Higher Education" (referred to in this Agreement as the "Statewide Transfer System");

WHEREAS, Act 114 of 2006 requires all community colleges in Pennsylvania and Pennsylvania State System of Higher Education (PASSHE) universities to participate in the Statewide Transfer System;

WHEREAS, Act 114 of 2006 permits independent and state-related institutions of higher education in Pennsylvania, as each is defined in Article XX-C, to elect to participate in the Statewide Transfer System;

WHEREAS, the General Assembly of the Commonwealth of Pennsylvania enacted Act 50 of 2009, which requires institutions participating in the Statewide Transfer System to accept the transfer of Associate of Arts and Associate Science degrees into parallel baccalaureate programs and recognize all competencies attained within the associate degree program;

WHEREAS, Act 50 of 2009 defines an Associate of Arts (AA) or Associate of Science (AS) degree containing a minimum of 60 college-level credits and designed primarily for transfer to a baccalaureate institution;

WHEREAS, Act 50 of 2009 requires the Transfer Articulation Oversight Committee (TAOC), as established in section 2004-C of the Public School Code of 1949, to identify Associate of Arts and Associate of Science degree programs for transfer with full junior standing into parallel baccalaureate degrees annually; and,

WHEREAS, Act 50 of 2009 requires members of the Transfer Articulation Oversight Committee established in section 2004-C of the Public School Code of 1949, to identify modifications that may be required in existing associate or baccalaureate degrees to satisfy external accreditation or licensure requirement;

All Institutions participating in the Statewide Transfer System enter into this Articulation Agreement and mutually agree as follows:

1. The statewide program-to-program articulation agreement ensures that students who complete an AA or AS degree from a participating institution will have their coursework and credits transfer into a parallel baccalaureate program with full junior standing and without the need for course-by-course equivalency.

2. Students are subject to the admissions and transfer credit policies of the participating institutions. The admissions and transfer credit policies for all of the institutions participating in Pennsylvania's college credit transfer system can be found at www.PAcollegetransfer.com.

3. The AA or AS degree must include a minimum of 60 college-level credits designed and acceptable for transfer, not including developmental or remedial courses or career, technical or applied courses.

4. The transfer of coursework with a grade less than a C (2.0 on a 4.0 scale) in the AA or AS will be consistent with the policies of native students at the participating college or university.

5. Students and institutional personnel will be able to find out which institutions offer articulated programs by accessing a searchable database located at www.PAcollegetransfer.com. PDE will maintain this database through program information provided to TAOC by the individual participating institutions.

6. References to courses in all agreements designate competencies and are not to be construed as making a reference to a specific course at a specific institution. Course titles in the agreements are presented for guidance in advising students as to which coursework they should take even though the course at the student's college may not have the specific title mentioned in the agreement.[2]

7. **Responsibilities of Associate Degree Institutions**
   a. The AA or AS degree leading to a parallel bachelor degree will include the minimum number of credits and competencies of major-specific coursework as defined by the Agreement.

   b. Any remaining AA or AS degree requirements will be accepted from arts and sciences electives designed and acceptable for transfer, not including developmental, remedial, career, technical or applied courses.

   c. By awarding the AA or AS, the Associate Degree Institution is validating that the student has met the competency requirements outlined in the Agreement.

8. **Responsibilities of Bachelor Degree Institutions**
   a. The Bachelor Degree Institution will recognize all competencies attained within the AA or AS degree and accept a transfer student who has earned the associate degree with full junior standing into a parallel baccalaureate degree program.

   b. All decisions made with respect to the transfer process shall be based on the principle of equivalence of expectations and requirements for native and transfer students.

   c. A transfer student's admission into the parallel baccalaureate degree will be subject to the Bachelor Degree Institution's specific requirements for admission to that major and be consistent with such requirements for native students.

9. **Agreement Revision and Assessment**
   a. Once a statewide program-to-program articulation agreement has been approved by TAOC, no amendments to the agreement can be offered by any party within the initial six (6) months of the agreement. After that time, a TAOC member with a proposed amendment to an approved agreement should submit the change to PDE.

      Amendments that are offered as clarifying or technical but do not alter the substantive portions or intent of the agreement must be forwarded to TAOC. TAOC representatives will have at least thirty (30) days to review, comment and approve or deny the proposed amendments.

      Amendments that seek to alter the substantive nature or intent of the agreement in any part must be forwarded to the appropriate PAC for review and consideration. The PAC will then make a recommendation to the TAOC, and TAOC shall approve or deny the proposed amendments.[3]

   b. PDE and TAOC will exercise responsibility for monitoring the effectiveness of the Agreement and its implementation.

   c. PDE shall collect data annually from the participating institutions that will enable the Department and TAOC to assess the effectiveness of the implementation of the Agreement in fostering a seamless transfer process and the academic success of transfer students at the senior institutions.

[2] Adopted by TAOC and added to the agreement on April 11, 2012.
[3] Approved by TAOC and added to agreement on August 18, 2011.

**10. Transfer Appeal Process**

a. In accordance with Pennsylvania's Statewide Transfer System, each Bachelor Degree Institution shall have a procedure through which a transfer student can appeal a decision that he/she believes is not consistent with this Agreement.

b. The Transfer Appeal Process shall be published, at minimum, in the institution's catalog and posted to the Commonwealth's official website of the Statewide Transfer System, www.PAcollegetransfer.com.

**11. Institutional Resolution of Disputes**

a. In the event that an Associate Degree Institution considers the decision of a Bachelor Degree Institution to be inconsistent with this Agreement, the Associate Degree Institution shall consult directly with the Bachelor Degree Institution and attempt to resolve the matter.

b. If the institutions are unable to resolve the issue, the Associate Degree Institution may submit their concern to PDE for consideration by the TAOC Dispute Resolution Committee. The Dispute Resolution Subcommittee will act according to the policies and procedures developed by TAOC as part of the Statewide Transfer System. The determination made by the Dispute Resolution Subcommittee will be binding upon the parties.

12. **Implementation Date and Applicability**

Having fulfilled the requirements outlined in the Program-to-Program Articulation Agreement, students transferring with an AA or AS degree from a participating institution will be considered by the receiving baccalaureate degree institution to have received adequate preparation in the field of study at the foundation level and therefore eligible to transfer as a junior into advanced major coursework.

Participating institutions will enact the Agreement in accordance to the timeline outlined by the TAOC, but no later Fall 2013.[4]

Continuation of the agreement remains in effect until such time as all cooperating institutions of the Statewide Transfer System formally approve any revisions.

## GLOSSARY OF TERMS

**Articulation:** The aligning of curriculum between institutions of higher education to ensure the efficient and effective movement of students among those institutions.

**Associate of Arts (AA) and Associate of Science (AS) Degree:** A degree consisting of at least 60 college-level credits and designed for transfer into a baccalaureate degree program.

**Foundation Coursework:** Courses at a level of comprehension usually associated with freshman and sophomore students and typically offered during the first half of a baccalaureate degree program. Such coursework typically does not have course prerequisites.

**Native Student:** A student who entered a given college or university without first matriculating at another college.

**Parallel Baccalaureate Degree:** A bachelor degree program in a comparable field of study and with similar foundation-level major-specific competencies as an associate degree program.

**Receiving Institution:** The college or university where a transfer student plans to enroll and to apply previously earned credit toward a degree program.

[4] Agreements approved by TAOC prior to August 31, 2011 must be implemented by the institutions by Fall 2012. Agreements approved by TAOC after August 31, 2011 but before May 1, 2012 must be implemented by the institutions by Fall 2013.

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**Transfer Credit:** The credit granted by a college or university for college-level courses or other academic work completed at another institution.

**Transfer Student:** A student who enters a participating college or university after earning college-level credit at another college or university.

**Transfer:** The process by which a student moves from one postsecondary institution to another. Also refers to the mechanics of credit, course and curriculum exchange between institutions.

**Advanced Coursework:** Courses with advanced depth of content knowledge in the field of study and carry the expectation of more complex competencies identified in the expected student learning outcomes is referred to as advanced coursework. These courses often have prerequisites and are usually beyond the "Introduction to…" or "Foundation of…" level.