

Academic Standards for Environment and Ecology

*June 1, 2009 FINAL
Grades 3-8, 10,12*



Pennsylvania Department of Education

*These standards are offered as a voluntary resource for Pennsylvania's schools and await action by the State Board of Education.
The course level standards are offered as a voluntary resource for Pennsylvania's schools.*

GRADES 3-8, 10, 12
Environment and Ecology

X. TABLE OF CONTENTS

| | |
|--|-------------|
| Introduction / Rationale..... | XI. |
| <u>THE ACADEMIC STANDARDS</u> | |
| Ecology | 4.1. |
| <i>A. The Environment</i> | |
| <i>B. Materials Cycles</i> | |
| <i>C. Energy Flow</i> | |
| <i>D. Biodiversity</i> | |
| <i>E. Succession</i> | |
| <i>F. Science as Inquiry</i> | |
| Watersheds and Wetlands | 4.2. |
| <i>A. Watersheds</i> | |
| <i>B. Wetlands</i> | |
| <i>C. Aquatic Ecosystems</i> | |
| <i>D. Science as Inquiry</i> | |
| Natural Resources | 4.3. |
| <i>A. Use of Natural Resources</i> | |
| <i>B. Availability of Natural Resources</i> | |
| <i>C. Science as Inquiry</i> | |
| Agriculture and Society | 4.4. |
| <i>A. Food and Fiber System</i> | |
| <i>B. Importance of Agriculture</i> | |
| <i>C. Applying Sciences to Agriculture</i> | |
| <i>D. Technology Influences on Agriculture</i> | |
| <i>E. Science as Inquiry</i> | |
| Humans and the Environment | 4.5. |
| <i>A. Sustainability</i> | |
| <i>B. Integrated Pest Management</i> | |
| <i>C. Pollution</i> | |
| <i>D. Waste Management</i> | |
| <i>E. Human Health Issues</i> | |
| <i>F. Science as Inquiry</i> | |
| Glossary..... | XII. |

GRADES 3-8, 10, 12

Environment and Ecology

XI. INTRODUCTION

This document includes Environment and Ecology standards that describe what students should know and be able to do in these areas:

- ◇ 4.1. Ecology
- ◇ 4.2. Watersheds and Wetlands
- ◇ 4.3. Natural Resources
- ◇ 4.4. Agriculture and Society
- ◇ 4.5. Humans and the Environment

The Declaration of Rights, Article I of the Pennsylvania Constitution states in Section 27: “The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and aesthetic values of the environment. Pennsylvania’s public natural resources are the common property of all people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.” To this end it is our responsibility to develop a citizenry that is aware of and concerned about the total environment and has the knowledge and skills to work toward solutions to current problems and the prevention of new ones.

Environment and Ecology is grounded in the complexity of the world we live in and its sustainability. It examines the world’s natural processes and systems. Environment and Ecology places its main emphasis in the real world. Allowing students to understand, through a sound academic content base, how their everyday lives evolve around their use of the natural world and the resources it provides.

These standards establish the essential elements of what students should know and be able to do at the end of grades four, seven, ten and twelve. The sequential nature of this document reflects the need for rigorous academic content that students will be expected to achieve. The document reinforces all areas across the grade levels with increasing degrees of difficulty as the students mature intellectually.

The study of Environment and Ecology will allow students to be active participants and problem solvers in real issues that affect them, their homes, schools and communities.

A glossary is included to assist the reader in understanding terminology contained in the standards.

GRADES 3-8, 10, 12

Environment and Ecology

Science as Inquiry: Understanding of science content is enhanced when concepts are grounded in inquiry experiences. The use of scientific inquiry will help ensure that students develop a deep understanding of science content, processes, knowledge and understanding of scientific ideas, and the work of scientists; therefore, inquiry is embedded as a strand throughout all content areas. Teaching science as inquiry provides teachers with the opportunity to help all students in grades K-12 develop abilities necessary to understand and do scientific inquiry. These are very similar across grade bands and evolve in complexity as the grade level increases.

| Grades K-4 | Grades 5-7 | Grades 8-10 | Grades 11-12 |
|---|--|---|---|
| <ul style="list-style-type: none"> • Distinguish between scientific fact and opinion. • Ask questions about objects, organisms and events. • Understand that all scientific investigations involve asking and answering questions and comparing the answer with what is already known. • Plan and conduct a simple investigation and understand that different questions require different kinds of investigations. • Use simple equipment (tools and other technologies) to gather data and understand that this allows scientists to collect more information than relying only on their senses to gather information. • Use data/evidence to construct explanations and understand that scientists develop explanations based on their evidence and compare them with their current scientific knowledge. • Communicate procedures and explanations giving priority to evidence and understanding that scientists make their results public, describe their investigations so they can be reproduced and review and ask questions about the work of other scientists. | <ul style="list-style-type: none"> • Understand how theories are developed. • Identify questions that can be answered through scientific investigations and evaluate the appropriateness of questions. • Design and conduct a scientific investigation and understand that current scientific knowledge guides scientific investigations. • Describe relationships using inference and prediction. • Use appropriate tools and technologies to gather, analyze, and interpret data and understand that it enhances accuracy and allows scientists to analyze and quantify results of investigations. • Develop descriptions, explanations, and models using evidence and understand that these emphasize evidence, have logically consistent arguments and are based on scientific principles, models, and theories. • Analyze alternative explanations and understanding that science advances through legitimate skepticism. • Use mathematics in all aspects of scientific inquiry. • Understand that scientific investigations may result in new ideas for study, new methods or procedures for an investigation, or new technologies to improve data collection. | <ul style="list-style-type: none"> • Compare and contrast scientific theories. • Know that both direct and indirect observations are used by scientists to study the natural world and universe. • Identify questions and concepts that guide scientific investigations. • Formulate and revise explanations and models using logic and evidence. • Recognize and analyze alternative explanations and models. | <ul style="list-style-type: none"> • Examine the status of existing theories. • Evaluate experimental information for relevance and adherence to science processes. • Judge that conclusions are consistent and logical with experimental conditions. • Interpret results of experimental research to predict new information, propose additional investigable questions, or advance a solution. • Communicate and defend a scientific argument. |

GRADES 3-8, 10, 12
Environment and Ecology

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| Content Area Strand | 4.1.3.F. | 4.1.4.F. | 4.1.5.F. | 4.1.6.F. | 4.1.7.F. | 4.1.8.F. | 4.1.10.F. | 4.1.12.F. |
| | 4.2.3.D. | 4.2.4.D. | 4.2.5.D. | 4.2.6.D. | 4.2.7.D. | 4.2.8.D. | 4.2.10.D. | 4.2.12.D. |
| | 4.3.3.C. | 4.3.4.C. | 4.3.5.C. | 4.3.6.C. | 4.3.7.C. | 4.3.8.C. | 4.3.10.C. | 4.3.12.C. |
| | 4.4.3.E. | 4.4.4.E. | 4.4.5.E. | 4.4.6.E. | 4.4.7.E. | 4.4.8.E. | 4.4.10.E. | 4.4.12.E. |
| | 4.5.3.F. | 4.5.4.F. | 4.5.5.F. | 4.5.6.F. | 4.5.7.F. | 4.5.8.F. | 4.5.10.F. | 4.5.12.F. |

4.1. Ecology

| 4.1.3. GRADE 3 | 4.1.4. GRADE 4 | 4.1.5. GRADE 5 | 4.1.6. GRADE 6 | 4.1.7. GRADE 7 | 4.1.8. GRADE 8 | 4.1.10 GRADE 10 | 4.1.12. GRADE 12 |
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| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.1. Ecology | | | | | | | | |
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| 4.1.3. GRADE 3 | 4.1.4. GRADE 4 | 4.1.5. GRADE 5 | 4.1.6. GRADE 6 | 4.1.7. GRADE 7 | 4.1.8. GRADE 8 | 4.1.10 GRADE 10 | 4.1.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| The Environment | <p>4.1.3.A. Differentiate between the living and non-living components in an environment.</p> | <p>4.1.4.A. Explain how living things are dependent upon other living and nonliving things for survival.</p> <ul style="list-style-type: none"> Explain what happens to an organism when its food supply, access to water, shelter or space (niche / habitat) is changed. Identify similarities and differences between living organisms, ranging from single-celled to multi-cellular organisms through the use of microscopes, video, and other media. | <p>4.1.5.A. Describe the roles of producers, consumers, and decomposers within a local ecosystem.</p> | <p>4.1.6.A. Intentionally Blank</p> | <p>4.1.7.A. Describe the relationships between biotic and abiotic components of an ecosystem.</p> <ul style="list-style-type: none"> Compare and contrast different biomes and their characteristics. Describe symbiotic and predator/ prey relationships. | <p>4.1.8.A. Intentionally Blank</p> | <p>4.1.10.A. Examine the effects of limiting factors on population dynamics.</p> <ul style="list-style-type: none"> Analyze possible causes of population fluctuations. Explain the concept of carrying capacity in an ecosystem. Describe how organisms become classified as threatened or endangered. Describe how limiting factors cause organisms to become extinct. | <p>4.1.12.A. Analyze the significance of biological diversity in an ecosystem.</p> <ul style="list-style-type: none"> Explain how species adapt to limiting factors in an ecosystem. Analyze the differences between natural causes and human causes of extinction. Research wildlife management laws and their effects on biodiversity. |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.1. Ecology | | | | | | | | |
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| 4.1.3. GRADE 3 | 4.1.4. GRADE 4 | 4.1.5. GRADE 5 | 4.1.6. GRADE 6 | 4.1.7. GRADE 7 | 4.1.8. GRADE 8 | 4.1.10 GRADE 10 | 4.1.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Materials Cycles | 4.1.3.B. Intentionally Blank | 4.1.4.B. Identify how matter cycles through an ecosystem . • Trace how death, growth, and decay cycle matter through an ecosystem . | 4.1.5.B. (See Science and Technology: 3.3.5.A4.) | 4.1.6.B. Intentionally Blank | 4.1.7.B. Explain biogeochemical cycles within an ecosystem . (See Science and Technology: 3.3.7.A1.) | 4.1.8.B. (See Science and Technology: 3.3.10.A1.) | 4.1.10.B. Explain the consequences of interrupting natural cycles. | 4.1.12.B. Research solutions to problems caused by interrupting natural cycles. |
| Energy Flow | 4.1.3.C. Identify sources of energy. | 4.1.4.C. Explain how most life on earth gets its energy from the sun. | 4.1.5.C. Describe different food webs including a food web containing humans. | 4.1.6.C. Intentionally Blank | 4.1.7.C. Explain the flow of energy within an ecosystem . • Compare and contrast the flow of energy between organisms in different habitats . • Explain the concept of trophic levels. | 4.1.8.C. Intentionally Blank | 4.1.10.C. Evaluate the efficiency of energy flow within a food web . Describe how energy is converted from one form to another as it moves through a food web (photosynthetic, geothermal). | 4.1.12.C. Research how humans affect energy flow within an ecosystem . • Describe the impact of industrial, agricultural, and commercial enterprises on an ecosystem . |

GRADES 3-8, 10, 12
Environment and Ecology

4.1. Ecology

| 4.1.3. GRADE 3 | 4.1.4. GRADE 4 | 4.1.5. GRADE 5 | 4.1.6. GRADE 6 | 4.1.7. GRADE 7 | 4.1.8. GRADE 8 | 4.1.10 GRADE 10 | 4.1.12. GRADE 12 |
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Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:

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|---------------------|---|---|---|---|---|--|---|--|
| Biodiversity | <p>4.5.3.D. Identify organisms that are dependent on one another in a given ecosystem.</p> <ul style="list-style-type: none"> • Define habitat and explain how a change in habitat affects an organism. | <p>4.5.4.D. Explain how specific adaptations can help organisms survive in their environment.</p> | <p>4.5.5.D. Explain the differences between threatened, endangered, and extinct organisms.</p> | <p>4.5.6.D. Identify reasons why organisms become threatened, endangered, and extinct.</p> | <p>4.5.7.D. Explain how biological diversity relates to the viability of ecosystems.</p> <ul style="list-style-type: none"> • Compare and contrast monoculture with diverse ecosystems. • Explain how biological diversity relates to the ability of an ecosystem to adapt to change. • Explain how an adaptation is an inherited, structure, function, or behavior that helps an organism survive and reproduce. | <p>4.5.8.D. Use the theory of natural selection to examine the causes and consequences of extinction.</p> | <p>4.5.10.D. Research practices that impact biodiversity in specific ecosystems.</p> <ul style="list-style-type: none"> • Analyze the relationship between habitat changes to plant and animal population fluctuations. | <p>4.5.12.D. Analyze the effects of new and emerging technologies on biodiversity in specific ecosystems.</p> <ul style="list-style-type: none"> • Evaluate the impact of laws and regulations on reducing the number of threatened and endangered species. |
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GRADES 3-8, 10, 12
Environment and Ecology

| 4.1. Ecology | | | | | | | | |
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| | 4.1.3. GRADE 3 | 4.1.4. GRADE 4 | 4.1.5. GRADE 5 | 4.1.6. GRADE 6 | 4.1.7. GRADE 7 | 4.1.8. GRADE 8 | 4.1.10 GRADE 10 | 4.1.12. GRADE 12 |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Succession | 4.1.3.E. Identify changes in the environment over time. | 4.1.4.E. Explain that ecosystems change over time due to natural and/ or human influences. | 4.1.5.E. Intentionally Blank | 4.1.6.E. Intentionally Blank | 4.1.7.E. Identify factors that contribute to change in natural and human-made systems. • Explain the processes of primary and secondary succession in a given ecosystem . | 4.1.8.E. Intentionally Blank | 4.1.10.E. Analyze how humans influence the pattern of natural changes (e.g. primary / secondary succession and desertification) in ecosystems over time. | 4.1.12.E. Research solutions addressing human impacts on ecosystems over time. |
| Science as Inquiry | 4.1.3.F See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.1.4.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.1.5.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.1.6.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.1.7.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.1.8.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.1.10.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.1.12.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.2. Watersheds and Wetlands | | | | | | | | |
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| 4.2.3. GRADE 3 | 4.2.4. GRADE 4 | 4.2.5. GRADE 5 | 4.2.6. GRADE 6 | 4.2.7. GRADE 7 | 4.2.8. GRADE 8 | 4.2.10 GRADE 10 | 4.2.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Watersheds | <p>4.2.3.A. Define the term watershed.</p> <ul style="list-style-type: none"> Identify the watersheds in which you reside. | <p>4.2.4.A. Describe the physical characteristics of a watershed.</p> <ul style="list-style-type: none"> Identify and explain what determines the boundaries of a watershed. Identify water systems and their components as either lotic or lentic. | <p>4.2.5.A. Explain the water cycle.</p> | <p>4.2.6.A. Identify the five major watersheds of Pennsylvania.</p> | <p>4.2.7.A. Explain how water enters, moves through, and leaves a watershed.</p> <ul style="list-style-type: none"> Explain the concept of stream order. Describe factors that affect the flow and water quality within a watershed. | <p>4.2.8.A. Describe factors that affect the quality of ground and surface waters.</p> | <p>4.2.10.A. Examine the interactions between abiotic and biotic factors within a watershed.</p> <ul style="list-style-type: none"> Describe how topography influences the flow of water in a watershed. Describe how vegetation affects water runoff. Investigate and analyze the effects of land use on the quality of water in a watershed. | <p>4.2.12.A. Examine environmental laws related to land use management and its impact on the water quality and flow within a watershed.</p> |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.2. Watersheds and Wetlands | | | | | | | | |
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| 4.2.3. GRADE 3 | 4.2.4. GRADE 4 | 4.2.5. GRADE 5 | 4.2.6. GRADE 6 | 4.2.7. GRADE 7 | 4.2.8. GRADE 8 | 4.2.10 GRADE 10 | 4.2.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Wetlands | 4.2.3.B. Identify plants and animals found in a wetland . | 4.2.4.B. Describe the characteristics of different types of wetlands . | 4.2.5.B. Identify important wetlands in the United States | 4.2.6.B. Describe the characteristics of soils found in a wetland . | 4.2.7.B. Explain the primary functions of a wetland within a watershed . <ul style="list-style-type: none"> • Providing habitat, flood control, water purification. • Serving as buffer zones, wildlife propagation areas, and food and fiber systems. | 4.2.8.B. Explain the value of wetlands to other living things. | 4.2.10.B. Examine how human interactions impact wetlands and their surrounding environments . <ul style="list-style-type: none"> • Describe how land use decisions affect wetlands | 4.2.12.B. Analyze the effects of policies and regulations at various governmental levels on wetlands and their surrounding environments . <ul style="list-style-type: none"> • Examine various public policies relating to wetlands. • Investigate the intended and unintended effects of public polices and regulations relating to wetlands. |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.3. Natural Resources | | | | | | | | |
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| 4.3.3. GRADE 3 | 4.3.4. GRADE 4 | 4.3.5. GRADE 5 | 4.3.6. GRADE 6 | 4.3.7. GRADE 7 | 4.3.8. GRADE 8 | 4.3.10 GRADE 10 | 4.3.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Use of Natural Resources | <p>4.3.3.A. Identify the natural resources used to make various products.</p> | <p>4.3.4.A. Identify ways humans depend on natural resources for survival.</p> <ul style="list-style-type: none"> • Identify resources used to provide humans with energy, food, employment, housing and water. | <p>4.3.5.A. Intentionally Blank</p> | <p>4.3.6.A. Intentionally Blank</p> | <p>4.3.7.A. Explain how products are derived from natural resources.</p> <ul style="list-style-type: none"> • Describe the process of converting raw materials to consumer goods. • Differentiate between renewable and nonrenewable resources. | <p>4.3.8.A. Compare and contrast alternative sources of energy.</p> | <p>4.3.10.A. Evaluate factors affecting the use of natural resources.</p> <ul style="list-style-type: none"> • Evaluate the effect of consumer demands on the use of natural resources. • Analyze how technologies such as modern mining, harvesting, and transportation equipment affect the use of our natural resources. • Describe how local and state agencies manage natural resources. | <p>4.3.12.A. Evaluate the advantages and disadvantages of using renewable and nonrenewable resources.</p> <ul style="list-style-type: none"> • Explain how consumption rate affects the sustainability of resource use. • Evaluate the advantages and disadvantages of using renewable resources such as solar power, wind power, and biofuels. |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.3. Natural Resources | | | | | | | | |
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| 4.3.3. GRADE 3 | 4.3.4. GRADE 4 | 4.3.5. GRADE 5 | 4.3.6. GRADE 6 | 4.3.7. GRADE 7 | 4.3.8. GRADE 8 | 4.3.10 GRADE 10 | 4.3.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Availability of Natural Resources | 4.3.3.B. Identify local natural resources . | 4.3.4.B. Identify the geographic origins of various natural resources . | 4.3.5.B. Intentionally Blank | 4.3.6.B. Intentionally Blank | 4.3.7.B. Explain the distribution and management of natural resources . • Differentiate between resource uses: conservation, preservation, and exploitation . | 4.3.8.B. Intentionally Blank | 4.3.10.B. Analyze how humans manage and distribute natural resources . • Describe the use of a natural resource with an emphasis on the environmental consequences of extracting, processing, transporting, using, and disposing of it. • Analyze the impact of technology on the management, distribution, and disposal of natural resources . | 4.3.12.B. Analyze factors that influence the local, regional, national, and global availability of natural resources . • Compare the use of natural resources in different countries. • Analyze the social, economic, and political factors that affect the distribution of natural resources (e.g., wars, political systems, classism, racism). |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.3. Natural Resources | | | | | | | | |
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| | 4.3.3. GRADE 3 | 4.3.4. GRADE 4 | 4.3.5. GRADE 5 | 4.3.6. GRADE 6 | 4.3.7. GRADE 7 | 4.3.8. GRADE 8 | 4.3.10 GRADE 10 | 4.3.12. GRADE 12 |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Science as Inquiry | 4.3.3.C. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.3.4.C. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.3.5.C. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.3.6.C. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.3.7.C. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.3.8.C. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.3.10.C. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.3.12.C. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.4. Agriculture and Society | | | | | | | | |
|--|--|--|---|--|---|---|---|--|
| | 4.4.3. GRADE 3 | 4.4.4. GRADE 4 | 4.4.5. GRADE 5 | 4.4.6. GRADE 6 | 4.4.7. GRADE 7 | 4.4.8. GRADE 8 | 4.4.10 GRADE 10 | 4.4.12. GRADE 12 |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Food and Fiber System | 4.4.3.A. Identify Pennsylvania crops that provide food for the table and fiber for textiles . | 4.4.4.A. Describe the journey of local/global agricultural commodities from production to consumption. | 4.4.5.A. Explain why animal production is dependent upon plant production. | 4.4.6.A. Explain how different plants and animals in the United States have specific growing requirements related to climate and soil conditions. | 4.4.7.A. Describe how agricultural practices, the environment , and the availability of natural resources are related. | 4.4.8.A. Identify and describe how food safety issues have impacted the food and fiber system . | 4.4.10.A. Explain the relationships between and among the components of the food and fiber system . (i.e., production, processing, research and development, marketing, distribution, and regulations .) | 4.4.12.A. Research and analyze the social, political, economic, and environmental factors that affect agricultural systems. |
| Importance of Agriculture | 4.4.3.B. Explain how agriculture meets the basic needs of humans. | 4.4.4.B. Describe how humans rely on the food and fiber system . • Identify Pennsylvania's important agricultural products. | 4.4.5.B. Intentionally Blank | 4.4.6.B. Analyze how soil types and geographic regions have impacted agriculture in Pennsylvania. | 4.4.7.B. Describe the economic importance of agriculture to society. | 4.4.8.B. Intentionally Blank | 4.4.10.B. Analyze the effects of agriculture on a society's economy, environment , standard of living, and foreign trade. | 4.4.12.B. Research and evaluate laws and policies that affect the food and fiber system . |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.4. Agriculture and Society | | | | | | | | |
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| | 4.4.3. GRADE 3 | 4.4.4. GRADE 4 | 4.4.5. GRADE 5 | 4.4.6. GRADE 6 | 4.4.7. GRADE 7 | 4.4.8. GRADE 8 | 4.4.10 GRADE 10 | 4.4.12. GRADE 12 |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Applying Sciences to Agriculture | 4.4.3.C. Use scientific inquiry to investigate what animals and plants need to grow. | 4.4.4.C Use scientific inquiry to investigate the composition of various soils. | 4.4.5.C. Investigate the factors influencing plant and animal growth. (e.g., soil, water, nutrients, and light) | 4.4.6.C. Intentionally Blank | 4.4.7.C. Investigate resources, their relation to land use, and their impact on the food and fiber system . | 4.4.8.C. Intentionally Blank | 4.4.10.C. Analyze how agricultural sciences and technologies strive to increase efficiency while balancing the needs of society with the conservation of our natural resources . | 4.4.12.C. Analyze research and development initiatives as they relate to agriculture . |
| Technology Influences on Agriculture | 4.4.3.D. Identify technology used in agriculture . • Identify tools and machinery used in agricultural processes. | 4.4.4.D. Identify how technology affects the development of civilizations through agricultural production. | 4.4.5.D. Intentionally Blank | 4.4.6.D. Intentionally Blank | 4.4.7.D. Identify the positive and negative effects of technology used in agriculture and its effects on the food and fiber system and the environment over time. | 4.4.8.D. Intentionally Blank | 4.4.10.D. Evaluate the use of technologies to increase plant and animal productivity. | 4.4.12.D. Describe how policies, regulations , and laws affect the technologies adopted in agriculture . |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.4. Agriculture and Society | | | | | | | | |
|--|---|---|---|---|---|---|--|--|
| | 4.4.3. GRADE 3 | 4.4.4. GRADE 4 | 4.4.5. GRADE 5 | 4.4.6. GRADE 6 | 4.4.7. GRADE 7 | 4.4.8. GRADE 8 | 4.4.10 GRADE 10 | 4.4.12. GRADE 12 |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Science as Inquiry | 4.4.3.E. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.4.4.E. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.4.5.E. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.4.6.E. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.4.7.E. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.4.8.E. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.4.10.E. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.4.12.E. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.5. Humans and the Environment | | | | | | | | |
|--|--|--|------------------------------------|---|--|--|---|---|
| 4.5.3. GRADE 3 | 4.5.4. GRADE 4 | 4.5.5. GRADE 5 | 4.5.6. GRADE 6 | 4.5.7. GRADE 7 | 4.5.8. GRADE 8 | 4.5.10 GRADE 10 | 4.5.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Sustainability | 4.5.3.A. Identify resources humans take from the environment for their survival. | 4.5.4.A. Identify how people use natural resources in sustainable and non-sustainable ways. | 4.5.5.A. Intentionally Blank | 4.5.6.A. Examine how historical events have shaped the sustainable use of natural resources . | 4.5.7.A. Describe how the development of civilization affects the use of natural resources . • Compare and contrast how people use natural resources in sustainable and non-sustainable ways throughout the world. | 4.5.8.A. Explain how Best Management Practices (BMP) can be used to mitigate environmental problems. | 4.5.10.A. Explain how public policy encourages or discourages the sustainable use of natural resources . • Research laws and policies that address the sustainable use of natural resources (e.g., solid and liquid waste management , industry, agriculture and enterprise). | 4.5.12.A. Research how technology influences the sustainable use of natural resources . • Analyze how consumer demands drive the development of technology enabling the sustainable use of natural resources . |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.5. Humans and the Environment | | | | | | | | |
|--|---|---|--|------------------------------------|--|------------------------------------|---|--|
| 4.5.3. GRADE 3 | 4.5.4. GRADE 4 | 4.5.5. GRADE 5 | 4.5.6. GRADE 6 | 4.5.7. GRADE 7 | 4.5.8. GRADE 8 | 4.5.10 GRADE 10 | 4.5.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Integrated Pest Management | 4.5.3.B. Define the term pest and identify various plants and animals that humans may call pests . | 4.5.4.B. Determine the circumstances that cause humans to identify an organism as a pest . | 4.5.5.B Intentionally Blank . | 4.5.6.B. Intentionally Blank | 4.5.7.B. Describe the impact of pests in different geographic locations and techniques used to manage those pests . <ul style="list-style-type: none"> • Identify introduced species that are classified as pests in their new environments. • Research integrated pest management practices. | 4.5.8.B. Intentionally Blank | 4.5.10.B. Describe the impact of integrated pest management practices on the environment . | 4.5.12.B. Evaluate pest management using methods such as cost/benefit analysis, cumulative effects analysis, environmental impact analysis, ethical analysis, and risk analysis. |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.5. Humans and the Environment | | | | | | | | |
|--|--|---|--|--|---|---|---|--|
| 4.5.3. GRADE 3 | 4.5.4. GRADE 4 | 4.5.5. GRADE 5 | 4.5.6. GRADE 6 | 4.5.7. GRADE 7 | 4.5.8. GRADE 8 | 4.5.10 GRADE 10 | 4.5.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Pollution | 4.5.3.C. Identify different types of pollution and their sources. | 4.5.4.C. Describe how human activities affect the environment . | 4.5.5.C. Explain the difference between point and non-point source pollution . | 4.5.6.C. Identify key people and events that shaped the environmental history in the United States. | 4.5.7.C. Explain how human actions affect the health of the environment . <ul style="list-style-type: none"> • Identify residential and industrial sources of pollution and their effects on environmental health. | 4.5.8.C. Describe how humans can reduce pollution. | 4.5.10.C. Analyze real-world data and explain how point and non-point source pollution can be detected and eliminated. <ul style="list-style-type: none"> • Compare and contrast the environmental effects of different industrial strategies. | 4.5.12.C. Analyze the costs and benefits of means to control pollution. <ul style="list-style-type: none"> • Analyze the role of technology in the reduction of pollution. • Research and analyze the local, state, and national laws that deal with point and non-point source pollution. • Explain mitigation and its role in maintaining environmental health. |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.5. Humans and the Environment | | | | | | | | |
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| 4.5.3. GRADE 3 | 4.5.4. GRADE 4 | 4.5.5. GRADE 5 | 4.5.6. GRADE 6 | 4.5.7. GRADE 7 | 4.5.8. GRADE 8 | 4.5.10 GRADE 10 | 4.5.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Waste Management | <p>4.3.3.D. Describe how waste is generated.</p> <ul style="list-style-type: none"> Identify and propose a solution for a waste issue in the school setting (e.g., litter in the hallway). | <p>4.3.4.D. Describe a waste stream.</p> <ul style="list-style-type: none"> Identify sources of waste derived from the use of natural resources. Identify those items that can be recycled and those that can not. Describe how everyday activities may affect the environment. | <p>4.3.5.D. Explain how different items are recycled and reused.</p> | <p>4.3.6.D. Explain the costs and benefits of recycling in controlling resource use.</p> | <p>4.3.7.D. Describe the wastes derived from using resources, how the waste is managed, and the potential impact on the environment.</p> | <p>4.3.8.D. Compare and contrast waste generated from various sources of energy.</p> | <p>4.3.10.D. Evaluate various methods of managing waste as related to economic, environmental, and technological factors.</p> | <p>4.3.12.D. Evaluate waste management practices.</p> <ul style="list-style-type: none"> Analyze current solid waste regulations. Research the impact of new and emerging technologies in the use, reuse, recycling and disposal of materials. Evaluate ways that waste could be reduced during the production of specific product. |

GRADES 3-8, 10, 12
Environment and Ecology

| 4.5. Humans and the Environment | | | | | | | | |
|--|---|---|---|---|---|---|---|--|
| 4.5.3. GRADE 3 | 4.5.4. GRADE 4 | 4.5.5. GRADE 5 | 4.5.6. GRADE 6 | 4.5.7. GRADE 7 | 4.5.8. GRADE 8 | 4.5.10 GRADE 10 | 4.5.12. GRADE 12 | |
| <i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to:</i> | | | | | | | | |
| Human Health Issues | 4.5.3.E. Intentionally Blank | 4.5.4.E. Identify different ways human health can be affected by pollution. | 4.5.5.E. Intentionally Blank | 4.5.6.E. Intentionally Blank | 4.5.7.E. Describe how length and degree of exposure to pollutants may affect human health. <ul style="list-style-type: none"> Identify diseases/ conditions that have been associated with exposure to pollutants. | 4.5.8.E. Intentionally Blank | 4.5.10.E. Describe the impact of occupational exposure to pollutants. <ul style="list-style-type: none"> Analyze laws and regulations designed to protect human health. Analyze efforts to prevent, control, and/or reduce pollution through cost and benefit analysis and risk management. | 4.5.12.E. Analyze how consumer demands promote the production of pollutants that affect human health. |
| Science as Inquiry | 4.5.3.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.5.4.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.5.5.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.5.6.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.5.7.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.5.8.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.5.10.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) | 4.5.12.F. See <i>Science as Inquiry</i> in the Introduction for grade level indicators.(As indicated on page 4) |

GRADES 3-8, 10, 12
Environment and Ecology

XII. GLOSSARY

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| Abiotic: | A nonliving factor or element (e.g., light, water, heat, rock, energy, mineral). |
| Agriculture: | The production of food, feed, fiber, and other goods by the systematic growing/harvesting of plants, animals and other life forms. |
| Best Management Practices (BMP): | Methods that have been determined to be the most effective, practical means of preventing or reducing pollution and improving efficiency. |
| Diversity index | A mathematical means of determining how many different species exist in a particular environment in order to determine environmental health. |
| Biogeochemical: | The movement of chemical elements between organisms and non-living compartments of atmosphere, aquatic systems, and soils. |
| Biological Diversity (Biodiversity): | The variety and complexity of species present and interacting in an ecosystem and the relative abundance of each. |
| Biomes: | Distinct ecological communities of plants and animals living together in a particular climate. |
| Biofuels: | Renewable fuels derived from biological materials that can be regenerated. |
| Biotic: | An environmental factor related to or produced by living organisms. |
| Buffer Zone: | A designated land or water area, along the perimeter of some land use, the use of which is regulated so as to resist, absorb, or otherwise preclude unwanted development or other intrusions (visual, noise, recreational use) into areas beyond the strip of undisturbed vegetation that retards the flow of runoff water, causing deposition of transported material and thereby reducing sediment in receiving streams. |
| Carrying Capacity: | The maximum population that can be sustained indefinitely in a given area without changing the ecosystem in ways that will eventually reduce the sustainable population. |
| Consumer: | Organisms that obtain energy by feeding on other organisms and their remains. |
| Desertification: | A process of landscape change usually due to land mismanagement whereby the land becomes increasingly arid and vegetation is replaced by more dry-adapted species. |

GRADES 3-8, 10, 12

Environment and Ecology

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| Decomposer: | An organism, often microscopic in size, that obtains nutrients by consuming dead organic matter, thereby making nutrients accessible to other organisms; examples of decomposers include fungi, scavengers, rodents, and other animals. |
| Ecosystem: | A community of living organisms and their interrelated physical and chemical environment. |
| Endangered Species: | A species that is in danger of extinction throughout all or a significant portion of its range. |
| Environment: | The total of the surroundings (air, water, soil, vegetation, people, wildlife) influencing each living being's existence, including physical, biological and all other factors; the surroundings of a plant or animal, including other plants or animals, climate and location. |
| Extinction: | The complete elimination of a species from the earth. |
| Fiber | Parts of plants and animals used for non-food products. |
| Food Web: | The set of organism relationships, often based on who-eats whom or which organisms cycle a particular nutrient within and ecological community. |
| Food and Fiber System: | Food and fiber systems, or agriculture, encompass all the processes necessary to bring food and fiber products to the consumer; including production, processing, research, development, distribution, and marketing. |
| Habitat | Consists of food, water, shelter, and space in a suitable arrangement. |
| Integrated Pest Management: | A variety of control methods including cultural, mechanical, biological, and chemicals to control pest population. |
| Lentic: | Relating to or living in still water. |
| Limiting Factors: | Chemical or physical factors that limit the existence, growth, abundance, or distribution of an organism. |
| Lotic: | Relating to or living in actively moving water. |
| Matter: | The substance of which physical objects are composed; it constitutes much of the observable universe (excluding light). It is normally defined as anything that has mass and takes up space. |
| Mitigation: | The policy of constructing or creating man-made habitats, such as wetlands, to replace those lost to development. |

GRADES 3-8, 10, 12

Environment and Ecology

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| Monoculture: | The system of growing only one crop in a given area. |
| Natural Resources: | Any material produced by nature that can be used to produce goods or provide services. |
| Niche (Ecological): | The role played by an organism in an ecosystem; its food preferences, requirements for shelter, special behaviors, and the timing of its activities (e.g., nocturnal, diurnal), interaction with other organisms and its habitat. |
| Non-Point Source Pollution: | Contamination that originates from many locations that all discharge into a location (e.g., lake, stream, land area). |
| Nonrenewable Resources: | Substances (e.g., oil, gas, coal, copper, gold) that, once used, cannot be replaced in this geological age. |
| Organism: | A form of life considered as an entity; an animal, plant, fungus, protist, or bacteria. |
| Pest: | A label applied to an organism when it is in competition with humans for some resource. |
| Point Source Pollution: | Pollutants discharged from a single identifiable location (e.g., pipes, ditches, channels, sewers, tunnels, containers of various types). |
| Predators: | Animals that live by capturing and feeding on other animals. |
| Prey: | Animal hunted or caught for food. |
| Producers: | Plants that perform photosynthesis and provide food to consumers. |
| Population Dynamics: | A description of the ways in which a given population's numbers grow and shrink over time, as controlled by birth, death and emigration. |
| Recycling: | Collecting and reprocessing a resource or product to make new products. |
| Regulation: | A rule or order issued by an executive authority or regulatory agency of a government and having the force of law. |
| Renewable Resource: | A naturally occurring raw material or form of energy that will be replenished through natural ecological cycles or sound management practices (e.g., the sun, wind, water, trees). |

GRADES 3-8, 10, 12

Environment and Ecology

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| Risk Management: | A strategy developed to reduce or control the chance of harm or loss to one's health or life; the process of Identifying, evaluating, and selecting and implementing actions to reduce the risk to human health and to ecosystems. |
| Symbiotic: | Intimate relationship between two organisms often resulting in mutualism (win-win), parasitism (win-lose), or commensalism (win-no harm). |
| Stream Order: | Energy and nutrient flow that increases as water moves toward the oceans [e.g., the smallest stream (primary) that ends when rivers flow into oceans]. |
| Succession: | The series of changes that occur in an ecosystem with the passing of time. |
| Sustainability: | The ability to keep in existence or maintain. A sustainable ecosystem is one that can be maintained. |
| Technology: | The application of knowledge to the practical aims of human life or to changing and manipulating the human environment. Technology is a broad concept that deals with a species' usage and knowledge of tools and crafts, and how it affects a species' ability to control and adapt to its environment. |
| Textile | A flexible material comprised of a network of natural or artificial fibers. |
| Topography: | The physical features of a place or the study and depiction of physical features, including terrain relief. |
| Water Cycle: | The cycle by which water evaporates from soils, vegetation, oceans, and other bodies of water; accumulates as water vapor in clouds; returns to the Earth, oceans, and other bodies of water as rain and snow; and runs off as river flow, through the soil or an aquifer. |
| Waste Management: | Administration of the reduction, collection, separation, storage, transportation, transfer, processing, treatment, and disposal of wastes. |
| Watershed: | The land area from which surface runoff drains into a stream, channel, lake, reservoir, or other body of water; also called a drainage basin. |
| Waste Stream: | The flow of (waste) materials from generation, collection, and separation to disposal. |
| Wetlands: | Lands where water saturation is the dominant factor determining the nature of the soil development and the plant and animal communities (e.g., sloughs, estuaries, marshes). |