Academic Standards for Science and Technology and Engineering Education

April 2012
Elementary Standards
(Grades Pre-K – 3)

Pennsylvania Department of Education

ELEMENTARY STANDARDS
(GRADES Pre-K - 3)
Science and Technology and Engineering Education
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ELEMENTARY STANDARDS
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VIII. INTRODUCTION

Learning about science and technology is vitally important in today's increasingly complicated world. The rate of new discoveries and the development of increasingly sophisticated tools make science and technology rapidly changing subjects. As stated in Content Standard E of the National Science Education Standards, "the relationship between science and technology is so close that any presentation of science without developing an understanding of technology would portray an inaccurate picture of science."

In the near future, society will benefit from basic research discoveries that will lead to new tools, materials, and medical treatments. Learning about the world around us, by observing and experimenting, is the core of science and technology and is strongly reflected in Pennsylvania's Academic Standards for Science and Technology.

This document describes what students should know and be able to do in the following four standard categories:

- ◊ 3.1. Biological Sciences
- ◊ 3.2. Physical Sciences: Chemistry and Physics
- ◊ 3.3. Earth and Space Sciences
- ◊ 3.4. Technology and Engineering Education

These standards describe what students should know and be able to do at each grade level. In addition, these standards reflect the increasing complexity and sophistication that students are expected to achieve as they progress through school. Additionally, Science as Inquiry is logically embedded in the Science and Technology standards as inquiry is the process through which students develop a key understanding of sciences. Unifying Themes in the sciences capture the big ideas of science. Teachers shall expect that students know and apply the concepts and skills expressed at the preceding level. Consequently, previous learning is reinforced but not re-taught.

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To clarify the coding of the standards, an example of the numbering system follows:

- Biological Sciences (3.1) is a **standard category.**
  - Organisms and Cells (3.1.A) is an **organizing category** under Biological Sciences.
    - Common Characteristics of Life (3.1.A1) is a **strand** under Organisms and Cells.
      - **Standard statements** indicate grade level appropriate learning for which students should demonstrate proficiency. For example, "Describe the similarities and differences of physical characteristics in plants and animals" (3.1.**4**.A1) is a fourth grade standard statement.

1 Common Characteristics of Life	3.1.3.A1.	3.1.4.A1. Describe the similarities and differences of physical characteristics in plants and animals.	3.1.5.A1.	3.1.6.A1.	3.1.7.A1. Describe the similarities and differences of physical characteristics in diverse **organisms**.	3.1.8.A1.

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The following descriptors explain the intent of each standard category:

3.1. Biological Sciences	Biology of organisms and cells concerns living things, their appearance, different types of life, the scope of their similarities and differences, where they live and how they live. Living things are made of the same components as all other matter, involve the same kinds of transformations of energy and move using the same basic kinds of forces as described in chemistry and physics standards. Through the study of the diversity of life, students learn how life has evolved. This great variety of life forms continues to change even today as genetic instructions within cells are passed from generation to generation, yet the amazing integrity of most species remain.
3.2. Physical Sciences: Chemistry and Physics	Physics and chemistry involve the study of objects and their properties. Students examine changes to materials during mixing, freezing, heating and dissolving and then learn how to observe and measure results. In chemistry students study the relationships between properties and structure of matter. Laboratory investigations of chemical interactions provide a basis for students to understand atomic theory and their applications in business, agriculture and medicine. Physics deepens the understanding of the structure and properties of materials and includes atoms, waves, light, electricity, magnetism and the role of energy, forces and motion.
3.3. Earth and Space Sciences	The dynamics of earth science include the studies of forces of nature that build up and wear down the earth's surface. Dynamics include energy flow across the earth's surface and its role in weather and climate. Space science is concerned with the origin and evolution of the universe. The understanding of these concepts uses principles from physical sciences, geography and mathematics.
3.4. Technology and Engineering Education	Technology and Engineering Education is the use of accumulated knowledge to process resources to meet human needs and improve the quality of life. It includes developing, producing, using and assessing technologies. It is human innovation in action and involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities. Its goal is to provide technological literacy to all students, including all students who traditionally have not been served by technology and engineering programs.

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. The chart on the following page illustrates behaviors that reflect science as inquiry across grade bands.

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Pre-Kindergarten	Grades K-4	Grades 5-7	Grades 8-10	Grades 11-12
• Ask questions about objects, organisms, and events. • Participate in simple investigations to answer a question or to test a prediction. • Use the five senses and simple equipment to gather data.	• 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.	• 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.	• 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. • Explain the importance of accuracy and precision in making valid measurements.	• 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.
Content Area Strand 3.1.PK.A9 3.1.PK.B6 3.1.PK.C4 3.2.PK.A6 3.2.PK.B7 3.3.PK.A7 3.3.PK.B3	3.1.K.A9 3.1.1.A9 3.1.2.A9 3.1.3.A9 3.1.4.A9 3.1.K.B6 3.1.1.B6 3.1.2.B6 3.1.3.B6 3.1.4.A9 3.1.K.C4 3.1.1.C4 3.1.2.C4 3.1.3.C4 3.1.4.C4 3.2.K.A6 3.2.1.A6 3.2.2.A6 3.2.3.A6 3.2.4.A6 3.2.K.B7 3.2.1.B7 3.2.2.B7 3.2.3.B7 3.2.4.B7 3.3.K.A7 3.3.1.A7 3.3.2.A7 3.3.3.A7 3.3.4.A7 3.3.K.B3 3.3.1.B3 3.3.2.B3 3.3.3.B3 3.3.4.B3	3.1.6.A9. 3.1.7.A9. 3.1.6.B6. 3.1.7.B6. 3.1.6.C4. 3.1.7.C4. 3.2.6.A6. 3.2.7.A6. 3.2.6.B7. 3.2.7.B7. 3.3.6.A8. 3.3.7.A8. 3.3.6.D3. 3.3.7.D3.	3.1.8.A9. 3.1.B.A9. 3.1.C.A9. 3.1.P.A9. 3.1.12.A9. 3.1.8.B6. 3.1.B.B6. 3.1.C.B6. 3.1.P.B6. 3.1.12.B6. 3.1.8.C4. 3.1.B.C4. 3.1.C.C4. 3.1.P.C4. 3.1.12.C4. 3.2.8.A6. 3.2.B.A6. 3.2.C.A6. 3.2.P.A6. 3.2.12.A6. 3.2.8.B7. 3.2.B.B7. 3.2.C.B7. 3.2.P.B7. 3.2.12.B7. 3.3.8.A8. 3.3.B.A8. 3.3.C.A8. 3.3.P.A8. 3.3.12.A8. 3.3.8.D3. 3.3.B.D3. 3.3.C.D3. 3.3.P.D3. 3.3.12.D3.	

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	3.1.PK.A. GRADE Pre-K	3 1.K.A. GRADE K	3.1.1.A. GRADE 1	3.1.2.A. GRADE 2	3.1.3.A. GRADE 3
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:					
1 Common Characteristics of Life	3.1.PK.A1. Recognize the difference between living and non-living things.	3.1.K.A1. Identify the similarities and differences of living and non-living things.	3.1.1.A1. Categorize living and nonliving things by external characteristics.	Intentionally Blank	3.1.3.A1. Describe characteristics of living things that help to identify and classify them.
2 Energy Flow	3.1.PK.A2. Identify basic needs of plants (water and light) and animals (food, air, water).	Intentionally Blank	3.1.1.A2. Investigate the dependence of living things on the sun's energy, water, food/nutrients, air, living space, and shelter.	Intentionally Blank	3.1.3.A2. Describe the basic needs of living things and their dependence on light, food, air, water, and shelter.
3 Life Cycles	3.1.PK.A3. Recognize that plants and animals grow and change.	3.1.K.A3. Observe, compare, and describe stages of life cycles for plants and/or animals.	Intentionally Blank	3.1.2.A3. Identify similarities and differences in the **life cycles** of plants and animals.	3.1.3.A3. Identify differences in the life **cycles** of plants and animals.
4 Cell Cycles	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank
5 Form and Function	3.1.PK.A5. Name basic parts of living things.	3.1.K.A5. Observe and describe structures and behaviors of a variety of common animals.	3.1.1.A5. Identify and describe plant parts and their function.	3.1.2.A5. Explain how different parts of a plant work together to make the organism function.	3.1.3.A5. Identify the structures in plants that are responsible for food production, support, water transport, reproduction, growth, and protection.

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	3.1.PK.A. GRADE Pre-K	3 1.K.A. GRADE K	3.1.1.A. GRADE 1	3.1.2.A. GRADE 2	3.1.3.A. GRADE 3
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:					
6 Organization	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank
7 Molecular Basis of Life	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank
8 Unifying Themes	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank
9 Science as Inquiry	3.1.PK.A9. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.K.A9. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.1.A9. See Science as Inquiry in the Introduction for grade level indicators. (As indicated on page 8)	3.1.2.A9. See Science as Inquiry in the Introduction for grade level indicators. (As indicated on page 8)	3.1.3.A9. See Science as Inquiry in the Introduction for grade level indicators. (As indicated on page 8)

3.1. Biological Sciences					
3.1.B. Genetics					
	3.1.PK.B. GRADE Pre-K	**3.1.K.B. GRADE K**	**3.1.1.B. GRADE 1**	**3.1.2.B. GRADE 2**	**3.1.3.B. GRADE 3**
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:					
1 Heredity	3.1.PK.B1. Match offspring to their parents.	3.1.K.B1. Observe and describe how young animals resemble their parents and other animals of the same kind.	3.1.1.B1. Grow plants from seed and describe how they grow and change. Compare to adult plants.	Intentionally Blank	3.1.3.B1. Understand that plants and animals closely resemble their parents.
2 Reproduction	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank
3 Molecular Basis of Life	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank
4 Biotechnology	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank

3.1. Biological Sciences					
3.1.B. Genetics					
	3.1.PK.B. GRADE Pre-K	**3.1.K.B. GRADE K**	**3.1.1.B. GRADE 1**	**3.1.2.B. GRADE 2**	**3.1.3.B. GRADE 3**
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:					
5 Unifying Themes	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.1.3.B5. PATTERNS Identify characteristics that appear in both parents and offspring.
6 Science as Inquiry	3.1.PK.B6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.K. B6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.1.B6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.2.B6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.3.B6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)

3.1. Biological Sciences					
3.1.C. Evolution					
	3.1.PK.C. GRADE Pre-K	**3.1.K.C. GRADE K**	**3.1.1.C. GRADE 1**	**3.1.2.C. GRADE 2**	**3.1.3.C. GRADE 3**
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:					
1 Natural Selection	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.1.3.C1. Recognize that plants survive through adaptations, such as stem growth towards light and root growth downward in response to gravity. Recognize that many plants and animals can survive harsh environments because of seasonal behaviors (e.g. hibernation, migration, trees shedding leaves).
2 Adaptation	Intentionally Blank	3.1.K.C2. Describe changes animals and plants undergo throughout the seasons.	Intentionally Blank	3.1.2.C2. Explain that living things can only survive if their needs are being met.	3.1.3.C2. Describe animal characteristics that are necessary for survival.

3.1. Biological Sciences

3.1.C. Evolution

	3.1.PK.C. GRADE Pre-K	3.1.K.C. GRADE K	3.1.1.C. GRADE 1	3.1.2.C. GRADE 2	3.1.3.C. GRADE 3
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:					
3 Unifying Themes	3.1.PK.C3 CONSTANCY AND CHANGE Describe changes that occur in animals.	3.1.K.C3. CONSTANCY AND CHANGE Describe changes that occur as a result of climate.	3.1.1.C3. CONSTANCY AND CHANGE Describe changes that occur as a result of habitat.	3.1.2.C3. CONSTANCY AND CHANGE Describe some plants and animals that once lived on Earth, (e.g., dinosaurs) but cannot be found anymore. Compare them to now living things that resemble them in some way (e.g. lizards and birds).	3.1.3.C3. CONSTANCY AND CHANGE Recognize that fossils provide us with information about living things that inhabited the Earth long ago.
4 Science as Inquiry	3.1.PK.C4. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.K.C4. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.1.C4. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.2.C4. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.1.3.C4. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)

3.2. Physical Sciences: Chemistry and Physics					
3.2.A. Chemistry					
	3.2.PK.A. GRADE PK	**3.2.K.A. GRADE K**	**3.2.1.A. GRADE 1**	**3.2.2.A. GRADE 2**	**3.2.3.A. GRADE 3**
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:					
1 Properties of Matter	3.2.PK.A1. Sort and describe objects according to size, shape, color, and texture.	3.2.K.A1. Identify and classify objects by observable properties of matter. Compare different kinds of materials and discuss their uses.	3.2.1.A1. Observe and describe the properties of liquids and solids. Investigate what happens when solids are mixed with water and other liquids are mixed with water.	Intentionally Blank	3.2.3.A1. Differentiate between properties of objects such as size, shape, weight and properties of materials that make up the objects such as color, texture, and hardness. Differentiate between the three states of matter, classifying a substance as a solid, liquid, or gas.
2 Structure of Matter	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.2.3.A2. Recognize that all objects and materials in the world are made of matter.
3 Matter & Energy	3.2.PK.A3. Notice change in matter.	3.2.K.A3. Describe the way matter can change.	3.2.1.A3. Identify how heating, melting, cooling, etc., may cause changes in properties of materials.	3.2.2.A3. Demonstrate how heating and cooling may cause changes in the properties of materials.	3.2.3.A3. Demonstrate how heating and cooling may cause changes in the properties of materials including phase changes.

3.2. Physical Sciences: Chemistry and Physics					
3.2.A. Chemistry					
	3.2.PK.A. GRADE PK	**3.2.K.A. GRADE K**	**3.2.1.A. GRADE 1**	**3.2.2.A. GRADE 2**	**3.2.3.A. GRADE 3**
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:					
4 Reactions	Intentionally Blank	Intentionally Blank	3.2.1.A4. Observe and describe what happens when substances are heated or cooled. Distinguish between changes that are reversible (melting, freezing) and not reversible (e.g. baking a cake, burning fuel).	3.2.2.A4. Experiment and explain what happens when two or more substances are combined (e.g. mixing, dissolving, and separated (e.g. filtering, evaporation).	3.2.3.A4. Use basic reactions to demonstrate observable changes in properties of matter (e.g., burning, cooking).
5 Unifying Themes	3.2.PK.A5. CONSTANCY AND CHANGE Recognize that everything is made of matter.	3.2.K.A5. CONSTANCY AND CHANGE Recognize that everything is made of matter.	3.2.1.A5. CONSTANCY AND CHANGE Recognize that everything is made of matter.	3.2.2.A5. CONSTANCY AND CHANGE Recognize that everything is made of matter.	3.2.3.A5. CONSTANCY AND CHANGE Recognize that everything is made of matter.
6 Science as Inquiry	3.2.PK.A6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.2.K.A6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.2.1.A6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.2.2.A6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.2.3.A6. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)

3.2. Physical Sciences: Chemistry and Physics					
3.2.B. Physics					
	3.2.PK.B. GRADE Pre-K	**3.2.K.B. GRADE K**	**3.2.1.B. GRADE 1**	**3.2.2.B. GRADE 2**	**3.2.3.B. GRADE 3**
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:					
1 Force & Motion of Particles and Rigid Bodies	3.2.PK.B1. Explore and describe motion of toys and objects.	Intentionally Blank	3.2.1.B1. Demonstrate various types of motion. Observe and describe how pushes and pulls change the motion of objects.	Intentionally Blank	3.2.3.B1. Explain how movement can be described in many ways.

3.2. Physical Sciences: Chemistry and Physics					
3.2.B. Physics					
	3.2.PK.B. GRADE Pre-K	**3.2.K.B. GRADE K**	**3.2.1.B. GRADE 1**	**3.2.2.B. GRADE 2**	**3.2.3.B. GRADE 3**
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:					
2 Energy Storage and Transformations: Conservation Laws	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.2.2.B2. Explore and describe how different forms of energy cause changes. (e.g., sunlight, heat, wind)	3.2.3.B2. Explore energy's ability to cause motion or create change. Explore how energy can be found in moving objects, light, sound, and heat.
3 Heat/Heat Transfer	Intentionally Blank	3.2.K.B3. Describe how temperature can affect the body.	3.2.1.B3. Observe and record daily temperatures. Draw conclusions from daily temperature records as related to heating and cooling.	Intentionally Blank	3.2.3.B3. Explore temperature changes that result from the addition or removal of heat.

3.2. Physical Sciences: Chemistry and Physics					
3.2.B. Physics					
	3.2.PK.B. GRADE Pre-K	**3.2.K.B. GRADE K**	**3.2.1.B. GRADE 1**	**3.2.2.B. GRADE 2**	**3.2.3.B. GRADE 3**
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:					
4 Electrical and Magnetic Energy	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.2.3.B4. Identify and classify objects and materials that are conductors or insulators of electricity. Identify and classify objects and materials as magnetic or non-magnetic.
5 Nature of Waves (Sound and Light Energy)	3.2.PK.B5. Create and describe variations of sound.	Intentionally Blank	3.2.1.B5. Compare and contrast how light travels through different materials. Explore how mirrors and prisms can be used to redirect a light beam.	Intentionally Blank	3.2.3.B5. Recognize that light travels in a straight line until it strikes an object or travels from one material to another.
6 Unifying Themes	3.2.PK.B6. ENERGY Recognize that light from the sun is an important source of energy for living and nonliving systems and some source of energy is needed for all organisms to stay alive and grow.	3.2.K.B6. ENERGY Recognize that light from the sun is an important source of energy for living and nonliving systems and some source of energy is needed for all organisms to stay alive and grow.	3.2.1.B6. ENERGY Recognize that light from the sun is an important source of energy for living and nonliving systems and some source of energy is needed for all organisms to stay alive and grow.	3.2.2.B6. ENERGY Recognize that light from the sun is an important source of energy for living and nonliving systems and some source of energy is needed for all organisms to stay alive and grow.	3.2.3.B6. ENERGY Recognize that light from the sun is an important source of energy for living and nonliving systems and some source of energy is needed for all organisms to stay alive and grow.

3.2. Physical Sciences: Chemistry and Physics					
3.2.B. Physics					
	3.2.PK.B. GRADE Pre-K	**3.2.K.B. GRADE K**	**3.2.1.B. GRADE 1**	**3.2.2.B. GRADE 2**	**3.2.3.B. GRADE 3**
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:					
7 Science as Inquiry	3.2.PK.B7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.2.K.B7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.2.1.B7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.2.2.B7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.2.3.B7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)

3.3. Earth and Space Sciences					
3.3.A. Earth Structure, Processes and Cycles					
	3.3.PK.A. GRADE Pre-K	**3.3.K.A. GRADE K**	**3.3.1.A. GRADE 1**	**3.3.2.A. GRADE 2**	**3.3.3.A. GRADE 3**
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:					
1 Earth Features and the Processes that Change It	3.3.PK.A1. Sort different types of earth materials.	3.3.K.A1. Distinguish between three types of earth materials – rock, soil, and sand.	3.3.1.A1. Observe, describe, and sort earth materials. Compare the composition of different soils.	Intentionally Blank	3.3.3.A1. Explain and give examples of the ways in which **soil** is formed.
2 Earth's Resources/Materials	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.3.3.A2. Identify the physical properties of minerals and demonstrate how minerals can be tested for these different physical properties.
3 Earth's History	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank

3.3. Earth and Space Sciences					
3.3.A. Earth Structure, Processes and Cycles					
	3.3.PK.A. GRADE Pre-K	**3.3.K.A. GRADE K**	**3.3.1.A. GRADE 1**	**3.3.2.A. GRADE 2**	**3.3.3.A. GRADE 3**
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:					
4 Water	3.3.PK.A4. Identify a variety of uses for water.	3.3.K.A4. Identify sources of water for human consumption and use.	3.3.1.A4. Identify and describe types of fresh and salt-water bodies (ocean, rivers, lakes, ponds).	3.3.2.A4. Explore and describe that water exists in solid (ice) and liquid (water) form. Explain and illustrate evaporation and condensation.	3.3.3.A4. Connect the various forms of precipitation to the weather in a particular place and time.
5 Weather and Climate	3.3.PK.A5. Identify seasons that correspond with observable conditions. Identify how weather affects daily life.	3.3.K.A5. Record daily weather conditions using simple charts and graphs Identify seasonal changes in the environment. Distinguish between types of precipitation.	3.3.1.A5. Become familiar with weather instruments. Collect, describe, and record basic information about weather over time.	Intentionally Blank	3.3.3.A5. Explain how air temperature, moisture, wind speed and direction, and precipitation make up the weather in a particular place and time.
6 Unifying Themes	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank
7 Science as Inquiry	3.3.PK.A7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.3.K.A7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.3.1.A7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.3.2.A7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.3.3.A7. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)

3.3. Earth and Space Sciences

3.3.B. Origin and Evolution of the Universe

	3.3.PK.B. GRADE Pre-K	3.3.K.B. GRADE K	3.3.1.B. GRADE 1	3.3.2.B. GRADE 2	3.3.3.B. GRADE 3
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:					
1 Composition and Structure	3.3.PK.B1. Identify objects that can be found in the day or night sky.	Intentionally Blank	3.3.1.B1. Explain why shadows fall in different places at different times of the day.	3.3.2.B1. Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.	3.3.3.B1. Relate the rotation of the earth and day/night, to the apparent movement of the sun, moon, and stars across the sky. Describe the changes that occur in the observable shape of the moon over the course of a month.
2 Unifying Themes	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank
3 Science as Inquiry	3.3.PK.B3. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.3.K.B3. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.3.1.B3. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.3.2.B3. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)	3.3.3.B3. See *Science as Inquiry* in the Introduction for grade level indicators. (As indicated on page 8)

3.4. Technology and Engineering Education					
3.4.A. The Scope of Technology					
	3.4.PK.A. GRADE Pre-K	**3.4.K.A. GRADE K**	**3.4.1.A. GRADE 1**	**3.4.2.A. GRADE 2**	**3.4.3.A. GRADE 3**
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:					
1 Characteristics Of Technology	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.A1. Identify how the natural made world and the human made world are different.
2 Core Concepts of Technology	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.A2. Identify that some systems are found in nature while others are made by humans.

3.4. Technology and Engineering Education					
3.4.B. Technology and Society					
	3.4.PK.B. GRADE PK	**3.4.K.B. GRADE K**	**3.4.1.B. GRADE 1**	**3.4.2.B. GRADE 2**	**3.4.3.B. GRADE 3**
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:					
1 Effects of Technology	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.B1. Describe how using technology can be good or bad.
2 Technology and Environment	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.B2. Explain how materials are re-used or recycled.
3 Society and Development of Technology	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.B3. Identify and define products made to meet individual needs versus wants.
4 Technology and History	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.B4. Illustrate how people have made tools to provide food, clothing, and shelter.

3.4. Technology and Engineering Education					
3.4.C. Technology and Engineering Design					
	3.4.PK.C. GRADE PK	**3.4.K.C. GRADE K**	**3.4.1.C. GRADE 1**	**3.4.2.C. GRADE 2**	**3.4.3.C. GRADE 3**
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:					
1 Design Attributes	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.C1. Recognize **design** is a creative process and everyone can design solutions to problems.
2 Engineering Design	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.C2. Explain why the **design** process requires creativity and consideration of all ideas.
3 Research & Development, Invention & Innovation, Experimentation / Problem Solving and Troubleshooting	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.C3. Recognize that all products and **systems** are subject to failure; many products and systems can be fixed.

3.4. Technology and Engineering Education					
3.4.D. Abilities for a Technological World					
	3.4.PK.D. GRADE PK	**3.4.K.D. GRADE K**	**3.4.1.D. GRADE 1**	**3.4.2.D. GRADE 2**	**3.4.3.D. GRADE 3**
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:					
1 Applying the Design Process	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.D1. Identify people's needs and wants and define some problems that can be solved through the design process.
2 Using and Maintaining Technological Systems	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.D2. Observe, analyze and document how simple **systems** work.
3 Assessing Impact of Products and Systems	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.D3. Collect information about everyday products and systems by asking questions.

3.4. Technology and Engineering Education					
3.4.E. The Designed World					
	3.4.3PK.E. GRADE PK	**3.4.K.E. GRADE K**	**3.4.1.E. GRADE 1**	**3.4.2.E. GRADE2**	**3.4.3.E. GRADE 3**
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:					
1 Medical Technologies	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.E1. Identify the technologies that support and improve quality of life.
2 Agricultural and Related Biotechnologies	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.E2. Identify some processes used in agriculture that require different procedures, products, or systems.
3 Energy and Power Technologies	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.E3. Recognize that tools, machines, products, and systems use energy in order to do work.

3.4. Technology and Engineering Education					
3.4.E. The Designed World					
	3.4.3PK.E. GRADE PK	**3.4.K.E. GRADE K**	**3.4.1.E. GRADE 1**	**3.4.2.E. GRADE2**	**3.4.3.E. GRADE 3**
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:					
4 Information and Communication Technologies	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.E4. Recognize that information and communication technology is the transfer of messages among people and/or machines over distances through the use of technology.
5 Transportation Technologies	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.E5. Understand that transportation has many parts that work together to help people travel.
6 Manufacturing Technologies	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.E6. Explain how manufacturing systems design and produce products in quantity.

3.4. Technology and Engineering Education					
3.4.E. The Designed World					
	3.4.3PK.E. GRADE PK	**3.4.K.E. GRADE K**	**3.4.1.E. GRADE 1**	**3.4.2.E. GRADE2**	**3.4.3.E. GRADE 3**
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:					
7 Construction Technologies	Intentionally Blank	Intentionally Blank	Intentionally Blank	Intentionally Blank	3.4.3.E7. Recognize that people live, work, and go to school in buildings representing different types of structures.

IX. GLOSSARY

Adaptation: A characteristic of an organism that has been favored by natural selection and increases its fitness.

Anatomical: Relating to the structure of the body.

Angular Momentum: The resistance of an object to changes of rotation.

Asexual Reproduction: Offspring produced from only one parent.

Atmosphere: The gaseous mass or envelope surrounding a celestial body, especially the one surrounding the Earth, and retained by the celestial body's gravitational field.

Atoms: The smallest unit of an element that retains the chemical properties of that element.

Biochemistry: The study of the body's chemical reactions.

Biomacromolecules: Carbon-containing polymers in living systems commonly referred to as the molecules of life.

Biosphere: The parts of the land, sea, and atmosphere in which organisms are able to live.

Biotechnology: Any technique that uses living organisms, or parts or organisms to make or modify products, improve plants or animals, or to develop microorganisms for specific uses.

Carbon Cycle: A cycle by which carbon is exchanged between the biosphere, pe`dosphere, geosphere, hydrosphere and atmosphere of the Earth.

Cell Cycle: The process by which cells duplicate themselves.

Colligative Properties: Properties of solutions that depend on the number of particles in a given volume of solvent and not on the mass of the particles.

Compounds: A substance consisting of two or more different elements chemically bonded together in a fixed proportion by mass.

Conduction: The transfer of heat through solids.

Convection: Transfer of heat by moving the molecules of a gas and/or liquid.

Coulomb's Law: Electrical charges attract or repel one another with a force proportional to the product of their charges and inversely proportional to the square of their separation distance.

Current: The flow of electrons through a conductor.

Density: The ratio of its mass (m) to its volume (V), a measure of how tightly the matter within it is packed together.

Design: An iterative decision-making process that produces plans by which resources are converted into products or systems that meet human needs and wants or solve problems.

Digestion: How the body breaks down eaten food into molecules.

DNA: The fundamental substance of which genes are composed. Deoxyribonucleic acid (DNA) is a nucleic acid that contains the genetic instructions directing the biological development of all cellular forms of life, and many viruses.

Electricity: The flow of electrons through a conductor or the additional or loss of electrons from a material.

Electrochemical Reactions: Any process either caused or accompanied by the passage of an electric current and involving in most cases the transfer of electrons between two substances—one a solid and the other a liquid.

Electromagnetic Force: The force that charged objects exert on one another.

Electromagnetic Spectrum: Electromagnetic waves can exhibit a distribution of frequencies ranging below radio wave to light beyond the visible.

Electron Orbital Transitions: The probability distribution of an electron in an atom or molecule.

Elements: A type of atom that is distinguished by its atomic number; i.e., by the number of protons in its nucleus. The term is also used to refer to a pure chemical substance composed of atoms with the same number of protons.

Endothermic: A process or reaction that absorbs energy in the form of heat.

Engineering The profession of or work performed by an engineer. Engineering involves the knowledge of the mathematical and natural sciences (biological and physical) gained by study, experience, and practice that are applied with judgment and creativity to develop ways to utilize the materials and forces of nature for the benefit of mankind.

Engineering Design Process: The seven step process or method used by engineers to solve a problem. (See 3.4.4.C2.)

Enzymes: Protein that catalyzes chemical reactions in cells.

Equilibrium: A condition in which all acting influences are cancelled by others, resulting in a stable, balanced or unchanging system.

Evolution: The change in genetic composition of a population over successive generations leading to the formation of a new species.

Exothermic: A process or reaction that releases energy usually in the form of heat, but it can also release energy in form of light (e.g. explosions), sound or electricity (e.g., a battery).

Extinction: The cessation of existence of a species.

Families: A taxonomic rank; a way of classifying organisms into groups based on similarities.

Food Chain: A relationship of who eats whom.

Food Web: A complex relationship where most organisms are eaten by more than one type of consumer.

Forensics: The use of DNA for identification. Some examples of DNA use are to establish paternity in child support cases; establish the presence of a suspect at a crime scene, and identify accident victims.

Frequency: The number of repeated wave cycles per second.

Galaxy: A massive, gravitationally bound system consisting of stars, an interstellar medium of gas and dust and dark matter.

Gamete: A sex cell containing one set of chromosomes, sperm or egg.

Gene Expression: The process by which inheritable information from a gene, such as the DNA sequence, is made into a functional gene product, such as protein or RNA.

Gene Recombination: The process by which a strand of genetic material (usually DNA but can also be RNA) is broken and then joined to a different DNA molecule.

Genetic Engineering: The technology entailing all processes of altering the genetic material of a cell to make it capable of performing the desired functions, such as mass-producing substances like insulin.

Genetic(s): The study of inheritance.

Genotypic: Referring to the actual genetic composition of an organism.

Geochemical Cycles: The Earth is a containing essentially a fixed amount of each stable chemical atom or element. Each element can exist in several different chemical reservoirs in the solid earth, oceans, atmosphere and organisms.

Geologic Time: A chronologic schema to describe the timing and relationships between events that have occurred during the history of Earth.

Geology: The science and study of the solid matter that constitutes the Earth.

Gradualism: Evolution model stating that mutations and phenotypic changes leading to the formation of new species are gradual and explain the fossil record gaps as simply missing because fossils are hard to find.

Gravity: The fundamental force of attraction that all objects with mass have for each other.

Hydrogen Bonds: A special type of dipole-dipole force that exists between an electronegative atom and a hydrogen atom bonded to Nitrogen, Oxygen or Fluorine.

Hydrologic Cycle: Describes the continuous movement of water on, above and below the surface of the Earth.

Hydrosphere: The water on or surrounding the surface of the globe, including the water of the oceans and the water in the atmosphere.

Igneous: Rock produced under conditions involving intense heat, as rocks of volcanic origin or rocks crystallized from molten magma.

Inertia: The resistance an object has to a change in its state of motion.

Innovation: The introduction of something new or a new idea, method or device. An innovation can be clearly complex or seemingly simple. Innovation is the process of modifying an existing product, process, or system, or system to improve it.

Intermodalism: The use of more than one form of transportation.

Invention: Invention is the process of turning ideas and imagination into new products, processes, or systems.

Kinetic Molecular Theory: Explains the forces between molecules and the energy that they possess; explains macroscopic properties of gases, such as pressure, temperature or volume, by considering their molecular composition and motion.

Law of Superposition: A general law stating that in any sequence of sediments or rocks that has not been overturned, the youngest sediments or rocks are at the top of the sequence and the oldest are at the bottom.

Life Cycles: The lifetime of an organism from birth to death.

Lithosphere: The outer part of the Earth, consisting of the crust and upper mantle.

Lymphocytes: White blood cells.

Magnets: A material that attracts or repels the same material and attracts iron and steel.

Mass: How much matter there is in an object.

Meiosis A type of cell division consisting or two rounds of nuclear and cellular division.

Mendelian Patterns of Inheritance: Predicting the inheritance of offspring traits.

Metamorphic: Rock that was once one form of rock but has changed to another under the influence of heat, pressure or some other agent without passing through a liquid phase.

Meteorology: The interdisciplinary scientific study of the atmosphere that focuses on weather processes and forecasting.

Mitosis: Process by which one cell divides into two cells.

Mixtures: A substance that is not the same from one sample to the next, and a mixture can be separated into its parts; Two or more substances that are mixed together but not chemically joined.

Model: A visual, mathematical, or three-dimensional representation in detail of an object or design, often a different scale than the original. A model is often used to test ideas, make changes to a design, and to learn more about what would happen to a similar, real object.

Molar Mass: The mass of one mole of a substance, chemical element or chemical compound.

Mole: Avogadro's number of the constituent entities of that substance; Avogadro's number, approximately 6.02214×10^{23}, makes the weight of a mole in grams equal to the weight of an entity in daltons.

Molecular Biology: The study of how genes work.

Molecules: The smallest particle of a substance that retains the chemical and physical properties of the substance and is composed of two or more atoms; a group of like or different atoms held together by chemical forces.

Multicellular: An organism made up of a multiple cells.

Mutations: Permanent transmissible change in the genetic material.

Nanotechnology: Deals with materials and machines on an incredibly tiny scale -- less than one billionth of a meter. A nanometer (nm) is one-billionth of a meter, smaller than the wavelength of visible light and a hundred-thousandth the width of a human hair [source: Berkeley Lab]. Nanotechnology is an expected future manufacturing technology that will make most products lighter, stronger, cleaner, less expensive and more precise.

The arrangement of carbon molecules and the ability to roll atoms into carbon nano tubes can create products that are incredibly strong but lightweight.

Natural Selection: A process in nature in which organisms possessing certain genes that code for traits that make them better adjusted to an environment tend to survive, reproduce, increase in number or frequency, and therefore, are able to transmit and perpetuate these traits.

Neurons: Nerve cells.

Newton's Laws: Three laws that explain the motion of objects caused by forces.

Nuclear Processes: The splitting (fission) or merging together (fusion) of the nuclei of atom(s).

Nuclear Reactions: A process in which two nuclei or nuclear particles collide to produce products different from the initial particles.

Nucleic Acids: The bimolecular DNA and RNA.

Ohm's Law: Voltage is equal to the *current* times the *resistance*.

Organic Molecules: Molecules that use carbon as their chemical backbones.

Organisms: A living individual.

Period: The time in seconds for one wave cycle to occur.

Periodic Table: A tabular method of displaying the chemical elements; used to illustrate recurring trends in the properties of the elements. The layout of the table has been refined and extended over time, as new elements have been discovered and new theoretical models have been developed to explain chemical behavior.

Phenotypic: Referring to the observable expression of an organism's genes.

Photosynthesis: The process used by plants and others to use light energy to power chemical reaction converting carbon dioxide and water into sugars and starches.

Physiology: The study of the body's cells function.

Plate Tectonics: The branch of geology studying the folding and faulting of the earth's crust.

Polarity: Description of how equally bonding electrons are shared between atoms.

Protein Synthesis: The creation of proteins using DNA and RNA.

Prototype: A rudimentary working model of a product or information system, usually built for demonstration purposes or as part of the development process.

Punctuated Equilibrium: Evolution model stating that over long periods of time, mutations simply accumulate but do not cause any drastic phenotypic changes, followed by short periods where these mutations are suddenly expressed and new species formed. This would account for the lack of transitional fossils in many phylogenic branches.

Radiation: Transfer of heat through light.

Radioactive Decay: The process in which an unstable atomic nucleus loses energy by emitting radiation in the form of particles or electromagnetic waves.

Red Blood Cells: Blood cells that carry oxygen through the body.

Resistance: A material that cause a reduction in voltage between two points.

Rock Cycle: The process by which rocks are formed, altered, destroyed, and reformed by geological processes and which is recurrent, returning to a starting point.

Sedimentary: Rock that has formed through the deposition and solidification of sediment.

Seismic Events: The rupture of geological faults, huge amounts of gas migration, mainly methane deep within the earth, but also by volcanic activity, landslides, mine blasts and nuclear experiments.

Sexual Reproduction Reproduction by the union of a sperm and an egg.

Simple Harmonic Motion: A motion that repeats over identical time intervals.

Speciation: The evolutionary process by which new biological species arise.

Species: A group of organisms capable of interbreeding and producing fertile offspring.

Specific Heat: The measure of the heat energy required to increase the temperature of a unit quantity of a substance by a certain temperature interval.

STEM: Acronym for Science, Technology, Engineering and Math. Science, Technology, Engineering, and Mathematics, are collectively considered core technological underpinnings of an advanced society.

Stem Cells: Cells that can divide to different type of cells.

Strains: Groups sharing common ancestry with clear-cut physiological distinctions but usually not structural distinctions.

Subsystem: A set of elements, which is a system itself, and a part of a larger system.

System: A set of interacting or interdependent entities, real or abstract, forming an integrated whole. An open system usually interacts with some entities in their environment. A closed system is isolated from its environment.

Technology: Technology is how people modify the natural world to suit their own purposes... generally it refers to the diverse collection of processes and knowledge that people use to extend human abilities and to satisfy human needs and wants.

Technology Transfer: Technology transfer is the process of sharing of skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services

Telemedicine: The use of telecommunications and information technologies for the provision of health care at a distance.

Theory of Evolution: Theory that explains the process of change in the inherited traits of a population of organisms from one generation to the next. There are two major mechanisms driving evolution: natural selection and genetic drift.

Topography: The three-dimensional arrangement of physical attributes (such as shape, height, and depth) of a land surface in a place or region; physical features that make up the topography of an area include mountains, valleys, plains, and bodies of water; human-made features such as roads, railroads and landfills are also often considered part of a region's topography.

Torque: A force applied at right angles to an object’s center of rotation that cause rotation.

Unicellular: An organism made up of a single cell.

Velocity: The speed and direction of an object or wave.

Voltage: The difference of electrical potential between two points that cause current to flow.

VSEPR: A model which is used for predicting the shapes of individual molecules based upon their extent of electron-pair electrostatic repulsion.

Wavelength: The physical length of one cycle or period of a wave.