The Brandywine School District Vertical Learning Team sponsored by the Advanced Placement Incentive Program Grant

Grade Level Expectations aligned to the topics of the AP Physics Course, AP Chemistry Course, AP Biology Course, and AP Environmental Science Course

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I	P	C	B	E	(I) Inquiry (P) Physics (C) Chemistry (B) Biology (E) Environmental Science
					KIINDERGARTEN
X					Students should be able to generate questions and predictions using observations and exploration about the natural world. (1.1.1) **K.1.a**
X					Students should be able to generate and follow simple plans using systematic observations to explore questions and predictions. (1.1.2) **K.1.b**
X					Students should be able to collect data using observations, simple tools and equipment. Students should be able to record data in tables, charts, and bar graphs. Students should be able to compare data with others to examine and question results. (1.1.3) **K.1.c**
X					Students should be able to construct a simple explanation by analyzing observational data. Revise the explanation when given new evidence or information gained from other resources or from further investigation. (1.1.4) **K.1.d**
X					Students should be able to share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation. (1.1.5) **K.1.e**
X					Students should be able to use mathematics, reading, writing, and technology when conducting an investigation and communicating the results. (1.1.6) **K.1.f**
		X			**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** Students should be able to observe and describe the properties of a variety of non-living materials using the senses (i.e., sight, touch, smell, hearing). (2.1.1) (6.3.1) **K.2.a**
		X	X	X	**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL REACTIVITY** **PERIODIC TABLE** **CLASSIFICATION** **THE LITHOSPHERE** Students should be able to use the physical properties of non-living materials (e.g., texture, size, shape, color) to describe similarities and differences. (2.1.1) (2.1.3) **K.2.b**
		X	X		**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL REACTIVITY** **CHEMICAL BONDING** **PERIODIC TABLE** **CLASSIFICATION**

					Students should be able to sort, group, and regroup a variety of familiar non-living materials based on their physical properties (e.g., shape, color, texture, size). (2.1.1) **K.2.c**
X					Students should be able to use a hand lens (magnifier) to inspect a variety of non-living materials and demonstrate through discussion or drawings how the lens extends the sense of sight. (1.2.1) (2.1.1) (5.1.6) (5.3.1) **K.2.d**
		X			**ATOMIC STRUCTURE AND THEORY** Students should be able to construct simple class graphs (e.g., pictographs, physical graphs) to organize information. (1.1.4) **K.2.e**
		X			**ATOMIC THEORY AND STRUCTURE** Students should be able to interpret and describe the simple graphs constructed by the class. (1.1.4) (1.1.5) **K.2.f**
		X			**STOICHIOMETRY** Students should be able to use non-standard units of measure (e.g., string, paper clips) to compare the size and weight of non-living materials. (1.1.6) **K.2.g**
		X			**CHEMICAL BONDING** **GASES** **LIQUIDS AND SOLIDS** Students should be able to observe and describe changes in the physical properties of objects that occur when they are exposed to a variety of treatments (i.e., temperature, sunlight, water). (2.1.3) **K.2.h**
		X		X	**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **GLOBAL POLITICS AND ECONOMICS** Students should be able to observe how materials can be modified for different uses (e.g., paper and wood can be modified to have new properties). (1.2.2) (2.5.1) **K.2.i**
	X	X	X	X	**TEMPERATURE AND HEAT – KINDERGARTEN** **THERMODYNAMICS** **ECOLOGY** **ENERGY CONCEPTS - KINDERGARTEN** Students should be able to recognize that the Sun warms and lights the Earth. (3.1.1) **K.3.a**
	X		X	X	**NEWTON'S LAWS OF MOTION – KINDERGARTEN** **ECOLOGY** **THE ATMOSPHERE – KINDERGARTEN** Students should be able to recognize that air surrounds us and that moving air (wind) has energy that can make things move. (3.1.2) (3.2.2) **K.3.b**
		X	X	X	**THERMODYNAMICS** **LIQUIDS AND SOLIDS** **CHEMICAL REACTIVITY** **ECOLOGY** **ENERGY CONCEPTS** Students should be able to recognize that heat energy can come from the burning of wood. (3.2.4) **K.3.c**
	X	X			**KINEMATICS – KINDERGARTEN** **PERIODIC TABLE** Students should be able to demonstrate that the position of an object can be above or below,

					in front of or behind, or to the left or right of another object. (3.2.1) **K.3.d**
	X				**KINEMATICS – KINDERGARTEN** Students should be able to observe that objects move in different ways such as fast, slow, sideways, zigzag and swaying back and forth. (3.2.1) (3.2.2) **K.3.e**
	X			X	**NEWTON'S LAWS OF MOTION – KINDERGARTEN** **THE ATMOSPHERE** Students should be able to observe how the air makes the trees and other objects move. Students should be able to describe how a fast moving wind can make objects move more than a gentle breeze (i.e., trees swaying). (3.2.2) **K.3.f**
	X	X			**TEMPERATURE AND HEAT – KINDERGARTEN** **THERMODYNAMICS** Students should be able to using the sense of touch, recognize that objects placed in direct sunlight feel warmer than objects in the shade. (3.2.4) (3.3.1) (6.3.1) **K.3.g**
	X	X	X	X	**TEMPERATURE AND HEAT – KINDERGARTEN** **LIQUIDS AND SOLIDS** **CHEMICAL REACTIVITY** **ECOLOGY** **RENEWABLE ENERGY RESOURCES** **GLOBAL POLITICS AND ECONOMICS** Students should be able to recognize that some people use energy from wood to heat their homes (fireplace) and that this energy is renewable as people replant and grow more trees. (3.4.1) **K.3.h**
		X			**ATOMIC THEORY AND STRUCTURE** Students should be able to describe the shape of the Earth as being like a sphere and describe how a globe models this shape. (4.1.1) **K.4.a**
					Students should be able to name and identify objects that can be observed in the sky including the Sun, Moon, and stars and man-made objects such as airplanes. (4.1.2) **K.4.b**
		X			**PERIODIC TABLE** Students should be able to describe the repeating cyclic pattern of day and night and include in this description that we can see the Sun only during the daytime. (4.1.4) **K.4.c**
X					Students should be able to describe how binoculars help our sense of sight by allowing us to magnify objects in the sky. (4.4.1) **K.4.d**
		X		X	**LIQUIDS AND SOLIDS** **CHEMICAL REACTIVITY** **CHEMCIAL BONDING** **THE LITHOSPHERE** Students should be able to observe and describe the properties of a variety of earth materials (i.e., rock, soil, sand, water) using the senses. **K.5.a**
		X	X	X	**PERIODIC TABLE** **CLASSIFICATION** **THE LITHOSPHERE** Students should be able to sort, group, and regroup a variety of earth materials based on their physical properties (e.g., shape, color, texture, size, etc.) to describe their similarities and differences. **K.5.b**

				X	**THE LITHOSPHERE** Students should be able to use a hand lens (magnifier) to inspect a variety of earth materials and demonstrate through discussion or drawings how the lens extends the sense of sight. (1.2.1) (5.3.1) **K.5.c**
			X		**CLASSIFICATION** Students should be able to observe and describe the properties of a variety of living and non-living things using the five senses. (6.1.1) **K.6.a**
			X		**CLASSIFICATION** Students should be able to identify the five sense structures and tell which sense is associated with which structure. (6.3.1)**K.6.b**
		X	X		**GASES** **LIQUIDS AND SOLIDS** **CHEMCIAL BONDING** **PERIODIC TABLE** **CLASSIFICATION** Students should be able to use the physical properties of living and non-living things to describe their similarities and differences. (6.1.1) **K.6.c**
		X	X		**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **PERIODIC TABLE** **CLASSIFICATION** Students should be able to sort, group, and regroup a variety of familiar living and non-living things based on their physical properties (e.g., shape, color, texture, taste, size, etc.). (2.1.1) (6.1.1) (8.1.1) **K.6.d**
X					Students should be able to use a hand lens (magnifier) to inspect a variety of living things and demonstrate through discussion and drawings how the lens extends the sense of sight to see structures in greater detail. (6.4.1) **K.6.e**
		X	X		**STOICHIOMETRY** **CLASSIFICATION** Students should be able to use non-standard units of measure to compare the size and mass of structures of living things (e.g., string around trees, paper clips to measure length of leaves). (1.1.6) **K.6.f**
			X	X	**CELL STRUCTURE AND FUNCTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify structures on plants and animals and describe how the structure functions (e.g., trees have bark for protection and rabbits have fur to keep them warm). (6.1.2) (6.2.1) (6.2.2) **K.6.g**
			X	X	**ECOLOGY** **GROWTH AND DEVELOPMENT** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify the basic needs that plants and animals need to survive including light, air, water, and nutrients. (6.2.1) **K.6.h**
			X	X	**REGULATION** **GLOBAL POLITICS AND ECONOMICS** Students should be able to describe how the five senses help humans react to their

					environment, (e.g., hear a whistle and line up, feel cold air and put on a jacket). (6.3.1) **K.6.i**
			X	X	**ECOLOGY** **REGULATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe how the living things in an environment change with the seasons (e.g., trees lose their leaves in the winter). (6.4.3) **K.6.j**
X					Students should be able to describe how the senses can be protected when conducting scientific investigations, e.g. goggles protect eyes, and gloves protect hands. (6.4.2) **K.6.k**
			X		**GROWTH AND DEVELOPMENT** **MENDENIAN GENETICS** **REPRODUCTION** Students should be able to observe and describe similarities and differences between parents and offspring (e.g., roots on a mature tree vs. roots on a seedling). Students should be able to use a hand lens (magnifier) as an appropriate instrument for observing in closer detail. (6.4.1) (7.1.1) **K.7.a**
			X		**GROWTH AND DEVELOPMENT** Students should be able to construct, through the use of pictorials, the life cycle of a tree. Students should be able to describe the tree in different stages of its life cycle. (1.1.4) (7.1.3) **K.7.b**
			X		**MENDELIAN GENETICS** **REPRODUCTION** Students should be able to realize that organisms reproduce organisms of the same kind (e.g., dogs have puppies). (7.1.1) **K.7.c**
			X		**ECOLOGY** **EVOLUTION** **CLASSIFICATION** Students should be able to recognize that there are many different kinds of trees in the world. While there are many similarities and differences among the trees, they are all trees. (7.2.1) **K.7.d**
			X	X	**TECHNOLOGY AND SOCIETY** **ECOLOGY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to identify and list the many different ways in which trees are used by people to meet human wants and needs (i.e., food, shelter, shade, paper products, wood for fuel, furniture, etc.). (7.3.1) **K.7.e**
			X		**ECOLOGY** Students should be able to recognize that humans interact with the environment through the use of their five senses. (6.3.1) (8.1.1) **K.8.a**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify ways in which living organisms interact with each other and their environment (e.g., birds nest in trees, birds eat worms).n (8.1.1) (8.1.2) **K.8.b**
			X		**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that animals use plants in a variety of ways (e.g., shelter,

					food and protection). (8.2.1) **K.8.c**
			X	X	**CELLULAR ENERGY** **REGULATION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that sunlight is needed by plants for energy. (3.1.1) **K.8.d**
			X	X	**ECOLOGY** **AGRICULTURE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to recognize that trees are replanted in an attempt to replace those that are cut down. (8.3.1) **K.8.e**
					GRADE 1
X					Students should be able to generate questions and predictions using observations and exploration about the natural world. (1.1.1) **1.1.a**
X					Students should be able to generate and follow simple plans using systematic observations to explore questions and predictions. (1.1.2) **1.1.b**
X					Students should be able to collect data using observations, simple tools and equipment. Students should be able to record data in tables, charts, and bar graphs. Students should be able to compare data with others to examine and question results. (1.1.3) **1.1.c**
X					Students should be able to construct a simple explanation by analyzing observational data. Revise the explanation when given new evidence or information gained from other resources or from further investigation. (1.1.4) **1.1.d**
X					Students should be able to share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation. (1.1.5) **1.1.e**
X					Students should be able to use mathematics, reading, writing, and technology when conducting an investigation and communicating the results. (1.1.6) **1.1.f**
	X	X	X		**FLUID MECHANICS – 1ST GRADE** **LIQUIDS AND SOLIDS** **PERIODIC TABLE** **CHEMICAL BONDING** **CLASSIFICATION** Students should be able to conduct simple investigations to identify the physical properties (e.g., ability to sink or float, dissolve in water, roll or stack) of solids and liquids. Students should be able to record the results on charts, diagrams, graphs, and/or drawings. (1.1.1) (1.1.2) (1.1.5) (2.1.2) **1.2.a**
		X	X		**LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **PERIODIC TABLE** **CLASSIFICATION** Students should be able to sort and group solids based on physical properties such as color, shape, ability to roll or stack, hardness, magnetic attraction, or whether they sink or float in water. (1.1.3) (2.1.1) (3.2.5) **1.2.b**

		X			**LIQUIDS AND SOLIDS** **PERIODIC TABLE** **CHEMCIAL BONDING** Students should be able to compare and describe similarities and differences in physical properties of various solid objects. (2.1.1) **1.2.c**
		X	X	X	**LIQUIDS AND SOLIDS** **PERIODIC TABLE** **CHEMICAL BONDING** **CLASSIFICATION** **THE HYDROSPHERE** Students should be able to sort and group liquids based on physical properties such as color, odor, tendency to flow, and whether they sink, or float. (2.1.1) **1.2.d**
		X			**LIQUIDS AND SOLIDS** **CHEMICAL BONDING** Students should be able to compare and describe similarities and differences in physical properties of various liquids. (2.1.1) **1.2.e**
		X			**LIQUIDS AND SOLIDS** **CHEMCIAL BONDING** **CHEMICAL REACTIVITY** Students should be able to construct individual and class diagrams (e.g., Venn, pictographs) to compare the similarities and differences between the properties of solids and liquids. (1.1.5) (2.1.1) **1.2.f**
		X			**LIQUIDS AND SOLIDS** **THERMODYNAMICS** **CHEMICAL BONDING** Students should be able to observe and describe changes in the physical properties of solids and liquids after exposure to various treatments (i.e., temperature, sunlight, water). (2.1.3) **1.2.g**
		X			**LIQUIDS AND SOLIDS** Students should be able to use writing, drawing, and discussion to communicate observations, descriptions, investigations, and experiences concerning solids and liquids. (1.1.5) (1.1.6) (2.5.1) **1.2.h**
	X	X	X	X	**TEMPERATURE AND HEAT – 1ST GRADE** **THERMODYNAMICS** **ECOLOGY** **ENERGY CONCEPTS** Students should be able to identify the Sun as the source of energy that warms and lights the Earth. (3.1.1) **1.3.a**
	X	X	X	X	**FLUID MECHANICS – 1ST GRADE** **GASES** **LIQUIDS AND SOLIDS** **ECOLOGY** **ENERGY CONCEPTS** Students should be able to identify air and water as moving objects that have energy. (3.1.2) **1.3.b**
	X	X	X	X	**TEMPERATURE AND HEAT – 1ST GRADE** **THERMODYNAMICS**

					ECOLOGY **ENERGY CONCEPTS** Students should be able to observe that heat energy makes things warmer. (3.1.3) **1.3.c**
	X	X		X	**FLUID MECHANICS – 1ST GRADE** **GASES** **THE ATMOSPHERE** Students should be able to observe the evidence of the force of air pushing on objects and materials such as pinwheels and kites. Students should be able to compare how the direction and speed (fast, slow) of the moving air affects the motion of the objects. (3.2.1) (3.2.3) **1.3.d**
	X	X			**TEMPERATURE AND HEAT – 1ST GRADE** **THERMODYNAMICS** **EQUILIBRIUM** Students should be able to observe and measure the temperature of hot and cold water. Students should be able to investigate what happens when hot and cold water are mixed. Students should be able to record data on a graph and use the data to summarize the results. (1.1.3) (1.1.4) (3.2.4) **1.3.e**
	X	X	X	X	**TEMPERATURE AND HEAT – 1ST GRADE** **THERMODYNAMICS** **ECOLOGY** **ENERGY CONCEPTS** Students should be able to investigate what happens to the temperature of an object when it is placed in direct sunlight. Students should be able to record data and conclude that the energy in the sunlight was changed into heat energy in the object. (3.3.1) **1.3.f**
	X	X			**TEMPERATURE AND HEAT – 1ST GRADE** **THERMODYNAMICS** Students should be able to compare what happens when sunlight strikes dark and light colored objects. Students should be able to draw conclusions that dark colored objects feel warmer and increase more in temperature in sunlight than do light colored objects. (3.3.1) **1.3.g**
	X	X	X	X	**TEMPERATURE AND HEAT – 1ST GRADE** **THERMODYNAMICS** **ECOLOGY** **ENERGY CONCEPTS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to observe that sunlight can be used to heat the inside of homes and other buildings by allowing the sunlight to pass through windows. (1.2.1) (3.4.1) **1.3.h**
					Students should be able to list objects that can be observed in the sky in the daytime and objects that can be observed in the sky at nighttime. Students should be able to discuss which objects are on which lists (e.g., the Moon can be observed sometimes in the day and sometimes at night). (4.1.2) (4.1.5) (4.4.1) **1.4.a**
					Students should be able to safely observe the location of the Sun at the same time in the morning, noon, and afternoon over several days. Students should be able to describe the Sun's movement across the sky over the course of the day. (4.1.2) (4.1.3) (4.1.4) **1.4.b**
					Students should be able to observe the Moon in the day sky over several months. Students should be able to draw a sequence of pictures that shows the repeating cyclic pattern of the Moon. (4.1.6) **1.4.c**

					Students should be able to use simple models to demonstrate how Earth's rotation causes day and night. (4.1.4) **1.4.d**
		X	X	X	**GASES** **LIQUIDS AND SOLIDS** **ECOLOGY** **THE LITHOSPHERE** Students should be able to identify the earth materials (i.e., rocks, soil, water, air) found in aquatic and terrestrial environments. (5.1.1) **1.5.a**
		X	X	X	**GASES** **LIQUIDS AND SOLIDS** **ECOLOGY** **THE ATMOSPHERE** Students should be able to keep daily records of weather conditions (wind speed, type and amount of precipitation, cloud cover and type, temperature) and use these records to identify patterns over short and long periods of time. (1.1.4) (5.2.1) **1.5.b**
		X		X	**GASES** **THE ATMOSPHERE** Students should be able to demonstrate that there is air all around and that the wind is moving air. Students should be able to use instruments to qualitatively measure wind speed and describe this by using a simplified Beaufort scale. (5.2.2) **1.5.c**
		X		X	**THERMODYNAMICS** **GASES** **THE ATMOSPHERE** Students should be able to use a thermometer to measure temperature in degrees Fahrenheit. Students should be able to describe how hot or cold an object or weather event feels by using a thermometer. (1.1.6) (5.3.2) **1.5.d**
		X		X	**GASES** **LIQUIDS AND SOLIDS** **THE ATMOSPHERE** Students should be able to identify three basic cloud types (cirrus, cumulus, stratus) all of which are made of water and/or ice. Conclude that wind moves clouds in the sky. (5.2.4) **1.5.e**
		X		X	**LIQUIDS AND SOLIDS** **THE ATMOSPHERE** Students should be able to use a rain gauge to measure precipitation and describe how this measurement would change when frozen precipitation such as snow or ice melts. (1.1.6) (1.3.2) (5.2.3) (5.3.2) **1.5.f**
			X	X	**ECOLOGY** **THE ATMOSPHERE** Students should be able to organize weather data on graphs and on long-term data collection charts and use this data to describe typical seasonal weather patterns. (1.1.4) (5.2.1) (5.3.2) **1.5.g**
			X	X	**ECOLOGY** **THE ATMOSPHERE** Students should be able to describe different weather conditions and discuss how these conditions affect plants, animals, and human activity. (5.2.1) (5.2.2) **1.5.h**

				X	**THE ATMOSPHERE** Students should be able to select and use appropriate instruments such as wind scales, thermometers, cloud charts, and rain gauges to measure weather conditions. (1.1.3) (5.3.1) **1.5.i**
X					Students should be able to identify a meteorologist as a scientist who uses technology to study, observe, and record information about the weather and who uses this information to forecast the weather. Students should be able to use weather forecasts to make decisions such as choice of clothing or outdoor activities. (1.3.1) (5.3.2) **1.5.j**
				X	**ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to select the hand lens as an appropriate instrument for observing the structure of aquatic and terrestrial organisms in greater detail. (1.1.6) (6.4.1) (6.4.2) **1.6.a**
			X	X	**CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe individuals of the same plant or animal group. Students should be able to describe physical differences (e.g., size, color, shape, markings). (6.1.1) **1.6.b**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify and describe structures of plants and animals that help them survive in aquatic and terrestrial environments. (6.1.2) **1.6.c**
			X	X	**CLASSIFICATION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to sort and group plants and animals based on the structures that enable them to function in their environment (e.g., animals that have fins for swimming versus animals that have legs for movement on land). (7.2.1) **1.6.d**
			X	X	**CLASSIFICATION** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to compare and contrast the observable structures of humans to those of other animals and plants. Students should be able to record and communicate the similarities and differences in their structures. (6.1.2) **1.6.e**
			X	X	**ECOLOGY** **CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe a variety of plants and animals and identify basic needs that are common to plants or animals of the same group, such as food, water, air, shelter, space and light. (6.2.1) **1.6.f**
			X		**ECOLOGY** Students should be able to using the senses to detect environmental conditions, respond by selecting the appropriate clothing for certain weather conditions based on temperature, wind speed, cloud cover and/or precipitation. Justify the selection of clothing and activity. (5.2.2) (6.3.1) **1.6.g**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to design terrestrial and aquatic habitats that provide healthy environments for the plant and animal inhabitants. (1.1.2) (6.4.3) **1.6.h**

			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to propose changes to an aquatic or terrestrial habitat that increase the health of organisms (i.e., moisten the soil in a terrarium, add water to an aquarium). (6.4.3) **1.6.i**
			X	X	**EVOLUTION** **GROWTH AND DEVELOPMENT** **MENDELIAN GENETICS** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that organisms change over time. Students should be able to record and communicate changes observed in living things over time. (7.1.3) **1.7.a**
			X		**GROWTH AND DEVELOPMENT** Students should be able to construct, through the use of pictorials, the life cycle of guppies. Students should be able to describe the guppy in different stages of its life cycle. (1.1.4) (1.1.5) (7.1.3) **1.7.b**
			X	X	**GROWTH AND DEVELOPMENT** **MENDELIAN GENETICS** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe similarities and differences between parents and offspring, such as size and color. (7.1.1) (7.1.2) **1.7.c**
			X	X	**CLASSIFICATION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that there are many different kinds of plants and animals in the world. Sort terrestrial animals from aquatic animals. Students should be able to identify the characteristics used to separate the terrestrial from aquatic animals. (7.2.1) **1.7.d**
			X	X	**TECHNOLOGY AND SOCIETY** **EVOLUTION** **GLOBAL POLITICS AND ECONOMICS** Students should be able to recognize that some plants and animals are maintained in artificial environments to meet human wants and needs (i.e., scientific study, education, food). (7.3.1) **1.7.e**
			X	X	**ECOLOGY** **THE ATMOSPHERE** Students should be able to describe the impact weather conditions (e.g., sun, fog, rain, snow) have on plant and animal activities. (5.2.2) **1.8.a**
			X	X	**ECOLOGY** **CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify the number of different kinds of living things in an aquatic or terrestrial environment. Students should be able to recognize that living things coexist in these environments. (6.1.1) (8.1.1) **1.8.b**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe how aquatic plants and animals interact with each other and their environment (e.g., fish use plants for food and shelter). (6.2.1) (8.1.1) (8.1.2) (8.2.1)

					1.8.c
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe how terrestrial plants and animals interact with each other and their environment (e.g., millipedes eat decaying bark). (6.2.1) (6.4.3) (8.1.1) (8.2.1) **1.8.d**
			X	X	**ECOLOGY** **CELLULAR ENERGY** **ENERGY CONCEPTS** Students should be able to recognize that energy needed by all living things originates from the Sun. (3.1.1) **1.8.e**
			X	X	**ECOLOGY** **CELLULAR ENERGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify and give examples showing that animals eat plants or other animals for energy, and that plants get energy from the Sun. (8.2.1) **1.8.f**
					GRADE 2
X					Students should be able to generate questions and predictions using observations and exploration about the natural world. (1.1.1) **2.1.a**
X					Students should be able to generate and follow simple plans using systematic observations to explore questions and predictions. (1.1.2) **2.1.b**
X					Students should be able to collect data using observations, simple tools and equipment. Students should be able to record data in tables, charts, and bar graphs. Students should be able to compare data with others to examine and question results. (1.1.3) **2.1.c**
X					Students should be able to construct a simple explanation by analyzing observational data. Revise the explanation when given new evidence or information gained from other resources or from further investigation. (1.1.4) **2.1.d**
X					Students should be able to share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation. (1.1.5) **2.1.e**
X					Students should be able to use mathematics, reading, writing, and technology when conducting an investigation and communicating the results. (1.1.6) **2.1.f**
		X			**EQUILIBRIUM** **STOICHIOMETRY** Students should be able to use an equal arm balance to weigh and compare a variety of objects and recognize that weighing is the process of balancing an object against a certain number of standard units. (1.2.2) (2.1.1) **2.2.a**
X					Students should be able to predict the serial order for the weights of a variety of objects and test these predictions by weighing the objects. (1.1.3) (2.1.1) **2.2.b**
		X			**STOICHIOMETRY** **CHEMICAL BONDING** **PERIODIC TABLE** Students should be able to recognize that equal volumes of different materials may have

					different weights. (1.1.3) (2.1.1) **2.2.c**
	X	X			**WORK, ENERGY, AND POWER – 2ND GRADE** **KINETICS** Students should be able to identify that objects that move have energy because of their motion. Students should be able to demonstrate that a hanging mobile has energy because of its motion and the mobile was given this energy by the push of moving air. (3.1.2) **2.3.a**
	X				**NEWTON'S LAWS OF MOTION – 2ND GRADE** Students should be able to investigate how to change an object's movement by giving it a push or pull. Students should be able to demonstrate that the greater the force, the greater the change in motion of the object. Summarize this understanding through the use of visuals or writing. (1.1.3) (1.1.4) (1.1.5) (3.2.1) (3.2.2) **2.3.b**
	X				**NEWTON'S LAWS OF MOTION – 2ND GRADE** Students should be able to demonstrate that when the pushes and pulls acting on an object are balanced, the object will not move. Students should be able to investigate the conditions necessary for objects to balance. Students should be able to describe how the object was made to balance. (3.2.2) **2.3.c**
		X	X	X	**LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **ECOLOGY** **THE LITHOSPHERE** Students should be able to observe and identify basic components of soil. Students should be able to use the senses to observe and then describe the physical properties of soil components. (1.1.4) (5.1.3) **2.5.a**
		X	X	X	**LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **ECOLOGY** **THE LITHOSPHERE** Students should be able to conduct simple tests to identify the three basic components of soil (sand, clay, humus) and to compare and contrast the properties of each of the components. (1.1.3) (5.1.3) (5.1.5) **2.5.b**
		X	X	X	**LIQUIDS AND SOLIDS** **ECOLOGY** **THE LITHOSPHERE** Students should be able to interpret test results (touch and roll, smear, settling, ability to absorb and retain water) and draw conclusions about a soil's components. (5.1.3) (5.1.5) **2.5.c**
			X	X	**ECOLOGY** **THE LITHOSPHERE** **AGRICULTURE** Students should be able to record and organize the results of soil tests and explain these results through writing, drawing, and discussion. (1.1.4) (1.1.5) (5.1.3) (5.1.4) (5.1.5) **2.5.d**
			X	X	**ECOLOGY** **THE LITHOSPHERE** **AGRICULTURE** Students should be able to reflect on the test results and predict how plants will grow in different soil components. Students should be able to apply this knowledge to describe how the properties of each soil component contribute to an appropriate soil mixture in growing plants. (5.1.4) (6.2.2) **2.5.e**

			X	X	**ECOLOGY** **POLLUTION CONCEPTS** Students should be able to use worms to enhance decomposition of plant material in composting. Students should be able to explain how composting is an effective method to recycle plants and other discarded organic matter. (5.1.4) (6.4.3) (8.1.1) **2.5.f**
X					Students should be able to select and use appropriate instruments (e.g., hand lens/magnifier, droppers, funnels, filter paper, sieves) to analyze soil samples. (1.2.1) (1.2.2) (2.5.2) (5.1.1) (5.3.1) **2.5.g**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify and describe the structures of insects and various other organisms that enable them to function in their environment. (6.1.1) (6.1.2) **2.6.a**
			X	X	**GROWTH AND DEVELOPMENT** **CELL STRUCTURE AND FUNCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to compare and contrast the structures on different kinds of insects at different stages of development. (7.1.1) (7.1.2) (7.1.3) **2.6.b**
			X	X	**CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to given several pictures of adult organisms, identify and explain which organisms are insects and which are not. (6.1.1) (6.1.2) **2.6.c**
			X	X	**CLASSIFICATION** **CELL STRUCTURE AND FUNCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe common structures of different insects (e.g., mouth parts or legs). Students should be able to describe the similarities and differences among the structures. Students should be able to recognize that the structure is related to the function it performs (e.g., a caterpillar mouth for chomping leaves differs from a butterfly proboscis for obtaining nectar). (6.1.2) **2.6.d**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify the basic needs of all insects for survival. These include food, water, air, space, light, and shelter. Students should be able to recognize that insects also have specific needs according to their kind, (i.e., specific food such as nectar or mulberry leaves). (6.2.1) (6.2.2) **2.6.e**
			X	X	**ECOLOGY** **CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe a variety of plants and animals. Students should be able to compare specific needs that are common to plants or animals of the same group (i.e., all fish need water but some fish need cold water to live and some need warm water to live, all plants need water but some need a humid environment and some need a dry environment). (6.2.2) (6.4.3) **2.6.f**
			X		**ECOLOGY** Students should be able to conduct simple investigations to determine and describe how insects and various other organisms respond to different kinds of stimuli, (e.g., light versus

					dark environment). (1.1.3) (1.1.4) (6.3.2) **2.6.g**
			X	X	**ECOLOGY** **GROWTH AND DEVELOPMENT** **AGRICULTURE** Students should be able to investigate and evaluate how plant growth is affected by varying amounts of different soil components. (5.1.4) (6.2.2) **2.6.h**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to conduct simple investigations using artificial habitats to describe how the survival of insects is affected by the environment. (6.2.1) (6.2.2) (6.4.3) (8.1.1) (8.1.2) **2.6.i**
			X		**GROWTH AND DEVELOPMENT** Students should be able to observe the life cycle of a selected organism (e.g., plant, butterfly, frog, etc.) and recognize that the stages of the life cycle are predictable and describable. (7.1.3) **2.7.a**
			X		**GROWTH AND DEVELOPMENT** Students should be able to identify the stages in a life cycle of an organism that goes through complete metamorphosis (e.g., butterfly, mealworm). Students should be able to describe the similarities and differences in the structures and behaviors of the egg, larvae, pupae, and adult insect. (7.1.2) **2.7.b**
			X		**GROWTH AND DEVELOPMENT** Students should be able to identify the stages in the life cycle of an organism that goes through simple (incomplete) metamorphosis (e.g., grasshopper, cricket). Students should be able to describe the similarities and differences in the structures and behaviors of the egg, nymph, and adult insect. (7.1.1) **2.7.c**
			X		**CLASSIFICATION** Students should be able to recognize that there are many different kinds of animals in the world, of which insects are one grouping. Sort insects from animals that are not insects. Students should be able to identify the characteristics used to sort the insects (i.e., three body parts, six legs). (7.2.1) **2.7.d**
			X	X	**TECHNOLOGY AND SOCIETY** **ECOLOGY** **AGRICULTURE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to recognize that some insects are considered harmful to humans, plants, and other animals while other insects can be beneficial. Technology allows us to help control the harmful insects (i.e., control of mosquitoes, termites, ticks, etc.). (7.3.1) **2.7.e**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe the effects that result from plants, insects and other animals changing the environment in which they live (e.g., worms make tunnels in the earth, crickets eat the grass). (6.4.3) (8.1.1) **2.8.a**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe the plants and animals living in an environment. Students should be able to identify ways in which plants and animals benefit from each other (e.g.,

					animals use plants for food and shelter, and plants need insects to spread pollen). (8.1.1) **2.8.b**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe and describe the effects of plant and animal overcrowding in a given space (i.e., many guppies in an aquarium, many beetles in a habitat). Students should be able to recognize that this overcrowding results in an increased need for basic resources. (8.1.2) (8.2.1) **2.8.c**
			X	X	**TECHNOLOGY AND SOCIETY** **ECOLOGY** **POLLUTION CONCEPTS** Students should be able to investigate how natural composting recycles plants and other discarded organic matter. Students should be able to recognize the importance of this process to the environment. (8.3.1) **2.8.d**
					GRADE 3
X					Students should be able to generate questions and predictions using observations and exploration about the natural world. (1.1.1) **3.1.a**
X					Students should be able to generate and follow simple plans using systematic observations to explore questions and predictions. (1.1.2) **3.1.b**
X					Students should be able to collect data using observations, simple tools and equipment. Students should be able to record data in tables, charts, and bar graphs. Students should be able to compare data with others to examine and question results. (1.1.3) **3.1.c**
X					Students should be able to construct a simple explanation by analyzing observational data. Revise the explanation when given new evidence or information gained from other resources or from further investigation. (1.1.4) **3.1.d**
X					Students should be able to share simple plans, data, and explanations with an audience and justify the results using the evidence from the investigation. (1.1.5) **3.1.e**
X					Students should be able to use mathematics, reading, writing, and technology when conducting an investigation and communicating the results. (1.1.6) **3.1.f**
		X	X	X	**GASES** **LIQUIDS AND SOLIDS** **ECOLOGY** **THE HYDROSPHERE** Students should be able to explore evaporation and condensation. Students should be able to identify the changes of state from liquid to gas in evaporation and gas to liquid in condensation using water as an example. (2.1.2) **3.2.a**
		X			**GASES** **LIQUIDS AND SOLIDS** Students should be able to observe and describe changes in the properties of water as it changes from solid to liquid to gas. (2.1.2) **3.2.b**
		X		X	**THERMODYNAMICS** **ENERGY CONCEPTS**

					Students should be able to identify heat energy as the energy that makes things warmer. (3.1.3) **3.3.a**
	X			X	**ELECTRIC CIRCUITS – 3RD GRADE** **ENERGY CONCEPTS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to identify electrical energy as a form of energy that is used to operate many of our machines and tools. (3.1.4) **3.3.b**
	X	X		X	**TEMPERATURE AND HEAT – 3RD GRADE** **THERMODYNAMICS** **ENERGY CONCEPTS** Students should be able to determine the effect of adding heat energy (warming) or removing heat energy (cooling) on the properties of water as it changes state (gas to liquid to solid, and vice versa). (3.2.4) **3.3.c**
	X	X		X	**TEMPERATURE AND HEAT – 3RD GRADE** **THERMODYNAMICS** **ENERGY CONCEPTS** Students should be able to investigate and describe what happens when an object at a higher temperature is placed in direct contact with an object at a lower temperature. Students should be able to record data and use the data to describe which way the heat energy is moving between the objects. (1.1.3) (1.1.4) (3.2.4) **3.3.d**
	X	X			**WORK, ENERGY, AND POWER – 3RD GRADE** **KINETICS** **GASES** Students should be able to demonstrate that energy of motion can be transferred from one object to another (e.g., moving air transfers energy to make a pinwheel spin). Students should be able to give examples of energy transfer from one object to another. (3.1.2) (3.2.1) (3.2.2) **3.3.e**
	X				**WORK, ENERGY, AND POWER – 3RD GRADE** Students should be able to simulate how bones, muscles and joints in the human body work to transfer energy to objects, making them move. (3.2.1) (6.1.3) **3.3.f**
	X		X	X	**FLUID MECHANICS – 3RD GRADE** **ECOLOGY** **TECHNOLOGY AND SOCIETY** **RENEWABLE ENERGY RESOURCES** **GLOBAL POLITICS AND ECONOMICS** Students should be able to investigate and describe how moving water and air can be used to make objects and machines, such as a waterwheel and windmill, move. (3.4.1) **3.3.g**
		X		X	**PERIODIC TABLE** **THE LITHOSPHERE** Students should be able to examine rocks in order to observe their composition and describe the many components found in rocks. (5.1.6) **3.5.a**
		X		X	**CHEMICAL BONDING** **PERIODIC TABLE** **THE LITHOSPHERE** Students should be able to identify minerals as materials that cannot be physically broken apart any further and may be a rock component. (5.1.1) (5.1.6) **3.5.b**

		X	X		**PERIODIC TABLE** **CHEMCIAL BONDING** **CLASSIFICATION** Students should be able to sort and group an assortment of minerals based on similarities and differences in their physical properties. (5.1.6) **3.5.c**
		X		X	**PERIODIC TABLE** **CHEMICAL BONDING** **THE LITHOSPHERE** Students should be able to sort and group minerals based on the physical properties of hardness, color, luster, and reaction to vinegar (weak acid). Students should be able to use these properties to identify common minerals (quartz, fluorite, calcite, and gypsum). (5.1.6) **3.5.d**
		X			**LIQUIDS AND SOLIDS** **CHEMICAL REACTIVITY** **CHEMICAL BONDING** Students should be able to describe water in terms of its observable properties (transparency, shapelessness, flow). (5.1.2) **3.5.e**
		X		X	**LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **THE LITHOSPHERE** Students should be able to examine an assortment of rocks and use appropriate measuring tools (balances, meter tapes, syringes) to gather data about the rocks' physical properties (length, circumference, weight). (5.1.6) (5.3.1) **3.5.f**
				X	**THE LITHOSPHERE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to identify rocks and minerals as natural resources and list ways that humans use these resources to meet needs and wants (i.e., fluorite for toothpaste, marble for statues). (2.5.2) (5.3.1) **3.5.g**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to describe how bones, muscles, and joints function together in humans to enable movement, protection and support. (6.1.3) **3.6.a**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to identify the structures of different types of joints (gliding, hinged, ball and socket) and describe the movement enabled by each. Students should be able to recognize the importance of each type of joint to human movement. (6.1.3) **3.6.b**
			X	X	**CELL STRUCTURE AND FUNCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to compare and contrast the structure and function of the human skeleton to that of other vertebrate animals. (6.1.3) **3.6.c**
			X	X	**ECOLOGY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to explain that humans have basic needs for survival as do other animals. Students should be able to recognize that, like other animals, these basic needs may be specific, such as range of temperature and nutrients. (6.2.1) (6.2.2) **3.6.d**
			X		**REGULATION** **CELL STRUCTUTRE AND FUNCTION**

					BIOCHEMISTRY Students should be able to recognize that muscles move bones in response to signals from the brain. (6.3.2) **3.6.e**
			X		**GROWTH AND DEVELOPMENT** Students should be able to conduct simple investigations to determine and describe how different body parts respond to visual, auditory, and tactile stimuli. (1.1.3) (1.1.4) (6.3.1) **3.6.f**
			X		**GROWTH AND DEVELOPMENT** Students should be able to research and report on common diseases or problems of the muscular and skeletal systems. Students should be able to explain how these systems can be affected by external factors (i.e., bones can be broken and healed, good nutrition leads to strong bones). (1.1.4) (1.1.5) (6.4.1) **3.6.g**
			X		**GROWTH AND DEVELOPMENT** Students should be able to observe and describe similarities and differences in the skeleton of an infant to that of an adult human. Students should be able to recognize that as a human grows and develops the number of bones does not change but the sizes of the bones do change. (7.1.1) **3.7.a**
			X	X	**CLASSIFICATION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that there are many different kinds of vertebrates in the world. One way to sort or group vertebrates is according to the structure and function of their skeletons (i.e., bird wings and human arms). (7.2.1) **3.7.b**
			X		**TECHNOLOGY AND SOCIETY** Students should be able to recognize that technology extends the sense of sight for observing bones, muscles and joints in greater detail (i.e., X-Rays). (1.2.1) (1.2.2) **3.7.c**
			X	X	**ECOLOGY** **LAND AND WATER USE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to describe the changes to the environment that result from humans obtaining rock and mineral resources (e.g., strip mining). (8.1.1) (8.3.1) **3.8.a**
					GRADE 4
X					Students should be able to generate focused questions and informed predictions about the natural world. (1.1.1) **4.1.a**
X					Students should be able to design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested. (1.1.2) **4.1.b**
X					Students should be able to accurately collect data using observations, simple tools and equipment. Display and organize data in tables, charts, diagrams, and bar graphs or plots over time. Students should be able to compare and question results with and from others. (1.1.3) **4.1.c**
X					Students should be able to construct a reasonable explanation by analyzing evidence from the data. Revise the explanation after comparing results with other sources or after further investigation. (1.1.4) **4.1.d**

X					Students should be able to communicate procedures, data, and explanations to a variety of audiences. Justify the results by using evidence to form an argument. (1.1.5) **4.1.e**
X					Students should be able to use mathematics, reading, writing, and technology when conducting scientific inquiries (1.1.6) **4.1.f**
	X	X		X	**CONDUCTORS, CAPACITORS, AND DIELECTRICS - 4TH GRADE** **PERIODIC TABLE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to test objects for their conductivity and classify the objects based on whether they conduct electricity (conductors) or do not conduct electricity (insulators). (2.1.1) (3.2.7) **4.2.a**
	X				**MAGNETIC FIELDS - 4TH GRADE** Students should be able to test objects for their magnetism and classify objects based on whether they are attracted to a magnet or not attracted to a magnet. (3.2.8) **4.2.b**
	X	X	X	X	**KINETIC THEORY AND THERMODYNAMICS - 4TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **ECOLOGY** **THE HYDROSPHERE** Students should be able to investigate evaporation and condensation. Students should be able to recognize the relationship between temperature and changes of state from liquid to gas in evaporation and gas to liquid in condensation using water as an example. (2.1.2) (3.1.5) (3.2.5) **4.2.c**
	X	X		X	**ATOMIC PHYSICS AND QUANTUM EFFECTS (light energy) - 4TH GRADE** **KINETIC THEORY AND THERMODYNAMICS (heat energy) - 4TH GRADE** **WAVE MOTION (sound energy) - 4TH GRADE** **ELECTRISTATICS (electrical energy) - 4TH GRADE** **WORK, ENERGY, AND POWER (energy of motion) - 4TH GRADE** **THERMODYNAMICS** **KINETICS** **ENERGY CONCEPTS** Students should be able to identify, as basic forms of energy; light, heat, sound, electrical, and energy of motion. (3.1.1) (3.1.4) (3.1.5) (3.1.6) **4.3.a**
	X				**ELECTRIC CIRCUITS - 4TH GRADE** Students should be able to identify the basic components (i.e., battery, wires, bulbs, switch) of an electric circuit and understand their function. Students should be able to draw an example circuit and label the important parts. Students should be able to relate that circuits must take the form of complete (closed) loops before electrical energy can pass. (3.2.6) **4.3.b**
	X				**ELECTRIC CIRCUITS - 4TH GRADE** Students should be able to use diagrams to illustrate ways that two light bulbs can be attached in simple series and in parallel to a battery to make a complete circuit. Students should be able to explain any differences that will result in the brightness of the bulbs, depending upon the way they are connected to the battery. (3.2.6) **4.3.c**
	X	X		X	**CONDUCTORS, CAPACITORS, AND DIELECTRICS - 4TH GRADE** **PERIODIC TABLE** **CHEMICAL BONDING** **GLOBAL POLITICS AND ECONOMICS**

					Students should be able to test objects for their conductivity and classify the materials based on whether they conduct electricity (conductors) or do not conduct electricity (insulators). Choose which materials would be used to construct a circuit and justify your choices. (3.2.7) **4.3.d**
	X				**ELECTRIC CIRCUITS - 4TH GRADE** Students should be able to demonstrate, through writing and drawing, a variety of ways to construct open, closed, simple parallel and series circuits. Students should be able to list the advantages and/or disadvantages of series and parallel circuits. (3.2.6) **4.3.e**
	X				**ELECTRIC CIRCUITS - 4TH GRADE** Students should be able to use knowledge of electric circuits to explain how a wall switch can be used to "turn on" and "turn off a ceiling lamp. (3.2.6) (3.3.3) **4.3.f**
	X				**ELECTRIC CIRCUITS - 4TH GRADE** Students should be able to observe diagrams or pictures of a variety of circuits and demonstrate how the switch can be used to open or close the circuit. (3.2.6) **4.3.g**
	X				**MAGNETIC FIELDS - 4TH GRADE** Students should be able to recognize magnetism as a force that attracts or repels a variety of common materials and identify the physical property of materials that makes them attracted to magnets. (3.2.8) **4.3.h**
	X		X	X	**CONDUCTORS, CAPACITORS, AND DIELECTRICS - 4TH GRADE** **ECOLOGY** **ENERGY CONCEPTS** Students should be able to observe that electricity can be transformed into heat, light, and sound as well as the energy of motion. Students should be able to explain that electrical circuits provide a means of transferring electrical energy from sources such as batteries to devices where it is transformed into heat, light, sound, and the energy of motion. (3.3.3) **4.3.i**
	X			X	**CONDUCTORS, CAPACITORS, AND DIELECTRICS - 4TH GRADE** **ENERGY CONCEPTS** Students should be able to explain where the electrical energy available at an electric outlet in your home or school comes from. (3.4.1) **4.3.j**
	X		X	X	**ELECTRIC CIRCUITS - 4TH GRADE** **ECOLOGY** **TECHNOLOGY AND SOCIETY** **ENERGY CONCEPTS** **RENEWABLE ENERGY RESOURCES** Students should be able to use books, computers, and other resources, to search for ways that people use natural resources to supply energy needs for lighting, heating, and electricity. Report your results by making a poster, written report or oral presentation. (1.1.4) (1.1.5) (3.4.1) **4.3.k**
					Students should be able to observe and describe the path of the Sun at it appears to move across the sky from east to west during the course of a day. (4.1.1) **4.4.a**
					Students should be able to use models to describe how the Earth's rotation on its axis causes one half of the Earth to always be illuminated by the Sun (day) and one half to not be illuminated by the Sun (night). Students should be able to apply this model of the rotating Earth to explain why the Sun appears to move across the sky each day from east to west. (1.1.6) (4.1.1) (4.1.2) **4.4.b**

					Students should be able to using newspapers, the internet, and actual sky observations when possible, chart the appearance of the Moon in the night sky over the course of at least two months. Students should be able to identify the basic pattern of the Moon's appearance. Students should be able to classify the Moon's appearance by using the terms new, first quarter, full, last (third) quarter. (1.1.3) (4.1.3) **4.4.c**
					Students should be able to observe the size of the Sun and Moon in the sky. Students should be able to use models to illustrate the approximate size and distance relationship between the Sun and Moon. Students should be able to explain why the Sun and Moon appear to be similar in size when observed in the sky. (1.1.6) (4.1.4) **4.4.d**
					Students should be able to identify and order the major planets and describe how they all revolve around the Sun. (4.2.1) **4.4.e**
					Students should be able to research and develop a short report on one of the planets in the Solar System. Students should be able to compare the information learned in the reports. (1.1.5) (4.2.1) **4.4.f**
					Students should be able to describe our Sun as a star that is similar to other stars that are seen in the night sky. Students should be able to explain why our Sun appears to be larger in size than other stars. (4.2.1) **4.4.g**
					Students should be able to use photos gathered from robot probes, the Hubble telescope, and manned exploration of the Moon, to examine pictures of the planets and Moon. (1.2.1) (4.4.1) (4.4.2) **4.4.h**
		X	X	X	**LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **ECOLOGY** **THE LITHOSPHERE** Students should be able to examine materials that compose soil (i.e., sand, clay, humus, gravel, water) and describe these on the basis of their properties (i.e., color, luster, granularity, texture, mass relative to size, particle size, ability to absorb water, pore space, ability to compact). Students should be able to describe how certain soil properties affect the way in which soil is eroded and deposited by water. (5.1.2) **4.5.a**
		X	X	X	**GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **ECOLOGY** **THE HYDROSPHERE** Students should be able to create a model that can be used to describe how water moves from one place on Earth to another in a continuous cycle through the processes of evaporation, condensation, and precipitation. (1.1.6) (5.1.1) **4.5.b**
		X		X	**LIQUIDS AND SOLIDS** **THE HYDROSPHERE** Students should be able to use stream tables to observe the creation of landforms as water flows over and through the land. Students should be able to describe changes that result from the flowing of water, using correct geographic terminology (i.e., canyon, delta, tributary). Students should be able to describe changes to the water as it flows over land (i.e., color, transparency). (5.2.2) (5.2.3) (5.2.4) **4.5.c**
		X		X	**LIQUIDS AND SOLIDS** **THE LITHOSPHERE**

					Students should be able to describe how fast-moving water and slow-moving water over the land affect erosion and deposition. (5.1.3) (5.2.2) (5.2.4) **4.5.d**
		X		X	**LIQUIDS AND SOLDS** **LAND AND WATER USE** **THE LITHOSPHERE** Students should be able to use stream tables to model and describe the effects of slope. Students should be able to describe how the flow of water (fast or slow) is affected by the slope of the land, the amount and type of vegetation, and the landforms. (5.2.3) (5.2.4) **4.5.e**
			X	X	**ECOLOGY** **LAND AND WATER USE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to use stream tables to model the effect of human activity on erosion and deposition. Students should be able to describe how human activity (i.e., building a dam, clear cutting a forest, bulldozing a roadway) affects the amount of erosion and deposition and changes the environment. (5.2.3) (5.2.5) **4.5.f**
				X	**THE LITHOSPHERE** Students should be able to research and report on a specific landform created by the interaction of land and water (i.e., Cape Henlopen, Delaware Bay, Mississippi Delta, Appalachian Mountains). (5.2.1) (5.2.5) **4.5.g**
			X	X	**ECOLOGY** **THE ATMOSPHERE** Students should be able to keep daily records of weather conditions (wind speed and direction, type and amount of precipitation, cloud cover and type, temperature) and use these records to identify short term and seasonal patterns in Delaware. (5.2.6) (5.2.8) **4.5.h**
				X	**THE ATMOSPHERE** Students should be able to identify and describe different types of storm systems that occur in Delaware (i.e., tornadoes, hurricanes, thunderstorms, blizzards). From observed and gathered historical data, identify times of the year when these storms are most likely to occur. (1.1.4) (5.2.6) (5.2.7) **4.5.i**
				X	**THE ATMOSPHERE** Students should be able to using newspapers, computer internet sites, and other information resources, identify weather conditions in different parts of the world. Students should be able to compare this with the local weather in Delaware and discuss how weather conditions for a specific day may vary around the USA and world. (1.1.3) (5.2.8) **4.5.j**
				X	**LAND AND WATER USE** Students should be able to observe satellite photos showing change over time of landforms (i.e., Chesapeake Bay, Cape Henlopen, Delaware coastline) and predict future changes that may occur. Students should be able to describe how these predictions may affect human activities (i.e., locations for building). (1.2.1) (5.3.1) **4.5.k**
X					Students should be able to select and use a variety of appropriate instruments (i.e., graduated cylinders, stream tables, hand lens, ruler, balances) for collecting, recording, and analyzing data obtained from stream table investigations. Students should be able to communicate the results of stream table investigations through record sheets, oral and written observations, and drawings. (1.1.3) (1.1.5) (1.1.6) (1.2.1) (5.3.1) **4.5.l**
			X	X	**CELL STRUCTURE AND FUNCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY**

					Students should be able to compare and contrast structures that have similar functions in various organisms (e.g. eyes, ears, mouths). Students should be able to explain that the function of the structure is similar although the structures may have different physical appearances (e.g., compare eyes of an owl with the eyes of a crayfish). (6.1.1) **4.6.a**
			X	X	**CELL STRUCTURE AND FUNCTION** **GROWTH AND DEVELOPMENT** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe and identify structures of plants and describe the function of each structure. Students should be able to explain that most plants produce many seeds, most of which do not germinate and grow into new plants. (6.1.1) **4.6.b**
			X		**CLASSIFICATION** Students should be able to sort and group plants and animals according to similarities in structures or functions of structures. Students should be able to explain why the plants and animals have been grouped in this manner. (6.1.3) **4.6.c**
			X	X	**ECOLOGY** **CELLULAR ENERGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that plants need light energy from the sun to make food, while animals need to eat plants and/or other animals as their food. (6.2.1) (6.2.2) **4.6.d**
			X	X	**ECOLOGY** **REGULATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to select a living organism and develop descriptions of how the organism responds to a variety of stimuli (i.e., light/dark, warm temperature/cold temperature) based on multiple observations and data collection (e.g., crayfish and Bess Beetles). (6.3.1) **4.6.e**
			X	X	**ECOLOGY** **REGULATION** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain how individual organisms behave and use their structures to respond to internal and external cues such as hunger, drought, or temperature to improve their chances of survival. (6.3.2) **4.6.f**
			X	X	**ECOLOGY** **EVOLUTION** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to observe, record, and describe changes in the health or behavior of an organism as a result of changes in its environment. (6.4.2) **4.6.g**
			X		**MENDELIAN GENETICS** Students should be able to compare the similarities and differences of offspring to their parents (e.g., crayfish, bean sprouts). Know that offspring receive characteristics from both parents. (7.1.1) **4.7.a**
			X		**MENDELIAN GENETICS** Students should be able to recognize that some characteristics acquired by the parents are not inherited by the offspring (i.e., a lost claw does not mean offspring are born with only one claw). (7.1.2) **4.7.b**

			X		**GROWTH AND DEVELOPMENT** Students should be able to construct the life cycle of a bean plant through the use of diagrams. Students should be able to describe the plant in different stages of its life cycle from seed, to seedling, to mature plant, to death, and explain how the structures of the plant change over time. Students should be able to recognize that these stages of the life cycle are predictable and describable. (7.1.3) **4.7.c**
			X		**GROWTH AND DEVELOPMENT** Students should be able to research the life cycle of an organism. Diagram the life cycle of the organism and describe how the organism changes over time. Students should be able to compare the life cycle of this organism to the life cycle of various other organisms. Students should be able to recognize that all organisms go through a life cycle. (7.1.3) **4.7.d**
			X	X	**ECOLOGY** **CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe how similar structures found on different organisms (e.g., eyes, ears, mouths) have similar functions and enable those organisms to survive and reproduce in different environments (e.g., eyes of owls versus eyes of crustaceans). **4.7.e**
			X		**MENDELIAN GENETICS** Students should be able to recognize that there are variations among organisms of the same kind. Students should be able to observe organisms of the same kind and describe how their physical appearances differ. **4.7.f**
			X	X	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **AGRICULTURE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to explore how plants are grown using hydroponics. Students should be able to identify the benefits of hydroponic agriculture in meeting human wants and needs. (7.3.1) **4.7.g**
			X		**TECHNOLOGY AND SOCIETY** Students should be able to observe seeded and seedless varieties of fruits (i.e., watermelon). Provide reasoning for why seedless fruits have been developed by scientists. (7.3.1) **4.7.h**
		X	X	X	**LIQUIDS AND SOLIDS** **ECOLOGY** **THE LITHOSPHERE** **AGRICULTURE** Students should be able to predict, investigate and describe how plants can affect water flow, run off and erosion. Students should be able to relate this knowledge to an ecosystem in Delaware (i.e., planting beach grass to stabilize dunes, planting grass on a slope to decrease soil erosion). (8.1.2) **4.8.a**
					GRADE 5
X					Students should be able to generate focused questions and informed predictions about the natural world. (1.1.1) **5.1.a**
X					Students should be able to design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested. (1.1.2) **5.1.b**
X					Students should be able to accurately collect data using observations, simple tools and

					equipment. Display and organize data in tables, charts, diagrams, and bar graphs or plots over time. Students should be able to compare and question results with and from others. (1.1.3) **5.1.c**
X					Students should be able to construct a reasonable explanation by analyzing evidence from the data. Revise the explanation after comparing results with other sources or after further investigation. (1.1.4) **5.1.d**
X					Students should be able to communicate procedures, data, and explanations to a variety of audiences. Justify the results by using evidence to form an argument. (1.1.5) **5.1.e**
X					Students should be able to use mathematics, reading, writing, and technology when conducting scientific inquiries (1.1.6) **5.1.f**
		X			**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **SOLUTIONS** Students should be able to separate the components of a mixture by using the physical properties of the components and choosing the appropriate processes (e.g., evaporation, filtering). (1.1.2) (1.1.3) (1.2.1) (2.1.1) (2.2.3) (2.2.4) **5.2.a**
		X			**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **SOLUTIONS** Students should be able to make and implement a plan to separate mixtures. Revise the plan based on evidence collected. Students should be able to record and communicate the results. (1.1.2) (1.1.3) (1.1.4) (1.1.5) (2.1.1) (2.2.1) **5.2.b**
		X			**LIQUIDS AND SOLIDS** **SOLUTIONS** Students should be able to combine different amounts of solid material and water. Students should be able to compare the properties of these solutions (i.e., color, viscosity, clarity). (2.1.1) (2.2.1) **5.2.c**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **STOICHIOMETRY** Students should be able to compare the mass of mixtures and solutions to the mass of their component parts. (2.3.1) **5.2.d**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **STOICHIOMETRY** Students should be able to determine the quantities of two different materials (e.g., salt and sugar) required to saturate equal volumes of water and compare the results. Students should be able to recognize that some materials are more soluble in water than other materials. (1.1.3) (1.1.4) (1.1.6) (2.2.2) **5.2.e**
		X			**STOICHIOMETRY** Students should be able to explain why the total amount of a material remains the same even when exposed to a variety of physical treatments (e.g., flattening or balling up clay, breaking

					apart a candy bar, pouring liquid into a tall, slender glass vs. a short, fat glass). (2.3.1) **5.2.f**
		X		X	**LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **POLLUTION CONCEPTS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to research and report on recycling of household materials (e.g., glass, newspaper, plastics) and how these materials are reused. (1.2.1) (1.3.1) (2.5.1) **5.2.g**
	X	X	X	X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 5TH GRADE** **TEMPERATURE AND HEAT – 5TH GRADE** **THERMODYNAMICS** **CELLULAR ENERGY** **CELL STRUCTURE AND FUNCTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify sunlight as the source of energy needed for plants to make their own food. (3.3.2) (6.2.1) **5.3.a**
	X		X		**ATOMIC PHYSICS AND QUANTUM EFFECTS – 5TH GRADE** **ECOLOGY** Students should be able to identify that sunlight has three major components; visible, infrared, and ultraviolet, and that the infrared and ultraviolet components cannot be detected by human eyes. (3.1.1) (3.3.1) **5.3.b**
	X			X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 5TH GRADE** **THE ATMOSPHERE** Students should be able to design and implement an investigation to show that white light coming from the sun consists of a variety of component waves that appear to have different colors to our eyes. Students should be able to record observations of the investigation and use evidence to communicate results. (1.1.2) (1.1.3) (1.1.4) (3.3.1) (3.3.2) **5.3.c**
	X		X	X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 5TH GRADE** **ECOLOGY** **TECHNOLOGY AND SOCIETY** **STRATOSPHERIC OZONE** Students should be able to distinguish ultraviolet from infrared light energy. Although each is invisible to the human eye without the use of technology, describe how the presence of each is detected (i.e., night vision goggles to see infrared energy, sunburn indicates ultraviolet). (1.2.1) (3.1.1) **5.3.d**
	X				**WAVE MOTION – 5TH GRADE** Students should be able to observe that sound is produced by vibrating objects and give examples of vibrating objects that produce sound. (3.1.4) **5.3.e**
	X				**WAVE MOTION – 5TH GRADE** Students should be able to observe that volume is a property of sound that determines how loud the sound is and be able to describe what part of the vibrating object's motion determines the sound it produces. (3.1.4) **5.3.f**
	X				**WAVE MOTION – 5TH GRADE** Students should be able to describe the relationship between the pitch of a sound and the physical properties of the sound source (i.e., length of vibrating object, frequency of vibrations, and tension of vibrating string). Students should be able to describe how the pitch of sound is different from the volume. (3.1.4) **5.3.g**

	X				**WAVE MOTION – 5TH GRADE** Students should be able to identify that sound energy needs a medium through which to travel. Students should be able to compare how effectively sound travels through solids, liquids, and air. Students should be able to demonstrate that vibrations in materials set up wavelike disturbances that spread away from the source. Students should be able to construct a method to direct sound from the source to the receiver. (1.1.2) (3.1.4) **5.3.h**
	X				**WORK, ENERGY, AND POWER – 5TH GRADE** Students should be able to identify that the energy of a moving object depends upon its speed. Students should be able to give examples of how an object's energy of motion increases when the object's speed increases. (3.1.2) (3.2.2) **5.3.i**
	X				**WORK, ENERGY, AND POWER – 5TH GRADE** Students should be able to describe how energy can be stored in an elastic object or material by stretching it. Students should be able to use diagrams to describe ways that the energy stored in a stretched object can be used to make objects move. (1.1.6) (3.1.3) **5.3.j**
	X				**KINEMATICS – 5TH GRADE** Students should be able to use rulers, meter sticks, tapes, and watches to measure the distance objects travel in a given period of time and how much time it takes for an object to travel a certain distance. Organize the measurements in tables, and construct graphs based on the measurements. Reach qualitative conclusions about the speeds of the objects (faster versus slower). (1.1.3) (1.1.4) (1.1.5) (3.2.2) **5.3.k**
	X				**NEWTON'S LAWS OF MOTION – 5TH GRADE** Students should be able to demonstrate and explain how forces of different sizes and directions can produce different kinds of changes in the motion of an object. (3.2.1) (3.2.3) (3.2.4) **5.3.l**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 5TH GRADE** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** Students should be able to explain how the flow of heat energy contributes to the melting and freezing processes. Students should be able to describe which way heat energy must flow for liquid water to boil. (2.1.2) (3.1.5) (3.2.5) **5.3.m**
	X		X	X	**GEOMETRIC OPTICS – 5TH GRADE** **ECOLOGY** **CELLULAR ENERGY** **GLOBAL WARMING** Students should be able to observe that light travels in a straight line away from its source until it strikes an object. Students should be able to observe that when light strikes an object, it can reflect off the object, transmit through the object, be absorbed within the object, or a combination of these phenomena. Students should be able to give examples of light being reflected, transmitted, and/or absorbed by objects. (3.3.1) **5.3.n**
	X				**GEOMETRIC OPTICS – 5TH GRADE** Students should be able to, using the physical properties of objects, make predictions about how light will behave when it strikes the object. Students should be able to categorize materials as transparent, translucent, absorbent or reflective based on how they interact with light. (3.3.1) **5.3.o**
	X	X	X	X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 5TH GRADE** **THERMODYNAMICS**

					ECOLOGY **TECHNOLOGY AND SOCIETY** **RENEWABLE ENERGY REURCES** Students should be able to recognize that solar energy, an inexhaustible source, is an alternative energy source to fossil fuels, an exhaustible source. Using books, computers and other resources, students should be able to search for ways that we can use sunlight to heat and light our homes, and generate electrical energy. Report your results by making a poster, a written report or an oral presentation. (1.3.1) (3.4.1) **5.3.p**
			X		**CELL STRUCTURE AND FUNCTION** **BIOCHEMISTRY** Students should be able to recognize that the digestive system has many parts that work together to perform a function in humans and many other animals. (6.1.2) **5.6.a**
			X		**CELL STRUCTURE AND FUNCTION** **BIOCHEMISTRY** Students should be able to describe how to promote healthy digestion and recognize some symptoms that indicate disturbances associated with the normal functioning of the digestive system (i.e., stomach ache, flatulence).(6.1.2) **5.6.b**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to identify, label the parts, and describe the basic functions of the human digestive tract including the mouth, esophagus, stomach, small intestine, large intestine (colon), rectum, and anus. (6.1.1) (6.1.2) **5.6.c**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to compare and contrast the human body digestive system with that of other animals e.g., earthworm, chicken, fish, crayfish, snail, cow. (6.1.1) (6.1.2) **5.6.d**
			X	X	**CELL STRUCTURE AND FUNCTION** **GROWTH AND DEVELOPMENT** **CELLULAR ENERGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain that all organisms require a form of energy to survive and that humans and other animals obtain energy and materials from food. (6.2.2) **5.6.e**
			X	X	**CELL STRUCTURE AND FUNCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify external structures (i.e., legs) and behaviors (i.e., walking) of organisms that enable them to survive in their particular ecosystem and describe how these structures enable the organisms to respond to internal (i.e., hunger) and external (i.e., temperature, danger) cues. (6.1.3) (6.3.2) (8.1.3) **5.6.f**
			X	X	**CELL STRUCTURE AND FUNCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to research the ways that a variety of organisms respond to internal (i.e., need for food and shelter) and external (i.e., presence of predators) cues. Students should be able to describe the similarities and differences among the organisms. (1.1.4) (6.3.2) **5.6.g**
X					Students should be able to identify safety equipment (e.g., goggles, gloves) and procedures (e.g., washing hands, wafting, not eating) used in classroom science investigations. Students should be able to explain how these promote healthy living and prevent injuries. (6.4.1) **5.6.h**
			X	X	**ECOLOGY**

					ENVIRONMENTAL IMPACTS AND HUMAN HEALTH Students should be able to identify and discuss how short-term and long-term alterations in the environment affect the health of organisms found in that ecosystem. (6.4.2) (8.1.3) (8.1.4) **5.6.i**
			X	X	**ECOLOGY** **GROWTH AND DEVELOPMENT** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify plants and animals in an ecosystem (i.e., beach, woodland, marsh, meadow). Students should be able to examine the life cycles of the plants and animals and identify factors in the ecosystem that are beneficial or harmful to the organisms at various stages in its life cycle (i.e., young fish are small which makes them able to hide in plants but this characteristic also makes them more vulnerable to predators). (7.1.3) (8.1.2) (8.1.4) **5.7.a**
			X	X	**CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that there are many different kinds of vertebrates and invertebrates in the world's ecosystem with a diverse variety of organisms in each group. (6.1.3) (7.2.1) **5.7.b**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to examine a variety of ecosystems such as marsh, pond, field, forest. Students should be able to compare how the organisms, the habitat, and the food chains are similar and different in these ecosystems. (1.1.3) (8.1.2) (8.1.5) (8.2.1) (8.2.2) (8.2.3) **5.8.a**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to differentiate between an organism's "habitat" (where an animal lives) and its "territory" (an area claimed as its own space). Students should be able to select an organism and describe its habitat and territory. (8.1.3) **5.8.b**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to predict and describe how a dramatic increase or decrease in the population size of a single species within an ecosystem affects the entire ecosystem. (8.1.4) **5.8.c**
			X	X	**ECOLOGY** **EVOLUTION** **GROWTH AND DEVELOPMENT** **REPRODUCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify environmental factors that affect the growth and reproduction of organisms in an ecosystem (e.g., temperature can affect germination and soil moisture). (8.1.3) (8.1.5) **5.8.d**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to conduct investigations to simulate terrestrial and aquatic ecosystems and their interdependence. Students should be able to demonstrate and describe how alteration of one part of the ecosystem (i.e., change in pH, over fertilization, addition of salt) may cause changes throughout the entire ecosystem. (1.1.3) (1.1.4) (8.1.2) (8.1.4) **5.8.e**

			X	X	**ECOLOGY** **CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to categorize the organisms within an ecosystem according to the function they serve as producers, consumers, or decomposers. Students should be able to explain why the organism was categorized this way (8.2.1) (8.2.2) (8.2.3) **5.8.f**
			X	X	**ECOLOGY** **CELL STRUCTURE AND FUNCTION** **CELLULAR ENERGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify the Sun as a source of energy that drives an ecosystem. Students should be able to describe the path of energy from the Sun to the producers then to the consumer in the food chain. Students should be able to recognize that an organism has dependent and independent relationships in an ecosystem. (8.2.1) **5.8.g**
			X	X	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to identify natural (i.e., wildfire, flood, drought) and man-made changes (forest clear cutting, input of pollutants, filling in of marshland) to an ecosystem. Students should be able to discuss how these changes affect the balance of an ecosystem. (8.1.1) (8.1.5) (8.3.1) **5.8.h**
			X	X	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to explain why moving organisms from their ecosystem to a new ecosystem may upset the balance of the new ecosystem, for example, by introduction of diseases or depletion of resources. (8.1.4) (8.3.1) (8.3.2) **5.8.i**
					GRADE 6
X					Students should be able to frame and refine questions that can be investigated scientifically, and generate testable hypotheses.(1.1.1) **6.1.a**
X					Students should be able to design and conduct investigations with controlled variables to test hypotheses. (1.1.2) **6.1.b**
X					Students should be able to accurately collect data through the selection and use of tools and techniques appropriate to the investigation. Students should be able to construct tables, diagrams and graphs, showing relationships between two variables, to display and facilitate analysis of data. Students should be able to compare and question results with and from other students.(1.1.3) **6.1.c**
X					Students should be able to form explanations based on accurate and logical analysis of evidence. Revise the explanation using alternative descriptions, predictions, models and knowledge from other sources as well as results of further investigation.(1.1.4) **6.1.d**
X					Students should be able to communicate scientific procedures, data, and explanations to enable the replication of results. Students should be able to use computer technology to assist in communicating these results. Critical review is important in the analysis of these results.

					(1.1.5) **6.1.e**
X					Students should be able to use mathematics, reading, writing, and technology in conducting scientific inquiries. (1.1.6) **6.1.f**
	X	X		X	**ATOMIC PHYSICS AND QUANTUM EFFECTS (light energy) – 6TH GRADE** **KINETIC THEORY AND THERMODYNAMICS (heat energy) – 6TH GRADE** **WAVE MOTION (sound energy) – 6TH GRADE** **ELECTRISTATICS (electrical energy) – 6TH GRADE** **WORK, ENERGY, AND POWER (energy of motion) – 6TH GRADE** **THERMODYNAMICS** **ENERGY CONCEPTS** Students should be able to list, as basic forms of energy, light, heat, sound, electrical, and energy of motion. (3.1.1) (3.1.2) (3.1.3) (3.1.4) (3.1.5) **6.3.a**
	X			X	**ELECTRIC CIRCUITS – 6TH GRADE** **ENERGY CONCEPTS** Students should be able to explain that electrical energy is a form of energy that is transferred through circuits to devices that are designed to make use of this form of energy (e.g., lamps, fans, computers, etc.). (3.1.5) **6.3.b**
	X				**ELECTRIC CIRCUITS – 6TH GRADE** Students should be able to describe the role of electrical charge in circuits by using a model of electrical circuits. (3.1.5) (3.2.8) **6.3.c**
	X			X	**ELECTRIC CIRCUITS – 6TH GRADE** **ENERGY CONCEPTS** Students should be able to relate that electrical energy carried by charges in a circuit is transferred to devices in the circuit and is usually changed into (transformed) different kinds of energy by these devices (e.g., light bulbs change electrical energy into light and heat energy, motors turn the electrical energy into energy of motion). Students should be able to trace the flow of energy from electrical energy to other forms of energy, such as light. Students should be able to express whether energy was transferred, transformed or both. (3.1.5) (3.2.8) (3.3.1) **6.3.d**
	X				**ELECTRIC CIRCUITS – 6TH GRADE** Students should be able to construct both series and parallel circuits to investigate and describe how multiple devices in series or parallel (bulbs, motors) perform (dim versus bright, fast versus slow). Students should be able to describe how the way the devices are connected affects the functioning (i.e., dim versus bright) of the device and relate this to how much electrical energy is received. (3.2.8) (3.3.1) **6.3.e**
	X				**KINEMATICS – 6TH GRADE** Students should be able to conduct investigations on a moving object and make measurements of time and distance traveled and determine the average speed of moving objects. (1.1.6) (3.1.2) **6.3.f**
	X				**KINEMATICS – 6TH GRADE** Students should be able to graph and interpret distance versus time graphs for constant speed. Students should be able to use the graphs to describe how the position of an object changes in a time interval. (1.1.6) (3.1.2) **6.3.g**
	X				**KINEMATICS – 6TH GRADE** Students should be able to describe how the speed of an object depends on the distance traveled and the travel time. Students should be able to explain how the motion of an object can be described by its position, speed, and direction of motion. (3.1.2) **6.3.h**

	X				**OSCILLATIONS AND GRAVITATION – 6TH GRADE** Students should be able to explain that the earth will pull on all objects with a force called gravity that is directed inward toward the center of the Earth. (3.1.2) (3.2.2) **6.3.i**
	X				**NEWTON'S LAWS OF MOTION – 6TH GRADE** Students should be able to give examples of moving objects and identify the forces that act on these objects. Students should be able to select examples where only one force acts on the object and examples where two or more forces act on the object. Students should be able to explain that unbalanced forces acting on an object will change its speed, direction of motion or both (3.2.1) (3.2.2) **6.3.j**
	X				**NEWTON'S LAWS OF MOTION – 6TH GRADE** Students should be able to conduct investigations to describe how the relative directions of forces simultaneously acting on an object (reinforce or cancel each other) will determine how strongly the combination of these forces influences the motion of the object. (3.2.1) (3.2.2) **6.3.k**
	X				**NEWTON'S LAWS OF MOTION – 6TH GRADE** Students should be able to conduct investigations and describe how a force can be directed to increase the speed of an object, decrease the speed of the object or change the direction in which the object moves. (3.1.2) (3.2.1) (3.2.2) **6.3.l**
	X				**NEWTON'S LAWS OF MOTION – 6TH GRADE** Students should be able to explain that an object that feels the effects of balanced forces may be at rest or may be moving in a straight line with a speed that does not change. (3.1.2) (3.2.1) **6.3.m**
	X				**WORK, ENERGY, AND POWER - 6TH GRADE** Students should be able to conduct investigations using simple machines to demonstrate how forces transfer energy. Students should be able to explain that simple machine may change the direction of an applied force (directional advantage) or the size of the force that is applied (mechanical advantage) but that the amount of energy transferred by the simple machine is equal to the amount of energy transferred to the simple machine. (3.2.2) **6.3.n**
	X				**WORK, ENERGY, AND POWER - 6TH GRADE** Students should be able to explain that the transfer of energy from one object to another is caused by the exertion of a force. Students should be able to use the size of the force and the distance over which the force acts to compare how much energy is transferred into a simple machine to how much energy is transferred out of a simple machine. (3.2.1) (3.2.2) (3.3.1) **6.3.o**
	X				**WORK, ENERGY, AND POWER - 6TH GRADE** Students should be able to design a device that relies on the directional and/or mechanical advantage of a simple machine to perform a task (e.g., lift a weight, move a heavy object). Students should be able to identify the forces and motions involved, the source of the energy used to complete the task, and how the energy is used by the simple machine. (3.1.2) (3.2.1) (3.2.2) (3.3.1) **6.3.p**
	X				**MAGNETIC FIELDS - 6TH GRADE** Students should be able to show how electrical energy carried by currents in wires can be used to create magnetic fields. Students should be able to demonstrate how these fields exert magnetic forces on permanent magnets. Students should be able to explain how these magnetic forces in electric motors are used to change the electrical energy into the energy of motion. (3.2.9) **6.3.q**

	X		X	X	**ELECTRIC CIRCUITS - 6TH GRADE** **ECOLOGY** **TECHNOLOGY AND SOCIETY** **ENERGY CONCEPTS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to compare the differences in power usage in different electrical devices/appliances. Students should be able to discuss which devices/appliances (i.e., washer, dryer, refrigerator, electric furnace) are manufactured to require less energy. Students should be able to select one device/appliance, research different brands and their energy usage, determine which would be the better buy, and report on the findings. (3.4.2) (3.4.3) **6.3.r**
				X	**THE LITHOSPHERE** Students should be able to use appropriate instruments and tools to identify the sedimentary rocks limestone, shale, and sandstone. Infer the environmental conditions in which these rocks formed. (1.1.3) (1.1.4) (5.1.3) (5.2.11) **6.5.a**
				X	**THE LITHOSPHERE** Students should be able to examine sedimentary rock formations. Students should be able to use relative dating and fossil evidence to correlate sedimentary rock sequences. Infer the succession of environmental events that occurred from one rock sequence to another (transgression or regression of the seas). Students should be able to use the correlated sedimentary rock sequences to support Earth's geologic time scale. (5.1.3) (5.2.11) **6.5.b**
		X		X	**LIQUIDS AND SOLIDS** **THE LITHOSPHERE** Students should be able to investigate and describe how factors such as abrasion, frost/ice wedging, temperature changes, and plant growth cause physical weathering of rocks. Infer the environment in which the sedimentary particles were formed based on the results of weathering. (5.1.3) (5.2.4) (5.2.11) **6.5.c**
				X	**THE LITHOSPHERE** Students should be able to investigate how weathered materials are transported (i.e., mass movement and wind, water, and ice processes) in the process of erosion. Students should be able to explain how erosion shapes rock particles. (5.1.3) **6.5.d**
				X	**THE LITHOSPHERE** Students should be able to describe the process by which eroded materials can form horizontal layers of sedimentary rock. (5.2.11) **6.5.e**
				X	**THE LITHOSPHERE** Students should be able to explain how sedimentary rocks are formed through the processes of weathering, erosion, and deposition. (5.2.11) **6.5.f**
				X	**THE LITHOSPHERE** Students should be able to cite three lines of evidence such as the fit of coastlines, the similarity of rock type and contiguousness of bedding areas, and similarity of fossilized remains that indicate that the continents were once a large land mass. (5.2.12) (7.2.1) **6.5.g**
			X	X	**CELL STRUCTURE AND FUNCTION** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to explain that human body systems are comprised of organs (e.g., the heart, the stomach, and the lungs) that perform specific functions within one or more systems. (6.1.2) (6.1.6) **6.6.a**

			X	X	**CELL STRUCTURE AND FUNCTION** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to label and describe the functions of the basic parts of the circulatory system including the heart, arteries, veins and capillaries. (6.1.6) **6.6.b**
			X	X	**CELL STRUCTURE AND FUNCTION** **REPRODUCTION** **POPULATION DYNAMICS** Students should be able to label and describe the functions of the basic parts of the male and female reproductive systems. (6.1.6) (7.1.1) **6.6.c**
			X	X	**CELL STRUCTURE AND FUNCTION** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to label and describe the functions of the basic parts of the respiratory system including the trachea, bronchi and lungs. (6.1.6) **6.6.d**
			X	X	**CELL STRUCTURE AND FUNCTION** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to label and describe the functions of the basic parts of the digestive tract including the mouth, esophagus, stomach, small intestine, liver, large intestine (colon), rectum and anus. (6.1.6) **6.6.e**
			X	X	**CELL STRUCTURE AND FUNCTION** **ENVIRONMENTAL IMPACTS ANDHUMAN HEALTH** Students should be able to express how the human circulatory, respiratory, and digestive systems work together to carry out life processes. (6.1.1) (6.3.1) **6.6.f**
			X	X	**CELL STRUCTURE AND FUNCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to trace how the circulatory, respiratory, and digestive systems interact to transport the food and oxygen required to provide energy for life processes. (6.2.3) (6.3.1) **6.6.g**
			X		**ECOLOGY** **REGULATION** Students should be able to conduct simple investigations (how the body reacts to exercise, changes in temperature, etc.) to determine how the systems in the human organism respond to various external stimuli to maintain stable internal conditions. (1.1.3) (6.3.1) **6.6.h**
			X	X	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **ENVIRONMENTAL IMPACTS ANDHUMAN HEALTH** Students should be able to use knowledge of human body systems to synthesize research data and make informed decisions regarding personal and public health. (6.4.2) **6.6.i**
			X	X	**GROWTH AND DEVELOPMENT** **ENVIRONMENTAL IMPACTS ANDHUMAN HEALTH** Students should be able to research and report on how body systems are affected by lifestyle choices such as diet or exercise (for example lack of exercise leads to cardiovascular disease). (6.4.1) (6.4.2) **6.6.j**
				X	**THE LITHOSPHERE** Students should be able to recognize that fossils indicate that many organisms that lived long ago are extinct. Students should be able to use index fossils to determine the relative age of rock sequences, and environmental conditions at the time of formation. Students should be

					able to recognize, through fossil evidence, that some species can be traced back in geologic time. (7.2.1) (7.2.4) **6.7.a**
					GRADE 7
X					Students should be able to frame and refine questions that can be investigated scientifically, and generate testable hypotheses. (1.1.1) **7.1.a**
X					Students should be able to design and conduct investigations with controlled variables to test hypotheses. (1.1.2) **7.1.b**
X					Students should be able to accurately collect data through the selection and use of tools and techniques appropriate to the investigation. Students should be able to construct tables, diagrams and graphs, showing relationships between two variables, to display and facilitate analysis of data. Students should be able to compare and question results with and from other students. (1.1.3) **7.1.c**
X					Students should be able to form explanations based on accurate and logical analysis of evidence. Revise the explanation using alternative descriptions, predictions, models and knowledge from other sources as well as results of further investigation. (1.1.4) **7.1.d**
X					Students should be able to communicate scientific procedures, data, and explanations to enable the replication of results. Students should be able to use computer technology to assist in communicating these results. Critical review is important in the analysis of these results. (1.1.5) **7.1.e**
X					Students should be able to use mathematics, reading, writing, and technology in conducting scientific inquiries. (1.1.6) **7.1.f**
		X			**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** Students should be able to recognize that all matter consists of particles and how the particles are arranged determines the physical state. Students should be able to use the particle model to describe solids, liquids, and gases in terms of the packing and motion of particles. (2.1.1) (2.1.2) **7.2.a**
		X			**LIQUIDS AND SOLIDS** **THERMODYNAMICS** Students should be able to measure and record the temperature of ice water as it is heated. Plot the graph of measurements taken and interpret the change of phase graph using the particle model, identifying the states of matter. (1.1.6) (2.1.2) (3.1.4) **7.2.b**
		X			**GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **KINETICS** Students should be able to analyze a standard change of phase graph of water. Using the particle model, identify where water is a solid, liquid or gas, is freezing/melting or evaporating/condensing. Students should be able to relate the states of matter to the changes (increase, decrease) of energy in the system. (1.2.1) (2.1.2) (2.1.5) (3.2.6) **7.2.c**
		X			**GASES** **LIQUIDS AND SOLIDS**

					Students should be able to make a model or drawing of particles of the same material in solid, liquid, and gas state. Students should be able to describe the arrangement, spacing and energy in each state. (2.1.1) (3.3.2) **7.2.d**
		X			**GASES** **LIQUIDS AND SOLIDS** **STOICHIOMETRY** **EQUILIBRIUM** **THERMODYNAMICS** **CHEMICAL REACTIVITY** **SOLUTIONS** Students should be able to distinguish between physical properties that are dependent upon mass (size, shape) and those physical properties such as boiling point, melting point, solubility, density, conduction of heat and pH of a substance or material that are not altered when the mass of the material is changed. (2.1.3) (2.1.4) **7.2.e**
		X			**LIQUIDS AND SOLIDS** Students should be able to calculate the density of various solid materials. Students should be able to use density to predict whether an object will sink or float in water. Students should be able to given the density of various solids and liquids, create a density column and explain the arrangement in terms of density. (1.1.2) (1.1.3) (1.1.6) **7.2.f**
		X			**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** Students should be able to use physical properties to distinguish and separate one substance or material from another. (1.1.2) (1.1.3) (1.2.2) (2.2.1) (2.2.2) **7.2.g**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** Students should be able to distinguish between homogeneous and heterogeneous mixtures. Using their physical properties, design and conduct an investigation to separate the components of a homogeneous or heterogeneous mixture. Students should be able to recognize that a homogeneous mixture is a solution. ((1.1.3) (1.1.5) (2.2.1) (2.2.2) **7.2.h**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** Students should be able to prepare solutions of different concentrations recognizing that the properties of the solution (color, density, boiling point) depend on the nature and concentration of the solute and solvent. (2.2.2) (2.2.3) **7.2.i**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** Students should be able to conduct investigations to determine the effect of temperature and surface area of the solute on the rate of solubility. Students should be able to describe the rate of solubility using the particle model. (1.1.3) (1.1.4) (2.2.3) **7.2.j**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **THERMODYNAMICS** Students should be able to conduct investigations to determine the effect of temperature on

					saturation point. Students should be able to construct a solubility curve based on data collected. Students should be able to describe solubility and saturation point using the particle model. (1.1.3) (1.1.4) (1.1.5) (2.2.4) (3.1.4) **7.2.k**
		X	X		**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **CELL STRUCTURE AND FUNCTION** **REGULATION** Students should be able to conduct investigations to demonstrate the process of diffusion. Students should be able to use the particle model to describe the movement of materials from an area of higher concentration to an area of lower concentration. **7.2.l**
		X		X	**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **STOICHIOMETRY** **BIOGEOCHEMICAL CYCLES** Students should be able to show that mass is conserved when adding a solute to a solvent (mass of solvent + mass of solute = total mass of solution). (2.3.1) **7.2.m**
				X	**GLOBAL POLITICS AND ECONOMICS** Students should be able to select a manufactured item and identify its component materials. Students should be able to explain how the physical properties of the materials contribute to the function of the item. (1.2.2) (2.5.1) **7.2.n**
				X	**POLLUTION CONCEPTS** **ENVIRONMENTAL IMPACTS ANDHUMAN HEALTH** **GLOBAL POLITICS AND ECONOMICS** Students should be able to discuss the social, economic, and/or environmental consequences of the production of new materials to meet human wants and needs. (1.2.2) (1.3.1) (2.5.2) **7.2.o**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 7TH GRADE** **THERMODYNAMICS** Students should be able to describe how heat energy when added to a substance, will increase its temperature or change its state. Students should be able to explain that as more heat energy is added to a substance, the particles' vibrations increase and the spacing between the particles increases, but the size of the particles stays the same. (3.2.6) **7.3.a**
			X	X	**ECOLOGY** **THE HYDROSPHERE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to create models that simulate the amount of salt, frozen, fresh, and potable water available on Earth's surface. Students should be able to compare total water supply on Earth to the amount of potable water available for human use. (5.1.1) **7.5.a**
			X	X	**ECOLOGY** **THE HYDROSPHERE** Students should be able to calculate the ratio/percent of water generally found in solid, liquid and gaseous form on or within the Earth's surface and use this ratio to compare the amounts of water stored in different states. (1.1.6) (5.1.1) **7.5.b**
			X	X	**ECOLOGY** **THE HYDROSPHERE**

					Students should be able to use diagrams of the hydrologic cycle to show and describe the circulation of water through the Earth's crust, oceans, and atmosphere. (5.2.1) **7.5.c**
		X	X	X	**GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **ECOLOGY** **THE HYDROSPHERE** Students should be able to use the particle model to describe solids, liquids, and gases in terms of the packing, motion of particles, and energy gain or loss. Students should be able to apply this to the processes of evaporation, condensation, and precipitation in the water cycle. Students should be able to explain how heat energy drives the water cycle. (2.1.1) (3.1.1) (5.2.1) **7.5.d**
			X	X	**ECOLOGY** **THE HYDROSPHERE** Students should be able to use models or diagrams to explain how water stored underground (groundwater and aquifers) and water stored above ground (lakes, rivers, air, etc.) interact to form a continuous cycle. (5.2.1) (5.2.2) **7.5.e**
		X	X	X	**SOLUTIONS** **ECOLOGY** **POLLUTION CONCEPTS** **THE HYDROSPHERE** Students should be able to investigate, through the use of models, how water acts as a solvent and as it passes through the water cycle it dissolves minerals, gases, and pollutants and carries them to surface water and ground water supplies. (2.2.2) (5.2.2) **7.5.f**
		X		X	**LIQUIDS AND SOLIDS** **THE LITHOSPHERE** Students should be able to conduct investigations and use the data to describe the extent to which the permeability and porosity of a soil sample affect the rate of water percolation. (5.1.3) (5.2.2) **7.5.g**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe the role of wetlands and streamside forests (riparian) in filtering water as it runs off into local streams, rivers, and bays or seeps into ground water. (2.2.1) (8.1.1) **7.5.h**
				X	**THE HYDROSPHERE** Students should be able to use topographic maps to locate Delaware watersheds and to identify the bodies of water into which they drain. Students should be able to analyze and describe the relationship between elevation of land and the flow rate of water in a watershed. (1.2.1) (5.2.3) (5.2.4) **7.5.i**
			X	X	**ECOLOGY** **BIOCHEMISTRY** **THE HYDROSPHERE** Students should be able to conduct tests including temperature, pH, salinity, dissolved oxygen, turbidity, nitrate, and phosphate to determine the potability of local water samples. (5.3.2) **7.5.j**
			X	X	**CELL STRUCTURE AND FUNCTION** **ECOLOGY**

					ECOSYSTEM STRUCTURE AND DIVERSITY Students should be able to identify macro-invertebrates in a local stream and apply this identification in determining the stream's ecological health. (6.4.3) (8.1.1) **7.5.k**
			X	**X**	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **THE HYDROSPHERE** Students should be able to explain the impact of human activities (e.g., building roads, fertilizing golf courses, etc.) on the quality of Delaware's waters. (1.3.1) (8.3.1) (8.3.3) **7.5.l**
			X	**X**	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **THE HYDROSPHERE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to research and report on the processes used by municipalities to ensure water taken from local reservoirs is safe to return to the environment. (5.3.2) (6.4.3) (8.3.1) **7.5.m**
			X	**X**	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **GLOBAL POLITICS AND ECONOMICS** **LOSS OF BIODIVERSITY** Students should be able to investigate and report on legislation such as the Clean Water Act and its impact on the quality of Delaware water. (1.2.2) (1.3.1) (8.3.3) **7.5.n**
			X	**X**	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **THE HYDROSPHERE** **GLOBAL POLITICS AND ECONOMICS** Students should be able to list ways in which human intervention can help maintain an adequate supply of fresh water for human consumption. Students should be able to apply knowledge and skills learned about water as a resource to study local sources of drinking water and devise a water quality stewardship plan. (1.3.1) (5.3.2) (8.3.3) **7.5.o**
			X		**CLASSIFICATION** Students should be able to identify and apply criteria for determining whether specimens or samples are living, dead, dormant or nonliving. (6.1.1) **7.6.a**
			X		**CLASSIFICATION** Students should be able to classify organisms based on shared characteristics into currently recognized kingdoms and justify their placement. Students should be able to give examples of organisms from each kingdom. (6.1.2) **7.6.b**
			X		**CELL STRUCTURE AND FUNCTION** **REGULATION** **ECOLOGY** Students should be able to explain that individual cells are able to carry out basic life functions that are similar in organisms; however, explain that in multi-cellular organisms, cells become specialized, interdependent upon one another, and unable to survive independently. (6.1.3) (6.1.4) **7.6.c**
			X		**CLASSIFICATION** **CELL STRUCTURE AND FUNCTION** Students should be able to describe the hierarchical organization of multi-cellular organisms. Students should be able to recognize that multi-celled organisms are organized as specialized

					cells within tissues that make up organs within organ systems, which work together to carry out life processes for the entire organism. (6.1.2) (6.1.3) **7.6.d**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to observe and sketch cells using microscopes and other appropriate tools. Students should be able to compare and contrast plant, animal, protist, and bacterial cells by noting the presence or absence of major organelles (i.e., cell membrane, cell wall, nucleus, chloroplasts, mitochondria and vacuoles) using the sketches and other resources. (1.1.3) (1.2.1) (6.1.5) **7.6.e**
			X		**CELL STRUCTURE AND FUNCTION** **TECHNOLOGY AND SOCIETY** Students should be able to research the sequence of events that led to the formation of the cell theory and correlate these events with technological advancements (e.g., hand lens, microscopes, and staining techniques). (1.1.6) (1.2.1) (1.3.1) (6.1.4) **7.6.f**
		X	X	X	**CHEMICAL BONDING** **REACTION TYPES** **THERMODYNAMICS** **CELL STRUCTURE AND FUNCTION** **CELLULAR ENERGY** **GROWTH AND DEVELOPMENT** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that the process of photosynthesis occurs in the chloroplasts of producers. Summarize the basic process in which energy from sunlight is used to make sugars from carbon dioxide and water (photosynthesis). Indicate that this food can be used immediately, stored for later use, or used by other organisms. (6.1.5) (6.2.2) (8.2.1) **7.6.g**
		X	X	X	**CHEMICAL BONDING** **REACTION TYPES** **THERMODYNAMICS** **CELL STRUCTURE AND FUNCTION** **CELLULAR ENERGY** **ECOLOGY** **GROWTH AND DEVELOPMENT** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that the process of cellular respiration in the mitochondria of both plants and animals releases energy from food. Indicate that this food provides the energy and materials for repair and growth of cells. Students should be able to explain the complementary nature between photosynthesis and cellular respiration. (6.2.1) (6.2.3) **7.6.h**
			X	X	**ECOLOGY** **REGULATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to research external conditions needed by a variety of organisms for survival such as temperature, turbidity, pH, salinity, and amount of dissolved oxygen, phosphates, and nitrates. Students should be able to predict how organisms may respond to changes in these external conditions based on research findings. (6.1.1) (6.3.1) (6.4.3) **7.6.i**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to use various indicators (pH, turbidity, nitrates, phosphates, salinity, and macro-invertebrate surveys) to establish the health and potential potability of local bodies

					of water. (5.3.2) (6.4.3) **7.6.j**
			X		**REPRODUCTION** **MENDELIAN GENETICS** Students should be able to recognize that reproduction is a process that occurs in all living systems and is essential to the continuation of the species. Students should be able to use models or diagrams to identify the structures of a flowering plant that produce eggs and sperm and explain that plants, as well as, animals can reproduce sexually. (7.1.1) (7.1.2) **7.7.a**
			X		**REPRODUCTION** **MENDELIAN GENETICS** Students should be able to given varied scenarios (including one or two parent reproduction, and having traits identical to or different than the parents), classify offspring as either sexually or asexually produced and justify your response. (7.1.2) (7.1.3) **7.7.b**
			X		**REPRODUCTION** **MENDELIAN GENETICS** **EVOLUTION** Students should be able to compare and contrast asexual and sexual reproduction in terms of potential variation and adaptation to a static or changing environment. Students should be able to relate advantages and/or disadvantages of each strategy. (7.1.3) **7.7.c**
			X		**REPRODUCTION** **MENDELIAN GENETICS** **CELL STRUCTURE AND FUNCTION** Students should be able to make a simple labeled drawing of human reproductive cells. Indicate that the sex cells (sperm and egg) each have half of the chromosomal number (23) as a fertilized egg (46). The fertilized egg has the same number of chromosomes as each of the body cells of the new organism. Students should be able to recognize that different organisms may have different numbers of chromosomes and that the number of chromosomes does not relate to the complexity of the organism. (7.1.6) (7.1.7) (7.1.8) **7.7.d**
			X		**REPRODUCTION** **MENDELIAN GENETICS** **MOLECULAR GENETICS** Students should be able to make a simple labeled drawing of asexual reproduction as it occurs in sexually produced organisms at the cellular level. Indicate that resulting cells contain an identical copy of genetic information from the parent cell. (7.1.4) **7.7.e**
			X		**MENDELIAN GENETICS** **MOLECULAR GENETICS** Students should be able to describe the relationship between genes, chromosomes, and DNA in terms of location and relative size. (7.1.6) (7.1.9) **7.7.f**
			X		**MENDELIAN GENETICS** **MOLECULAR GENETICS** Students should be able to explain how the sex chromosomes inherited from each parent determines the gender of the offspring. (7.1.8) **7.7.g**
			X		**MENDELIAN GENETICS** Students should be able to model a random process (e.g., coin toss) that illustrates which alleles can be passed from parent to offspring. (7.1.9) **7.7.h**
			X		**MENDELIAN GENETICS** Students should be able to use single trait Punnett squares to examine the genotypes of

					individuals and indicate which individuals will express dominant or recessive traits. Justify the indication by relating that dominant alleles appearing heterozygously or homozygously are expressed or that two recessive alleles (homozygous) are required for an offspring to express a recessive trait phenotypically. (1.1.4) (1.1.5)(7.1.10) (7.1.11) (7.3.2) **7.7.i**
			X		**MENDELIAN GENETICS** Students should be able to use pedigrees to illustrate the heritability of dominant and recessive alleles over several generations. (7.3.1) **7.7.j**
			X		**MENDELIAN GENETICS** Students should be able to research and report on the contributions of Gregor Mendel and other genetic researchers and how their contributions altered the body of scientific knowledge. (1.3.1) (7.1.10) **7.7.k**
			X		**MENDELIAN GENETICS** Students should be able to explain through the use of models or diagrams, why sexually-produced offspring are not identical to their parents. (7.2.3) **7.7.l**
			X		**CLASSIFICATION** Students should be able to identify "kingdom" as the first main level of the standard classification system. Students should be able to observe a variety of living organisms and determine into which kingdom they would be classified. (7.2.5) **7.7.m**
			X	X	**MOLECULAR GENETICS** **TECHNOLOGY AND SOCIETY** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** **GLOBAL POLITICS AND ECONOMICS** Students should be able to research and report on selective breeding. Students should be able to select an organism (e.g., race horses, pedigree dogs, drought resistant plants) and trace its history of development and the traits of the plant or animal that were enhanced by selective breeding. (7.3.1) **7.7.n**
			X		**MENDELIAN GENETICS** **TECHNOLOGY AND SOCIETY** Students should be able to recognize that the health profession uses pedigree charts to trace genetic disorders in past generations make predictions for future generations. Students should be able to research and report on a chromosomal disorder. Complete a simulated pedigree for a fictional family based on your research. (7.3.2) **7.7.o**
			X	X	**ECOLOGY** **POLLUTION CONCEPTS** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** **GLOBAL POLITICS AND ECONOMICS** Students should be able to explain how sanitation measures such as sewers, landfills, and water treatment are important in controlling the spread of organisms that contaminate water and cause disease. (8.3.3) **7.8.a**
					GRADE 8
X					Students should be able to frame and refine questions that can be investigated scientifically, and generate testable hypotheses. (1.1.1) **8.1.a**
X					Students should be able to design and conduct investigations with controlled variables to test hypotheses. (1.1.2) **8.1.b**

X					Students should be able to accurately collect data through the selection and use of tools and techniques appropriate to the investigation. Students should be able to construct tables, diagrams and graphs, showing relationships between two variables, to display and facilitate analysis of data. Students should be able to compare and question results with and from other students. (1.1.3) **8.1.c**
X					Students should be able to form explanations based on accurate and logical analysis of evidence. Revise the explanation using alternative descriptions, predictions, models and knowledge from other sources as well as results of further investigation. (1.1.4) **8.1.d**
X					Students should be able to communicate scientific procedures, data, and explanations to enable the replication of results. Students should be able to use computer technology to assist in communicating these results. Critical review is important in the analysis of these results. (1.1.5) **8.1.e**
X					Students should be able to use mathematics, reading, writing, and technology in conducting scientific inquiries. (1.1.6) **8.1.f**
		X			**THERMODYNAMICS** Students should be able to conduct simple investigations in which a variety of materials (sand, water, light colored materials, dark colored materials) are exposed to light and heat energy. Students should be able to measure the change in temperature of the material and describe any changes that occur in terms of the physical properties of the material. (2.1.5) **8.2.a**
		X		X	**LIQUIDS AND SOLIDS** **PERIODIC TABLE** **CHEMICAL BONDING** **GLOBAL POLITICS AND ECONOMICS** Students should be able to conduct investigations, using a variety of materials, to show that some materials conduct heat more readily than others. Students should be able to identify these materials as conductors or insulators. (2.1.4) **8.2.b**
		X		X	**THERMODYNAMICS** **PERIODIC TABLE** **CHEMICAL BONDING** **GLOBAL POLITICS AND ECONOMICS** Students should be able to explain why insulators may be used to slow the change of temperature of hot or cold materials. (2.1.4) **8.2.c**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to explain that kinetic energy is the energy an object has because of its motion and identify that kinetic energy depends upon the object's speed and mass. (3.1.2) **8.3.a**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to design and carry out investigations to determine how changing the mass of an object or changing its speed changes its kinetic energy. (3.1.2) **8.3.b**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to explain that gravitational potential energy (GPE) is the energy of position (above the Earth's surface) and that it depends on the object's mass and height above the ground. Students should be able to relate that lifted objects have GPE and that the size of an object's GPE depends on its mass and the vertical distance it was lifted. Students should

					be able to make a graph to demonstrate and describe how the GPE changes as the height of an object is increased or decreased. (3.1.2) **8.3.c**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to explain that the mechanical energy of an object is the sum of its kinetic energy and its potential energy at any point in time. Students should be able to identify the mechanical energy of objects in different circumstances and identify whether the mechanical energy consists of KE, PE or both (i.e., a ball at rest at the top of an incline and in its motion part of the way down the incline or a model plane driven by a 'rubber band' motor, etc.). (3.1.2) **8.3.d**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to interpret graphical representations of energy to describe how changes in the potential energy of an object can influence changes in its kinetic energy. (1.1.2) (1.1.4) (3.1.2) **8.3.e**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to explain that the mechanical energy of an object is a measure of how much the object can change the motion of other objects or materials (e.g.,, a ball (or air) having a large kinetic energy can do more damage than a ball (or air) with less kinetic energy). (3.1.2) (3.2.1) **8.3.f**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 8TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **KINETICS** Students should be able to use the particle model to explain heat energy as the combined random kinetic energy of particles that make up an object and while the heat energy and temperature of an object are related, they are different quantities. (2.1.2) (3.1.4) (3.2.6) **8.3.g**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 8TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **KINETICS** Students should be able to describe how the motion of water particles in a glass of cold water is different from the motion of water particles in a glass of hot water. (2.1.2) **8.3.h**
	X	X		X	**WAVE MOTION – 8TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THE LITHOSPHERE** Students should be able to explain that sound energy is mechanical energy that travels in the form of waves. Students should be able to use the Particle Model to explain why sound waves must travel through matter, and that sound travels more effectively through solids and liquids than through gases. Model and describe how sound energy travels through solids, liquids, and gases. (3.1.3) **8.3.i**
	X				**WAVE MOTION – 8TH GRADE** Students should be able to use the properties of sound waves and the Particle Model to describe how the pitch of two waves can be different and how the loudness of two waves can be different. (3.1.3) **8.3.j**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 8TH GRADE**

					WAVE MOTION – 8TH GRADE **GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** Students should be able to explain that heat energy and sound energy both make the particles of a substance move. Students should be able to use models to explain how the particles respond differently to these types of energy. Students should be able to use models to explain why sound travels much faster through substances than heat energy does. (3.1.3) (3.1.4) **8.3.k**
	X			X	**ATOMICS PHYSICS AND QUANTUM EFFECTS – 8TH GRADE** **ENERGY CONCEPTS** Students should be able to relate that the sun is the source of almost all of the Earth's energy and that this energy travels to the Earth in the form of electromagnetic waves. (3.1.1) **8.3.l**
	X		X	X	**ATOMICS PHYSICS AND QUANTUM EFFECTS – 8TH GRADE** **ECOLOGY** **CELL STRUCTURE AND FUNCTION** **CELLULAR ENERGY** **ENERGY CONCEPTS** **GLOBAL WARMING** **STRATOSPHERIC OZONE** Students should be able to explain that the electromagnetic waves from the sun consist of a range of wavelengths and associated energies. Students should be able to explain that the majority of the energy from the sun reaches Earth in the form of infrared, visible, and ultraviolet waves. Students should be able to use diagrams to demonstrate the differences in different types of electromagnetic waves. (3.1.1) (3.2.5) (3.3.3) **8.3.m**
	X		X	X	**ATOMICS PHYSICS AND QUANTUM EFFECTS – 8TH GRADE** **ECOLOGY** **GLOBAL WARMING** **STRATOSPHERIC OZONE** Students should be able to plan and conduct an experiment to identify the presence of UV and IR waves in sunlight or other sources of electromagnetic waves. Students should be able to use evidence to explain the presence of each. (1.1.2) (1.1.4) (3.1.1) (3.2.5) **8.3.n**
	X				**OSCILLATIONS AND GRAVITATION – 8TH GRADE** Students should be able to recognize that the force of gravity can act across very large distances of space. Through the force of gravity planets pull on their moons, and pull on each other. The sun pulls on all planets, moons and other celestial bodies in the solar system. Students should be able to use an understanding of how forces change the motion of objects to explain how gravity is responsible for creating the orbital motion of planets and moons. (3.2.1) (3.2.2) **8.3.o**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to explain that the transfer of energy from one object to another is caused by the exertion of a force. Students should be able to create an energy chain to show how forces can change the mechanical energy of an object. Students should be able to describe how the distance over which the forces act will influence the amount of energy transferred (and when appropriate, the amount of energy transformed). (3.2.2) (3.2.3) **8.3.p**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to give examples of how mechanical energy can be transferred to (or away from) an object and describe the changes that can take place in the motion of the object because of this energy transfer, (e.g., pulling on a trailer to start it moving or using friction to slow an object and bring it to rest). (3.1.2) (3.2.1) **8.3.q**

	X			X	**WORK, ENERGY, AND POWER – 8TH GRADE** **THE LITHOSPHERE** Students should be able to use diagrams to trace and describe the transfer of energy through a physical system (for example, the erosion effects of water flowing down an unprotected slope). (1.1.4) (1.1.6) (3.3.1) **8.3.r**
	X			X	**WAVE MOTION – 8TH GRADE** **THE LITHOSPHERE** Students should be able to use the Particle model to explain how mechanical waves can transport energy without transporting mass. Students should be able to give examples that support the transfer of energy without any net transfer of matter. (2.1.1) (3.1.3) (3.3.2) **8.3.s**
	X				**WAVE MOTION – 8TH GRADE** Students should be able to explain that the frequency and amplitude are two characteristics of waves that determine the mechanical energy carried and delivered by a sound wave per unit of time. Students should be able to use diagrams to explain how each of these properties will influence the KE of the particles in the substance when a sound wave passes through the substance. (3.1.3) **8.3.t**
	X				**WAVE MOTION – 8TH GRADE** Students should be able to give an example of a high frequency sound wave that delivers small quantities of energy every second and explain how this is possible. Students should be able to give an example of a low frequency sound wave that delivers large quantities of energy every second and explain how this is possible. (3.1.3) **8.3.u**
	X	X	X	X	**TEMPERATURE AND HEAT – 8TH GRADE** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **PERIODIC TABLE** **ECOLOGY** **TECHNOLOGY AND SOCIETY** **ENERGY CONCEPTS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to use the Particle Model to explain how heat energy is transferred through solid materials (conduction). Students should be able to give examples of materials that are good 'conductors' of heat energy and examples of materials that are poor conductors of heat energy and how both types of materials are used in typical homes. (2.1.4) (3.1.4) (3.2.7) (3.3.2) **8.3.v**
	X	X		X	**TEMPERATURE AND HEAT – 8TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **ENERGY CONCEPTS** Students should be able to use the Particle Model to describe the difference between heat energy transfer in solids and heat energy transfer in liquids and gases (i.e., the differences between conduction and convection). (2.1.4) (3.1.4) (3.2.7) (3.3.2) **8.3.w**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 8TH GRADE** **THERMODYNAMICS** Students should be able to use the particle model to explain why heat energy is always transferred from materials at higher temperatures to materials at lower temperatures. Students should be able to explain why heat energy transfer ceases when the equilibrium temperature is reached. Students should be able to explain that when this temperature is

					reached, the materials are in thermal equilibrium. (2.1.4) (3.1.4) (3.2.7) (3.3.2) **8.3.x**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 8TH GRADE** **THERMODYNAMICS** Students should be able to conduct simple investigations to demonstrate that heat energy is transferred from one material to another in predictable ways (from materials at higher temperatures to materials at lower temperatures), until both materials reach the same temperature. (1.1.4) (1.1.5) (2.1.4) (3.1.4) (3.2.7) (3.3.2) **8.3.y**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 8TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** Students should be able to explain how the addition or removal of heat energy can change an object's temperature or its physical state. Students should be able to conduct simple investigations involving changes of physical state and temperature. Students should be able to relate that there is no change in temperature when a substance is changing state. (1.1.2) (1.1.3) (1.1.4) (2.1.2) (3.2.6) **8.3.z**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to identify that energy can exist in several forms, and when it changes from one form into another the process is called energy transformation. (3.2.4) (3.3.1) **8.3.aa**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to explain that energy transformation and energy transfer are different processes and that energy transformations can take place during an energy transfer. Students should be able to give examples of energy transformations that take place during an energy transfer. (3.3.1) **8.3.bb**
	X				**WORK, ENERGY, AND POWER – 8TH GRADE** Students should be able to give examples of energy transfers that do not include energy transformations. Students should be able to give examples of energy transformations that take place without any energy transfer. (3.2.7) **8.3.cc**
	X		X	X	**WORK, ENERGY, AND POWER – 8TH GRADE** **ECOLOGY** **FOSSIL FUEL RESOURCES** **GLOBAL POLITICS AND ECONOMICS** Students should be able to use energy chains to trace the flow of energy through physical systems. Indicate the energy transfers and the energy transformations that are involved in the processes (for example, the lighting of an electric lamp in a region serviced by a hydroelectric (or coal fueled) electric power plant, or the sediment that clouds a stream after a heavy rainfall). (3.3.1) **8.3.dd**
	X		X		**ATOMIC PHYSICS AND QUANTUM EFFECTS – 8TH GRADE** **CELL STRUCTURE AND FUNCTION** Students should be able to recognize that when light enters an eye, the energy carried by the light waves carries information and allows living things to see. (3.2.5) **8.3.ee**
	X				**ATOMIC PHYSICS AND QUANTUM EFFECTS – 8TH GRADE** Students should be able to trace the flow of the energy carried by the light when the light strikes a material and is reflected from, transmitted through, and/or absorbed by the material. Students should be able to describe the energy transfers and transformations that take place when light energy is absorbed by a material. (3.1.1) (3.2.5) **8.3.ff**

	X	X	X	X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 8TH GRADE** **THERMODYNAMICS** **ECOLOGY** **GLOBAL WARMING** **STRATOSPHERIC OZONE** Students should be able to conduct investigations to show that materials can absorb some frequencies of electromagnetic waves, but reflect others or allow them to transmit through the material. Students should be able to use this selective absorption process to explain how objects obtain their color, how materials like sunscreen can serve to protect us from harmful electromagnetic waves and how selective absorption contributes to the Greenhouse Effect. (3.2.5) (3.3.3) **8.3.gg**
	X		X	X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 8TH GRADE** **ECOLOGY** **GLOBAL WARMING** Students should be able to trace what happens to the energy from the Sun when it reaches Earth and encounters various materials, such as, atmosphere, oceans, soil, rocks, plants, and animals. Students should be able to recognize that these materials absorb, reflect and transmit the electromagnetic waves coming from the sun differently. (3.3.3) (5.2.8) **8.3.hh**
	X	X		X	**TEMPERATURE AND HEAT – 8TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **THERMODYNAMICS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to conduct investigations to determine how the physical properties of materials (e.g., size, shape, color, texture, hardness) can account for the effect the materials have on sunlight and the degree of change observed in the materials (for example, dark cloth absorbs more heat than light cloth, clear water transmits more light than murky water, and polished materials reflect more light than dull materials). (3.3.3) **8.3.ii**
	X	X	X	X	**TEMPERATURE AND HEAT – 8TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **ECOLOGY** **THE ATMOSPHERE** Students should be able to use the properties of water and soil to explain how uneven heating of Earth's surface can occur. Students should be able to conduct an investigation that shows how water and soil are heated unequally by sunlight. Students should be able to describe how this can be used to explain unequal heating of the Earth's surface, producing atmospheric movements that influence weather. (1.1.3) (3.3.3) (5.2.8) (5.2.10) **8.3.jj**
	X	X			**TEMPERATURE AND HEAT – 8TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** Students should be able to use the particle model to explain why a material expands (takes up more space) as its temperature increases. Students should be able to recognize that this expansion is due to the increase in the motion of the particles, and that the particles themselves remain the same size. (3.3.2) **8.3.kk**
	X		X	X	**WORK, ENERGY, AND POWER – 8TH GRADE** **ECOLOGY**

					RENEWABLE ENERGY RESOURCES Students should be able to identify different forms of alternative energy (i.e., solar, wind, ocean waves, tidal and hydroelectric systems). Students should be able to research and report on the use of this alternative form of energy. Students should be able to discuss and compare findings to describe the advantages and disadvantages of different kinds of alternative energy. (3.4.1) (3.4.2) (3.4.3) **8.3.ll**
					Students should be able to describe how scientists have historically confirmed that the Earth is round, not flat. (1.1.1) (1.1.3) (1.1.4) (1.3.1) **8.4.a**
					Students should be able to analyze data on sunrise and sunset times (in terms of length of daylight) and describe patterns. Students should be able to explain the reason for the patterns by using models or computer simulations of the Earth and Sun. (1.1.3) (1.1.6) (4.1.2) **8.4.b**
					Using internet, newspaper, and actual observations of the night sky for at least two months, students should be able to collect data on the Moon's appearance, and moonrise and moonset times. Students should be able to analyze the data to describe the observable patterns (phases). Students should be able to explain why the Moon's appearance changes in a repeating cyclical pattern. (1.1.3) (4.1.3) **8.4.c**
					Students should be able to use models to describe how the relative positions of the Sun, Moon, and Earth account for Moon phases, eclipses, and tides. (4.1.3) (4.1.4) (4.1.5) **8.4.d**
					Students should be able to describe how the relative positions of the Earth, Moon and Sun can cause high and low tides, and unusually high or low tides. (4.1.5) **8.4.e**
					Students should be able to demonstrate an understanding of the components of our Solar System and their characteristics, including the Moon, the Sun, the planets and their moons, extra-solar planets, and smaller objects such as asteroids and comets. Students should be able to construct scale models of the Solar System in order to describe the relative sizes of planets and their distances from the Sun. (4.2.2) (4.2.4) **8.4.f**
					Students should be able to use a variety of resources (e.g., NASA photographs, computer simulations) to compare and contrast the physical properties (i.e., temperature, size, composition, surface features) of planets. (1.2.1) (4.2.3) **8.4.g**
					Students should be able to demonstrate an understanding of the motion of the bodies in our Solar System. Students should be able to use models, charts, illustrations, and other suitable representations to predict and describe regular patterns of motion for most objects in the Solar System. (4.2.2) **8.4.h**
			X	X	**ECOLOGY** **THE LITHOSPHERE** Students should be able to explain how the Sun is the central and largest body in our Solar System and the source of the light energy that hits our planet. Students should be able to use models to explain how variations in the amount of Sun's energy hitting the Earth's surface results in seasons. (4.1.1) (4.1.2) (4.2.1) **8.4.** i
					Students should be able to recognize that the force of gravity keeps planets in orbit around the sun and influences objects on Earth and other planets (i.e., tides, ability of humans to move and function). Students should be able to differentiate between an object's mass and weight. (4.2.1) **8.4.j**
					Students should be able to describe how scientists have acquired knowledge about components of our Solar System. Students should be able to recognize the importance of

					people and technologies that have led to our current understanding of space. (1.2.1) (1.2.2) (4.4.1) **8.4.k**
				X	**GLOBAL POLITICS AND ECONOMICS** Students should be able to recognize that spin offs are products which have undergone a technology transfer process from research to public use. Students should be able to research spin-offs from the space program that have affected our everyday lives (i.e., Velcro, smoke detectors, cordless tools). (1.2.2) (1.3.1) (4.4.2) **8.4.l**
			X	X	**ECOLOGY** **THE ATMOSPHERE** **THE HYDROSPHERE** Students should be able to observe, measure, and predict changes in weather using atmospheric properties (wind speed and direction, cloud cover and type, temperature, dew point, air pressure, and relative humidity). Students should be able to describe how air pressure and temperature change with increasing altitude and/or latitude. (1.1.4) (5.2.6) (5.2.7) **8.5.a**
			X	X	**ECOLOGY** **THE ATMOSPHERE** **THE HYDROSPHERE** Students should be able to explain how uneven heating of Earth's components – water, land, air – produce local and global atmospheric and oceanic movement. Students should be able to describe how these local and global patterns of movement influence weather and climate (3.3.2) (5.2.8) (5.2.10) **8.5.b**
		X			**GASES** **THERMODYNAMICS** Students should be able to investigate the rate at which different Earth materials absorb heat. Students should be able to explain how these differences in heat absorption causes air pressure differences that result in convection currents (i.e., local land and sea breezes). (3.2.7) (3.3.2) (5.2.8) **8.5.c**
		X	X	X	**GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **ECOLOGY** **THE HYDROSPHERE** Students should be able to use a variety of models, charts, diagrams, or simple investigations to explain how the Sun's energy drives the cycling of water through the Earth's crust, oceans, and atmosphere. (5.1.2) (5.2.8) (5.2.10) **8.5.d**
		X			**THERMODYNAMICS** Students should be able to examine maps of ocean currents and trace the origin and flow of such currents to explain the transfer of heat energy. Students should be able to identify which currents have dominant influence on the Delaware coast. (1.1.3) (1.1.6) (5.2.9) (5.2.13) (5.3.1) **8.5.e**
			X	X	**ECOLOGY** **THE ATMOSPHERE** **GLOBAL WARMING** Students should be able to differentiate between weather, which is the condition of the atmosphere at a given time, and climate, which is the weather averaged over a long period of time. (5.2.5) (5.2.7) **8.5.f**

		X	X	X	**THERMODYNAMICS** **ECOLOGY** **THE ATMOSPHERE** Students should be able to discuss the origin and identify characteristics (i.e., air circulation pattern, wind speed, temperature and dew point, and air pressure) of storm systems including hurricanes, Nor' easters, tornadoes, thunderstorms, and mid-latitude cyclones. Students should be able to explain how these weather events can transfer heat. Students should be able to describe the environmental, economic, and human impact of these storms. (1.2.2) (5.2.5) (5.2.13) **8.5.g**
					Students should be able to compare and contrast different storm systems in terms of size, formation, and associated weather. (5.2.6) (5.2.10) **8.5.h**
				X	**THE ATMOSPHERE** **THE HYDROSPHERE** Students should be able to describe how origin affects an air mass's temperature and moisture content. (5.2.10) **8.5.i**
				X	**THE ATMOSPHERE** **THE HYDROSPHERE** Students should be able to describe how the formation of clouds is influenced by the dew point, environmental temperature and amount of particles in the air. Students should be able to explain how various lifting mechanisms affect cloud formation. (2.1.2) (5.2.9) **8.5.j**
				X	**THE ATMOSPHERE** **THE HYDROSPHERE** Students should be able to use cloud characteristics (altitude, composition, and form) to predict the weather. Students should be able to discuss how different cloud types are indicators of weather and weather systems such as frontal systems and hurricanes. (5.2.6) **8.5.k**
				X	**THE ATMOSPHERE** Students should be able to examine isobars on weather maps to describe how wind (moving air) travels from a region of high pressure to a region of low pressure. Students should be able to apply this knowledge to explain the cause of wind. (5.3.1) **8.5.l**
				X	**THE ATMOSPHERE** Students should be able to record and interpret daily weather measurements over an extended period of time using a variety of instruments (i.e., barometer, anemometer, sling psychrometer, rain gauge, and thermometer) in order to predict and to identify weather patterns. (1.1.3) (5.2.6) (5.3.1) **8.5.m**
				X	**THE ATMOSPHERE** Students should be able to construct and use surface station models to represent local atmospheric data and interpret weather patterns on meteorological maps. (1.1.3) (5.2.6) (5.3.1) **8.5.n**
				X	**THE ATMOSPHERE** Students should be able to examine satellite imagery pictures and use these images to identify cloud patterns and storm systems. (1.1.3) (5.2.6) (5.3.1) **8.5.o**
				X	**THE ATMOSPHERE** Students should be able to use weather maps to describe the movement of fronts and storms and to predict their influence on local weather. (1.1.3) (5.2.6) (5.3.1) **8.5.p**

			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **BIOGEOCHEMICAL CYCLES** Students should be able to understand and describe how the maintenance of a relatively stable internal environment is required for the continuation of life and explain how stability is challenged by changing physical, chemical, and environmental conditions. (6.3.1) **8.6.a**
			X	X	**ECOLOGY** **REGULATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain that the regulatory and behavioral responses of an organism to external stimuli occur in order to maintain both short and long term equilibrium (e.g., migrating shorebirds behave differently along the migration path in order to support their life cycle). (6.3.1) (7.2.6) **8.6.b**
			X	X	**ECOLOGY** **EVOLUTION** **REPRODUCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to relate the advantages and disadvantages of different reproductive strategies in terms of energy expenditure per offspring and survival rates of that offspring. (7.1.1) (7.1.2) (7.1.3) **8.7.a**
			X	X	**GROWTH AND DEVELOPMENT** **ECOLOGY** **EVOLUTION** **REPRODUCTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to research and report on reproductive strategies of different organisms (i.e., broadcast spawning versus nurturing parenting) that allow them to be successful. (1.1.5) (7.1.5) **8.7.b**
			X	X	**MOLECULAR GENETICS** **ECOLOGY** **EVOLUTION** **MENDENIAN GENETICS** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that species acquire many of their unique characteristics through biological adaptations, which involve the selection of naturally occurring variations in populations. (7.2.6) **8.7.c**
			X	X	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to observe a variety of organisms and explain how a specific trait could increase an organism's chances of survival. (7.2.2) (7.2.6) **8.7.d**
			X	X	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain how the extinction of a species occurs when the environment changes and the adaptation of a species is insufficient to allow for its survival. (7.2.4) **8.7.e**
			X	X	**ECOLOGY**

					EVOLUTION **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to conduct a natural selection simulation to demonstrate how physical adaptations (i.e., protective camouflage, long neck for food gathering, muscular legs for running, heavy beak for nut cracking, etc…) have selective advantages for an organism. Students should be able to research and report on beneficial physical adaptations of a variety of organisms. (7.2.6) (8.1.6) **8.7.f**
			X	**X**	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to investigate and discuss how short-term physiological changes of an organism (e.g., skin tanning, muscle development, formation of calluses) differ from long-term evolutionary adaptations (e.g., white coloration of polar bears, seed formation in plants) that occur in populations of organisms over generations. (7.2.3) (7.2.6) **8.7.g**
			X	**X**	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to conduct simulations to investigate how organisms fulfill basic needs (i.e., food, shelter, air, space light/dark, and water) in a competitive environment. Students should be able to relate how competition for resources can determine survival. (1.1.3) (7.2.2) (8.1.6) (8.1.8) **8.7.h**
			X	**X**	**ECOLOGY** **CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to examine an assortment of plants and animals and use simple classification keys, based on observable features, to sort and group the organisms. (7.2.5) **8.7.i**
			X	**X**	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify a variety of reasons for extinction of a species. Students should be able to use research on a variety of extinct organisms to speculate causes of extinction (i.e., inability to adapt to environmental changes). (7.2.4) **8.7.j**
			X	**X**	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** **POPULATION DYNAMICS** Survey the diversity of organisms in a local or model ecosystem. Recognizing that a population consists of all individuals of a species that occur together at a given place and time, describe how to estimate and then calculate the size of a large population of a variety of organisms. Chart the diversity of the organisms in the ecosystem. (8.1.1) (8.1.2) (8.1.4) **8.8.a**
			X	**X**	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to categorize populations of organisms according to the roles (producers, consumers, and decomposers) they play in an ecosystem. (8.1.4) (8.2.3) **8.8.b**
			X	**X**	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **POPULATION DYNAMICS**

					Students should be able to describe and explain how factors (i.e., space, food, water, disease) limit the number of organisms an ecosystem can support. (8.1.5) (8.1.6) **8.8.c**
			X	X	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** **POPULATION DYNAMICS** Students should be able to construct a data table or line graph to show population changes of a selected species over time. Students should be able to describe the population changes portrayed by the graph. (1.1.5) (1.1.6) (8.1.5) **8.8.d**
			X	X	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** **POPULATION DYNAMICS** Students should be able to observe graphs or data tables showing both the population growth of a species and the consequences of resource depletion on the population. Students should be able to analyze the data and explain the effect that may occur from exponential growth of a population (given finite resources). (8.1.6) (8.1.7) **8.8.e**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to investigate local areas, disturbed and undisturbed, that are undergoing succession (i.e., abandoned gardens, ditch banks, and the edge of a forest). (8.1.3) (8.2.2) (8.2.3) **8.8.f**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to predict how plant communities that grow in the area may change over time and how their presence determines what kinds of animals may move into and out of the areas. (8.1.5) (8.1.6) **8.8.g**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to construct food webs and identify the relationships among producers, consumers, and decomposers. (8.1.4) (8.2.2) (8.2.3) **8.8.h**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to design food webs and trace the flow of matter and energy (beginning with the Sun) through the food web. (8.2.1) (8.2.2) (8.2.3) **8.8.i**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **HUMAN POPULATION** **GLOBAL POLITICS AND ECONOMICS** Students should be able to research and analyze data on human population changes that have occurred in a specific Delaware ecosystem. Students should be able to discuss reasons for changes in human population and explain how these changes have affected the biodiversity of local organisms and availability of natural resources in the given ecosystem (e.g., habitat loss, water quality, preservation/concentration efforts). (8.3.1) (8.3.2) **8.8.j**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY**

					Students should be able to identify ways in which invasive species can disrupt the balance of Delaware as well as other ecosystems (i.e., competition for resources including habitat and/or food). Students should be able to research and report on an invasive species, indicating how this species has altered the ecosystem. (1.1.5) (8.3.2) (8.3.3) **8.8.k**
					GRADE 9
X					Students should be able to identify and form questions that generate a specific testable hypothesis that guide the design and breadth of the scientific investigation. (1.1.1) **9.1.a**
X					Students should be able to design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis. (1.1.2) **9.1.b**
X					Students should be able to collect accurate and precise data through the selection and use of tools and technologies appropriate to the investigations. Display and organize data through the use of tables, diagrams, graphs, and other organizers that allow analysis and comparison with known information and allow for replication of results. (1.1.3) **9.1.c**
X					Students should be able to construct logical scientific explanations and present arguments which defend proposed explanations through the use of closely examined evidence. (1.1.4) **9.1.d**
X					Students should be able to communicate and defend the results of scientific investigations using logical arguments and connections with the known body of scientific information. (1.1.5) **9.1.e**
X					Students should be able to use mathematics, reading, writing and technology when conducting scientific inquiries. (1.1.6) **9.1.f**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** Students should be able to explain that matter is composed of tiny particles called atoms that are unique to each element, and that atoms are composed of subatomic particles called protons, neutrons, and electrons. (2.1.1.) **9.2.a**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** Students should be able to describe the relative charge, approximate mass, and location of protons, neutrons, and electrons in an atom. (2.1.1) **9.2.b**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **PERIODIC TABLE** Students should be able to classify matter as mixtures (which are either homogeneous or heterogeneous) or pure substances (which are either compounds or elements.) (2.1.2) **9.2.c**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **PERIODIC TABLE** Students should be able to explain that elements are pure substances that cannot be separated by chemical or physical means. Students should be able to recognize that compounds are pure substances that can be separated by chemical means into elements. (2.1.2) **9.2.d**

		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **PERIODIC TABLE** Students should be able to classify various common materials as an element, compound or mixture. (1.1.5) (2.1.2) **9.2.e**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** **STOICHIOMETRY** Students should be able to describe isotopes of elements in terms of protons, neutrons, electrons, and average atomic masses. Students should be able to recognize that isotopes of the same element have essentially the same chemical properties that are determined by the proton and electron number. (2.1.3) **9.2.f**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** **STOICHIOMETRY** Students should be able to use the Periodic Table to identify an element's atomic number, valence electron number, atomic mass, group/family and be able to classify the element as a metal, non-metal or metalloid. (2.1.4) **9.2.g**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** Students should be able to determine the physical and chemical properties of an element based on its location on the Periodic Table. (2.1.4) (2.1.5) (2.1.6) **9.2.h**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** Students should be able to investigate differences between the properties of various elements in order to predict the element's location on the Periodic Table. (2.1.4) (2.1.5) (2.1.6) **9.2.i**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** **CHEMICAL BONDING** Students should be able to use the Periodic table to predict the types of chemical bonds (e.g., ionic or covalent) in a variety of compounds. (2.1.4) (2.1.5) (2.1.6) **9.2.j**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** **CHEMICAL BONDING** Students should be able to use models or drawings to illustrate how molecules are formed when two or more atoms are held together in covalent bonds by "sharing" electrons. Students should be able to use models or drawings to illustrate how ionic compounds are formed when two or more atoms "transfer" electrons and are held together in ionic bonds. (2.1.6) **9.2.k**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** Students should be able to explain how an atom's electron arrangement influences its ability to transfer or share electrons and is related its position on the periodic table. Students should be able to recognize that an atom in which the positive and negative charges do not balance is an ion. (2.1.6) **9.2.l**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE**

					LIQUIDS AND SOLIDS Students should be able to recognize that metals have the physical properties of conductivity, malleability, luster, and ductility. (2.1.5) **9.2.m**
		X		**X**	**LIQUIDS AND SOLIDS** **PERIODIC TABLE** **ENERGY CONCEPTS** Explore the extent to which a variety of solid materials conduct electricity in order to rank the materials from good conductors to poor conductors. Based on the conductivity data, determine patterns of location on the Periodic Table for the good conductors versus the poor conductors. (1.1.4) (2.1.4) (2.1.5) **9.2.n**
		X			**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** Students should be able to recognize that physical changes alter some physical properties of a substance but do not alter the chemical composition of the substance. (2.1.7) **9.2.o**
		X		**X**	**GASES** **LIQUIDS AND SOLIDS** **THERMODYNAMICS** **THE HYDROSPHERE** Students should be able to conduct investigations to determine the effect of heat energy on the change of state (change of phase) of water. Sketch and interpret graphs representing the melting, freezing, evaporation and condensation of water. (1.1.2) (1.1.3) (1.1.6) (2.1.8) **9.2.p**
		X			**ATOMIC THEORY AND STRUCTURE** **CHEMICAL BONDING** Students should be able to recognize that molecular and ionic compounds are electrically neutral. (2.1.6) **9.2.q**
		X			**GASES** **THERMODYNAMICS** Students should be able to apply the kinetic molecular theory to explain that a change in the energy of the particles may result in a temperature change or a change of phase (change in state). (3.1.4) **9.2.r**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **CHEMCIAL BONDING** Students should be able to use a model or a diagram to explain water's properties (e.g., density, polarity, hydrogen bonding, boiling point, cohesion, and adhesion) in the three states of matter. Students should be able to cite specific examples of how water's properties are important (i.e., water as the "universal"). (2.1.7) **9.2.s**
		X			**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL BONDING** **SOLUTIONS** Students should be able to recognize that mixtures can be separated by physical means into pure substances. (2.2.2) **9.2.t**
		X			**LIQUIDS AND SOLIDS** **SOLUTIONS**

					CHEMICAL BONDING Students should be able to explain the effect of water's polarity on the solubility of substances (e.g., alcohol, salt, oil). (2.1.7) (2.2.1) **9.2.u**
		X	X		**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **CHEMCIAL BONDING** **BIOCHEMISTRY** Separate mixtures into their component parts according to their physical properties such as melting point, boiling point, magnetism, solubility and particle size. Students should be able to explain how the properties of the components of the mixture determine the physical separation techniques used. (1.1.2) (1.1.3) (2.2.2) **9.2.v**
		X	X		**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **CELL STRUCTURE AND FUNCTION** **BIOCHEMISTRY** Students should be able to describe how the process of diffusion or the movement of molecules from an area of high concentration to an area of low concentration (down the concentration gradient) occurs because of molecular collisions. **9.2.w**
		X	X		**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** **PERIODIC TABLE** **CHEMICAL BONDING** **BIOCHEMISTRY** Explore how various solutions conduct electricity and rank the liquids from good conductors to poor conductors. Students should be able to explain the characteristics that allow some solutions to have better electrical conductivity than others. (2.2.1) **9.2.x**
		X	X	X	**LIQUIDS AND SOLIDS** **EQUILIBRIUM** **CHEMICAL REACTIVITY** **REACTION TYPES** **BIOCHEMISTRY** **POLLUTION CONCEPTS** Students should be able to measure the pH of a solution using chemical indicators to determine the relative acidity or alkalinity of the solution. Students should be able to identify the physical properties of acids and bases. (1.1.3) (2.2.1) **9.2.y**
		X			**GASES** **LIQUIDS AND SOLIDS** **SOLUTIONS** Students should be able to investigate factors that affect the materials' solubility in water and construct solubility curves to compare the extent to which the materials dissolve. (2.2.2) **9.2.z**
		X		X	**GASES** **LIQUIDS AND SOLIDS** **STOICHIOMETRY** **BIOGEOCHEMICAL CYCLES** Students should be able to conduct and explain the results of simple investigations to demonstrate that the total mass of a substance is conserved during both physical and chemical

					changes. (1.1.3) (2.3.1) **9.2.aa**
		X	X		**CHEMICAL REACTIVITY** **REACTION TYPES** **CHEMICAL BONDING** **BIOCHEMISTRY** Students should be able to recognize that chemical changes alter the chemical composition of a substance forming one or more new substances. The new substance may be a solid, liquid, or gas. (2.4.1) **9.2.bb**
		X	X	X	**STOICHIOMETRY** **BIOCHEMISTRY** **BIOGEOCHEMICAL CYCLES** Balance simple chemical equations and explain how these balanced chemical equations represent the conservation of matter. (1.1.4) (2.3.1) **9.2.cc**
		X	X	X	**GASES** **LIQUIDS AND SOLIDS** **CHEMICAL REACTIVITY** **CHEMICAL BONDING** **BIOCHEMISTRY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to research and report on a variety of manufactured goods and show how the chemical properties of the component materials were used to achieve the desired qualities. (1.2.2) (2.5.1) **9.2.dd**
	X			X	**ELECTROMAGNETISM – 9TH GRADE** **ENERGY CONCEPTS** Students should be able to recognize that electromagnetic energy (radiant energy) is carried by electromagnetic waves. (3.1.1) **9.3.a**
	X			X	**PHYSICAL OPTICS – 9TH GRADE** **GLOBAL WARMING** **STRATOSPHERIC OZONE** Students should be able to use diagrams to illustrate the similarities shared by all electromagnetic waves and differences between them. Students should be able to show how wavelength is used to distinguish the different groups of EM waves (radio waves, microwaves, IR, visible and UV waves, X-rays and gamma waves). (3.1.1.) (3.3.4) **9.3.b**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to conduct investigations involving moving objects to examine the influence that the mass and the speed have on the kinetic energy of the object. Students should be able to collect and graph data that supports that the kinetic energy depends linearly upon the mass, but nonlinearly upon the speed. (1.1.1) (1.1.2) (3.1.2) **9.3.c**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to recognize that the kinetic energy of an object depends on the square of its speed, and that KE =½ mv^2. (3.1.2) **9.3.d**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to collect and graph data that shows that the potential energy of an object increases linearly with the weight of an object (mg) and with its height above a pre-defined reference level, h. (GPE = mgh) (1.1.3) (1.1.4) (3.1.2) **9.3.e**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to conduct investigations and graph data that indicates that the energy

					stored in a stretched elastic material increases nonlinearly with the extent to which the material was stretched. (1.1.3) (1.1.4) (3.1.2) **9.3.f**
					Students should be able to recognize that the energy stored in a stretched elastic material is proportional to the square of the stretch of the material, and a constant that reflects the elasticity of the material. (Elastic PE = ½ kx^2) (3.1.2) **9.3.g**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 9TH GRADE** **GASES** **THERMODYNAMICS** Students should be able to explain that heat energy represents the total random kinetic energy of molecules of a substance. (3.1.4) **9.3.h**
		X			**CHEMICAL BONDING** Students should be able to recognize that chemical energy is the energy stored in the bonding of atoms and molecules. (3.1.6) **9.3.i**
		X		X	**NUCLEAR CHEMISTRY** **ATOMIC THEORY AND STRUCTURE** **RENEWABLE ENERGY RESOURCES** Students should be able to describe the differences between nuclear energy and chemical energy, that chemical energy is derived from the energy of the electrons that move around the nucleus, while nuclear energy is associated with the protons and neutrons in the nucleus. (2.3.2) (3.1.7) **9.3.j**
	X				**ELECTROMAGNETISM – 9TH GRADE** Students should be able to recognize that electromagnetic waves transfer energy from one charged particle to another. Students should be able to use graphics or computer animations to illustrate this transfer process. Students should be able to give everyday examples of how society uses these transfer processes (for example, communication devices such as radios and cell phones). (3.2.6) **9.3.k**
	X				**WAVE MOTION – 9TH GRADE** Students should be able to use diagrams to illustrate how the motion of molecules when a mechanical wave passes through the substance is different from the motion associated with their random kinetic energies. (1.1.6) (3.1.3) (3.1.4) **9.3.l**
	X			X	**WAVE MOTION – 9TH GRADE** **THE LITHOSPHERE** Students should be able to use diagrams or models to explain how mechanical waves can transport energy without transporting matter. (1.1.4) (1.1.5) (3.1.3) (3.3.3) **9.3.m**
	X	X		X	**WAVE MOTION – 9TH GRADE** **GASES** **LIQUIDS AND SOLIDS** **THE LITHOSPHERE** Students should be able to reflect on why mechanical waves will pass through some states of matter better than others. (3.3.4) **9.3.n**
	X				**OSCILLATIONS AND GRAVITATION – 9TH GRADE** Students should be able to recognize that the gravitational force is a universal force of attraction that acts between masses, but this force is only significant when one (or both) of the objects is massive (for example, a star, planet or moon). (3.2.5) **9.3.o**
	X				**OSCILLATIONS AND GRAVITATION – 9TH GRADE**

					Students should be able to explain that as objects move away from the surface of a planet or moon, the gravitational pull on the object will decrease. (3.2.5) **9.3.p**
	X				**OSCILLATIONS AND GRAVITATION – 9TH GRADE** Students should be able to use examples to illustrate that near the surface of a planet or moon, the gravitational force acting on an object remains nearly constant. Students should be able to recognize that on Earth, the object would have to be moved several hundred miles above the surface before the decrease in the force of gravity would become detectable. (3.2.5) **9.3.q**
	X				**OSCILLATIONS AND GRAVITATION – 9TH GRADE** Students should be able to explain the difference between the mass of an object and its weight. Students should be able to identify that near the surface of the Earth, the gravitational force acting on the object (its weight) depends only on its mass, and that this force can be simply calculated from knowledge of the mass (F_G = mg). (3.2.5) **9.3.r**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to conduct investigations to determine the behavior of elastic materials. Students should be able to graph the data and identify the relationship between the extent of the stretch and the size of the elastic force (i.e., $F_{elastic}$ = kx where x = stretch). (1.1.4) (3.1.2) **9.3.s**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to describe the role that forces play when energy is transferred between interacting objects and explain how the amount of energy transferred can be calculated from measurable quantities. (1.1.6) (3.2.2) **9.3.t**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to identify that 'work' is the process by which a force transfers energy to an object, and use measured quantities to make calculations of the work done by forces (W = energy transferred = F·D). (3.2.2) (3.3.2) **9.3.u**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to conduct investigations to determine what factors influence whether a force transfers energy to an object or away from the object, and how the direction of the force (relative to the direction of motion) influences the quantity of energy transferred by the force. (1.1.2) (1.1.4) (3.2.3) **9.3.v**
	X	X			**WORK, ENERGY, AND POWER – 9TH GRADE** **CHEMICAL BONDING** Students should be able to recognize that power is a quantity that tells us how quickly energy is transferred to an object or transferred away from the object. Students should be able to give examples that illustrate the differences between power, force and energy (for example, the energy needed to propel a vehicle is stored in the chemical energy of the fuel. Static friction is the force that propels the vehicle, and the power of the vehicle's engine helps to determine how quickly the vehicle can speed up …. and how quickly its engine uses fuel!). (3.2.2) **9.3.w**
		X			**ATOMIC THEORY AND STRUCTURE** Students should be able to use models and diagrams to illustrate the structure of the atom. Include information regarding the distribution of electric charge and mass in the atom. Students should be able to identify the forces that are responsible for the stability of the atom, and which parts of the atom exert and feel these forces. (2.1.1) (3.2.9) **9.3.x**
		X			**ATOMIC THEORY AND STRUCTURE** Students should be able to recognize that there are attractive forces acting within the nucleus

					that are different from electric forces, and that these forces are responsible for the stability of the nucleus. (3.2.9) **9.3.y**
	X		X	X	**WORK, ENERGY, AND POWER – 9TH GRADE** **ECOLOGY** **ENERGY CONCEPTS** Students should be able to describe why it is significant that energy cannot be created (made) nor destroyed (consumed), and identify that that this property of energy is referred to as the Law of the Conservation of Energy. (3.3.1) **9.3.aa**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to give examples that illustrate the transfer of energy from one object (or substance) to another, and examples of energy being transformed from one to another. (3.3.2) **9.3.bb**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to use energy chains to trace the flow of energy through physical systems. Indicate the source of the energy in each example and trace the energy until it leaves the system or adopts a form in the system that neither changes nor is transferred. Students should be able to make qualitative estimates all the forms of the energy involved and reflect on the consequences of the energy transfers and transformations that take place. For example, trace the flow of the radiant energy carried by sunlight that strikes the roof of a home. Students should be able to reflect on how the color of the roof (light vs. dark) will have an impact on the ability to heat and cool the house and possibly the functional lifetime of the roofing materials themselves. (3.3.2) **9.3.cc**
	X		X	X	**WAVE MOTION – 9TH GRADE** **TECHNOLOGY AND SOCIETY** **THE LITHOSPHERE** Students should be able to use diagrams and energy chains to illustrate examples of the selective absorption of mechanical waves in natural phenomena and examples of how the selective absorption of mechanical waves is used to conduct investigations in medicine, industry and science (for example ultrasound imagery, detecting the epicenter of earthquakes, testing structures for defects, and conducting explorations of the earth's crust and mantle). (1.2.2) (3.3.4) **9.3.dd**
	X				**ATOMIC PHYSICS AND QUANTUM EFFECTS – 9TH GRADE** Students should be able to explain that what happens to electromagnetic waves that strike a substance (reflection, transmission, absorption) depends on the wavelength of the waves and the physical properties of the substance. (3.3.5) (3.3.6) **9.3.ee**
	X			X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 9TH GRADE** **GLOBAL WARMING** **STRATOSPHERIC OZONE** Students should be able to investigate how radio waves, microwaves, infrared waves, visible waves and ultraviolet waves behave when they strike different substances. Students should be able to record how effectively different materials reflect, absorb and transmit different kinds of EM waves. Students should be able to draw conclusions based on this data and the physical properties of the substances (for example some substances absorb visible waves, but not radio waves). Other materials absorb UV waves, but not visible waves). (3.3.4) (3.3.5) **9.3.ff**
	X			X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 9TH GRADE** **STRATOSPHERIC OZONE** Students should be able to give examples that illustrate how the selective absorption of EM

					waves explains physical phenomena. For example; how X-rays can be used to detect broken bones beneath the skin and how coating on eyeglasses and sunglasses protect the eyes by permitting visible waves to pass but absorb UV waves. (1.2.2) (3.3.5) **9.3.gg**
	X		X	X	**ATOMIC PHYSICS AND QUANTUM EFFECTS – 9TH GRADE** **ECOLOGY** **GLOBAL WARMING** **STRATOSPHERIC OZONE** Students should be able to use energy chains to trace the flow of energy in a selective absorption process (for example sunburn, Greenhouse Effect, microwave cooking). (3.3.2) **9.3.hh**
	X				**WORK, ENERGY, AND POWER – 9TH GRADE** Students should be able to use energy chains to trace the flow of energy through systems involving sliding friction and air resistance (for example, the braking action in vehicles or bicycles or a vehicle rolling to rest). (3.3.2) **9.3.ii**
	X	X			**WORK, ENERGY, AND POWER – 9TH GRADE** **THERMODYNAMICS** Students should be able to explain that through the action of resistive forces (friction and air resistance) mechanical energy is transformed into heat energy, and because of the random nature of heat energy, transforming all of the heat energy back into mechanical energy (or any other organized form of energy) is impossible. Students should be able to give examples where organized forms of energy (GPE, elastic PE, the KE of large objects) are transformed into heat energy but the reverse transformations are not possible. (3.2.2) (3.3.2) **9.3.jj**
	X	X			**KINETIC THEORY AND THERMODYNAMICS – 9TH GRADE** **THERMODYNAMICS** Students should be able to reflect on why organized forms of energy are more useful than disorganized forms (heat energy). (3.3.2) **9.3.kk**
	X	X		X	**KINETIC THEORY AND THERMODYNAMICS – 9TH GRADE** **THERMODYNAMICS** **CHEMICAL REACTIVITY** **FOSSIL FUEL RESOURCES** **GLOBAL POLITICS AND ECONOMICS** Students should be able to research the factors that contribute to the energy efficiency of cars and trucks. Students should be able to examine the role that the power of the engine and the weight and physical size and shape of the vehicle have on the fuel efficiency of the vehicle. Students should be able to identify and report on the sources of the fuels currently used by vehicles and alternative fuels being developed. (3.4.1) (3.4.2) **9.3.ll**
					Students should be able to explain the formation of solar systems using the Solar Nebular Theory including the origin of the planets and Sun from the nebula, the evolution of planets, and the dispersal of left over gas and dust. (4.2.1) **9.4.a**
				X	**THE LITHOSPHERE** Students should be able to describe how the Earth formed (using the Solar Nebular Theory) into a solid core, molten mantle, crust of solid rock composed of plates, and early atmosphere as a result of the densities of the elements. (4.2.2) **9.4.b**
		X			**LIQUIDS AND SOLIDS** **CHEMICAL BONDING** Students should be able to identify mineral specimens according to their chemical and physical properties. Mineral specimens include calcite, quartz, mica, feldspar, and

					hornblende. Properties include hardness (Moh's scale), streak, specific gravity, luster, cleavage, crystal shape, and color, and other properties that are useful for identification of specific minerals such as reaction with hydrochloric acid. (5.1.1) **9.5.a**
		X		X	**GASES** **LIQUIDS AND SOLIDS** **PERIODIC TABLE** **ORGANIC CHEMISTRY** **BIOGEOCHEMICAL CYCLES** Students should be able to identify a few of the most common elements in the Earth's crust, oceans, and atmosphere and confirm their location on the periodic table (example: Si, O, C, N, H, Al). Students should be able to compare the relative abundance of elements found in the Earth's crust, oceans, and atmosphere. Students should be able to trace carbon as it cycles through the crust, ocean, and atmosphere. (2.1.4) (5.1.1) **9.5.b**
				X	**THE LITHOSPHERE** Students should be able to classify and describe features that are used to distinguish between igneous, sedimentary, and metamorphic rocks. (5.1.2) **9.5.c**
				X	**THE LITHOSPHERE** Students should be able to describe energy sources, processes, and transformations of Earth materials as they progress through the rock cycle to form new sedimentary, metamorphic, and igneous rocks. Students should be able to discuss how the cycling of rock is continuous. (5.1.2) **9.5.d**
				X	**THE LITHOSPHERE** Students should be able to describe how igneous rocks are formed. Students should be able to classify igneous rocks according to crystal size and mineral assemblage. (5.1.2) **9.5.e**
				X	**THE LITHOSPHERE** Students should be able to identify sandstone, shale and limestone by their composition and texture. Students should be able to explain how sandstone, shale, and limestone can be changed into the metamorphic rocks quartzite, slate, and marble. (5.1.2) **9.5.f**
				X	**THE LITHOSPHERE** Students should be able to investigate the densities, composition, and relative age of continental (felsic) and oceanic (mafic) rocks. Students should be able to explain why the continental crust, although thicker in most places, overlies oceanic crust. Students should be able to use this information to explain why oceanic crust subducts below continental crust in convergent plate boundaries and explain the configuration of land masses and ocean basins. (5.1.3) (5.1.4) **9.5.g**
				X	**THE LITHOSPHERE** Students should be able to explain how exposivity, type (shield, strato, etc.) and shape of a volcano is related to the properties of its magma and its location along different plate margins. (5.2.4) **9.5.h**
				X	**THE LITHOSPHERE** Students should be able to identify volcanic products (lava, mudflow, pyroclastic projectiles, ash, gases) associated with various types of volcanoes and their eruptions. Students should be able to describe the effect of these products on life and property. Students should be able to explain how the products of volcanic activity influence both long-term and short-term changes in the Earth system. (5.2.1) (5.2.4) **9.5.i**
				X	**THE LITHOSPHERE**

					Students should be able to describe how energy within the Earth's interior is released in the form of earthquake waves, and explain how these waves affect Earth's surface. (5.2.3) **9.5.j**
				X	**THE LITHOSPHERE** Students should be able to describe how earthquake energy is represented on seismograms and describe how these waves can be used to determine the origin and intensity of earthquakes. (5.3.1) **9.5.k**
				X	**THE LITHOSPHERE** Students should be able to describe the effects on life and property from consequences of earthquake such as landslides, liquification, surface faulting and tsunamis. Students should be able to cite ways these hazards can be minimized. (1.2.1) (5.3.1) **9.5.l**
				X	**THE LITHOSPHERE** Students should be able to use models or computer simulations to demonstrate the processes and origin of landforms at diverging, converging and transform plate boundaries. Students should be able to show on a map how plate tectonics, earthquakes, and volcanoes are spatially related. (5.2.2) **9.5.m**
		X		X	**THERMODYNAMICS** **LIQUIDS AND SOLIDS** **THE LITHOSPHERE** Students should be able to investigate how thermal convection relates to movement of materials. Students should be able to apply this knowledge in explaining the cause of movement of the Earth's plates. (3.1.4) (5.2.1) (5.2.5) **9.5.n**
				X	**THE LITHOSPHERE** Students should be able to research and describe evidence that supports the Theory of Plate Tectonics to include rock magnetism and the age of the sea floor. (5.2.2) **9.5.o**
				X	**THE LITHOSPHERE** Students should be able to explain how the Theory of Plate Tectonics demonstrates that scientific knowledge changes by evolving over time. Students should be able to recognize that although some theories are initially rejected, they may be re-examined and eventually accepted in the face of new evidence. (1.3.1) (5.2.2) **9.5.p**
				X	**THE LITHOSPHERE** Students should be able to explain how data from Global Positioning Systems can be used to predict and determine the direction and rate of movement of Earth's plates and sea floor spreading. (5.3.1) **9.5.q**
				X	**THE LITHOSPHERE** Students should be able to explain how technology such as GPS, tilt meters, etc., can be used to predict earthquake and volcanic activity. (5.3.1) **9.5.r**
				X	**THE LITHOSPHERE** Students should be able to describe ways in which people use historical data, geologic maps, and technologies to minimize earthquake damage. (1.3.1) (5.3.1) **9.5.s**
					GRADE 10
X					Students should be able to identify and form questions that generate a specific testable hypothesis that guide the design and breadth of the scientific investigation. (1.1.1) **10.1.a**

X					Students should be able to design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis. (1.1.2) **10.1.b**
X					Students should be able to collect accurate and precise data through the selection and use of tools and technologies appropriate to the investigations. Display and organize data through the use of tables, diagrams, graphs, and other organizers that allow analysis and comparison with known information and allow for replication of results. (1.1.3) **10.1.c**
X					Students should be able to construct logical scientific explanations and present arguments which defend proposed explanations through the use of closely examined evidence. (1.1.4) **10.1.d**
X					Students should be able to communicate and defend the results of scientific investigations using logical arguments and connections with the known body of scientific information. (1.1.5) **10.1.e**
X					Students should be able to use mathematics, reading, writing and technology when conducting scientific inquiries. (1.1.6) **10.1.f**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to use microscopes to identify similarities and differences among a variety of cells (e.g., muscle, nerve, epithelial, blood, adipose), and explain how structural variations relate to the function that each of the cells performs. (1.2.1) (6.1.2) (6.1.3) **10.6.a**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to differentiate between prokaryotic cells and eukaryotic cells in terms of their general structures (cell membrane & genetic material) and degree of complexity. Students should be able to give examples of prokaryotic organisms and organisms with eukaryotic cells. (6.1.2) (6.1.3) (7.2.5) **10.6.b**
			X		**CELL STRUCTURE AND FUNCTION** **CELLULAR ENERGY** **GROWTH AND DEVELOPMENT** **REGULATION** **BIOCHEMISTRY** Students should be able to explain how organelles of single-celled organisms function as a system to perform the same basic life processes as are performed in multi-cellular organisms (e.g., acquisition of energy, elimination of waste, reproduction, gas exchange, growth, repair, and protein synthesis). (6.1.1) (6.1.3) **10.6.c**
			X		**CELL STRUCTURE AND FUNCTION** **CELLULAR ENERGY** **BIOCHEMISTRY** **REGULATION** Students should be able to use fluid mosaic models of the plasma membrane to explain how its structure regulates the movement of materials across the membrane. (6.1.4) **10.6.d**
			X		**CELL STRUCTURE AND FUNCTION** **CELLULAR ENERGY** **REGULATION** **BIOCHEMISTRY** Students should be able to show how water moves in and out of cells down a concentration gradient. Students should be able to recognize that this process, known as osmosis, requires no input of energy. (6.1.5) **10.6.e**

			X		**CELL STRUCTURE AND FUNCTION** Students should be able to explain the role of cell membranes as highly selective barriers (e.g., diffusion, osmosis, active transport). (6.1.4) (6.1.5) **10.6.f**
			X		**CELL STRUCTURE AND FUNCTION** **REGULATION** **CELLULAR ENERGY** Students should be able to distinguish between active and passive transport. Students should be able to recognize that active transport requires energy input to move molecules from an area of low concentration to an area of high concentration (against the concentration gradient). (6.1.5) **10.6.g**
			X		**CELL STRUCTURE AND FUNCTION** **REGULATION** Students should be able to design a controlled experiment to investigate the capacity of the cell membrane to regulate how materials enter and leave the cell. (6.1.5) **10.6.h**
			X		**CELL STRUCTURE AND FUNCTION** **GROWTH AND DEVELOPMENT** Students should be able to construct cell models (e.g., phenolphthalein-agar cubes, potato-iodine cubes) to investigate the relationship among cell size, surface area to volume ratio and the rates of diffusion into and out of the cell. Students should be able to explain why large organisms have developed from many cells rather than one large cell. (6.1.8) **10.6.i**
			X		**REGULATION** **ECOLOGY** Students should be able to recognize that as a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable despite changes in the outside environment. (6.3.1) (6.3.2) **10.6.j**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to explain how the cells of a multi-cellular organisms work together for the benefit of the colonial or singular organism. (6.1.8) **10.6.k**
		X	X	X	**CHEMICAL BONDING** **ORGANIC CHEMISTRY** **BIOCHEMISTRY** **BIOGEOCHEMICAL CYCLES** Students should be able to use molecular models to explain how carbon atoms uniquely bond to one another to form a large variety of molecules, including those necessary for life (e.g., polysaccharides, polypeptides). (2.4.6) **10.6.l**
		X	X		**CHEMICAL BONDING** **ORGANIC CHEMISTRY** **BIOCHEMISTRY** Students should be able to observe formulas and diagrams of compounds found in food (fats, proteins, carbohydrates). Students should be able to identify elements that comprise these compounds. (2.1.2) **10.6.m**
		X	X	X	**CHEMICAL BONDING** **ORGANIC CHEMISTRY** **BIOCHEMISTRY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain that physically breaking down food into smaller pieces by mechanical digestion helps facilitate breakdown (by increasing surface area) into chemical

					components and that digestive enzymes are necessary for the breakdown of food into those chemical components (e.g., starch to glucose, lipids and glycerol to fatty acids, proteins to amino acids). (2.4.3) (2.4.4) **10.6.n**
		X	X		**CHEMICAL BONDING** **ORGANIC CHEMISTRY** **BIOCHEMISTRY** **ECOLOGY** **CELLULAR STRUCTURE AND FUNCTION** Students should be able to observe and recognize that unicellular organisms take in food from their environment and chemically digest it (if needed) within their cell body. (6.1.8) (6.2.1) **10.6.o**
		X	X	X	**CHEMICAL BONDING** **CHEMICAL REACTIVITY** **BIOCHEMISTRY** **CELL STRUCTURE AND FUNCTION** **REGULATION** **CELLULAR ENERGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that both mechanical and chemical processes are necessary in digestion for multi-cellular organisms to get molecules that come from food to enter the cells. Students should be able to trace the process whereby nutrients are transported to cells where they serve as building blocks for the synthesis of body structures and as reactants for cellular respiration. (6.1.8) (6.2.1) **10.6.p**
		X	X	X	**CHEMICAL BONDING** **THERMODYNAMICS** **ECOLOGY** **REGULATION** **CELLULAR ENERGY** **BIOCHEMISTRY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain the processes used by autotrophs to transform light energy into chemical energy in the form of simple sugars. Students should be able to give examples of how these compounds are used by living things as sources of matter and energy. (6.2.2) **10.6.q**
			X		**BIOCHEMISTRY** **CELLULAR ENERGY** Students should be able to describe the process by which water is removed from sugar molecules (dehydration synthesis) to form carbohydrates and is added to break them down (hydrolysis). (6.2.1) **10.6.r**
		X	X	X	**CHEMICAL BONDING** **THERMODYNAMICS** **KINETICS** **CELLULAR ENERGY** **BIOCHEMISTRY** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe photosynthesis as an energy storing process and explain how environmental factors such as temperature, light intensity, and the amount of water available can affect photosynthesis. (6.2.2) **10.6.s**
		X	X	X	**STOICHIOMETRY**

					CHEMCIAL BONDING **CELLULAR ENERGY** **BIOCHEMISTRY** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify the reactants and the products in equations that represent photosynthesis and cellular respiration. Students should be able to explain how the equations demonstrate the Law of Conservation of Matter and Energy in terms of balanced equations. (2.3.1) (2.4.1) **10.6.t**
		X	**X**	**X**	**STOICHIOMETRY** **CHEMICAL BONDING** **CELLULAR ENERGY** **BIOCHEMISTRY** **ECOLOGY** **BIOGEOCHEMICAL CYCLES** Students should be able to investigate and describe the complementary relationship (cycling of matter and the flow of energy) between photosynthesis and cellular respiration. (6.2.4) **10.6.u**
		X	**X**	**X**	**STOICHIOMETRY** **CHEMICAL BONDING** **THERMODYNAMICS** **CELLULAR ENERGY** **BIOCHEMISTRY** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that during photosynthesis, plants use energy from the sun and elements from the atmosphere and the soil to make specific compounds. Students should be able to recognize that these compounds are used by living things as sources of matter and energy. (6.2.2) **10.6.v**
		X	**X**	**X**	**KINETICS** **CHEMICAL BONDING** **THERMODYNAMICS** **CELLULAR ENERGY** **BIOCHEMISTRY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to compare the amount of chemical potential energy stored in chemical bonds of a variety of foods (calorimetry). Students should be able to recognize that equal amounts of different types of food contain different amounts of energy. (3.1.6) **10.6.w**
		X	**X**	**X**	**KINETICS** **CHEMICAL BONDING** **THERMODYNAMICS** **CELL STRUCTURE AND FUNCTION** **CELLULAR ENERGY** **BIOCHEMISTRY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize that during cellular respiration, chemical bonds between food molecules are broken (hydrolysis), and energy is transferred to ADP to create ATP (the energy storage molecule that fuels cellular processes). Acknowledge that all organisms must break the high energy chemical bonds in food molecules during cellular respiration to obtain the energy needed for life processes. (6.2.1) (6.2.3) **10.6.x**
		X	**X**		**KINETICS**

					CHEMICAL BONDING **CELL STRUCTURE AND FUNCTION** **BIOCHEMISTRY** Students should be able to investigate the role of enzymes (e.g., protease, amylase and lipase) in the rate of chemical breakdown of a variety of foods. (2.4.5) (6.2.1) **10.6.y**
		X	X		**KINETICS** **CHEMICAL BONDING** **REGULATION** **BIOCHEMISTRY** Students should be able to explain how enzymes permit low temperature chemical reactions to occur in cells. (2.4.3) (2.4.5) (6.2.1) **10.6.z**
		X	X		**KINETICS** **CHEMICAL BONDING** **REGULATION** **BIOCHEMISTRY** Students should be able to investigate how various factors (temperature, pH, enzyme/substrate concentration) affect the rate of enzyme activity. (2.4.5) **10.6.aa**
			X		**CELL STRUCTURE AND FUNCTION** Students should be able to illustrate how nerve cells communicate with each other to transmit information from the internal and external environment often resulting in physiological or behavioral responses. (6.1.7) (6.3.1) (6.3.2) **10.6.bb**
			X		**REGULATION** Students should be able to draw a schematic to illustrate a positive and negative feedback mechanism that regulates body systems in order to help maintain homeostasis. (6.1.7) (6.1.9) **10.6.cc**
			X		**REGULATION** Students should be able to recognize that in order to help maintain the health of an organism, the immune system works in nonspecific ways (e.g., skin, mucous membranes) and specific ways (e.g., antibody-antigen interactions.) (6.1.10) (6.3.1) **10.6.dd**
			X	X	**TECHNOLOGY AND SOCIETY** **BIOCHEMISTRY** **ECOLOGY** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to investigate how scientists use biotechnology to produce more nutritious food, more effective medicine, and new ways to mitigate pollution. (1.2.1) (6.4.4) (7.3.2) **10.6.ee**
			X	X	**CELL STRUCTURE AND FUNCTION** **TECHNOLOGY AND SOCIETY** **BIOCHEMISTRY** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to investigate how drugs can affect neurotransmission. (6.4.3) **10.6.ff**
			X	X	**CELL STRUCTURE AND FUNCTION** **TECHNOLOGY AND SOCIETY** **REGULATION** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to explain how antibiotics (e.g., penicillin, tetracycline) kill bacterial cells without harming human cells due to differences between prokaryotic and eukaryotic cell

					structure. (6.1.2) (6.4.2) (7.3.3) **10.6.gg**
			X	X	**CELL STRUCTURE AND FUNCTION** **TECHNOLOGY AND SOCIETY** **ECOLOGY** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to describe how environmental factors (e.g., UV light or the presence of carcinogens or pathogens) alter cellular functions (6.4.1) **10.6.hh**
			X		**MOLECULAR GENETICS** **BIOCHEMISTRY** Students should be able to describe the relationship between DNA, genes, chromosomes and proteins. (7.1.1) **10.7.a**
			X		**MOLECULAR GENETICS** **BIOCHEMISTRY** Students should be able to explain that a gene is a section of DNA that directs the synthesis of a specific protein associated with a specific trait in an organism. (7.1.1) (6.1.6) **10.7.b**
			X		**MOLECULAR GENETICS** **BIOCHEMISTRY** **TECHNOLOGY AND SOCIETY** Students should be able to trace how a DNA sequence, through transcription and translation, results in a sequence of amino acids. (7.1.1) (7.1.3) **10.7.c**
			X		**MOLECULAR GENETICS** **BIOCHEMISTRY** Students should be able to demonstrate that when DNA replicates, the complementary strands separate and the old strands serve as a template for the new complementary strands. Students should be able to recognize that this results in two identical strands of DNA that are exact copies of the original. (7.1.5) **10.7.d**
			X		**MOLECULAR GENETICS** Students should be able to illustrate how a sequence of DNA nucleotides codes for a specific sequence of amino acids. (7.1.1) (6.1.6) **10.7.e**
			X		**MENDELIAN GENETICS** **REPRODUCTION** Students should be able to use Punnett squares, including dihybrid crosses, and pedigree charts to determine probabilities and patterns of inheritance (i.e., dominant/recessive, co-dominance, sex-linkage, multi-allele inheritance). (7.1.2) (7.1.8) **10.7.f**
			X		**MENDELIAN GENETICS** **REPRODUCTION** Students should be able to analyze a karyotype to determine chromosome numbers and pairs. Students should be able to compare and contrast normal and abnormal karyotypes. (7.1.6) (7.1.7) **10.7.g**
			X		**MENDELIAN GENETICS** **REPRODUCTION** Students should be able to explain how crossing over and Mendel's Laws of Segregation and Independent Assortment contribute to genetic variation in sexually reproducing organisms. (7.1.2) **10.7.h**
			X	X	**MENDELIAN GENETICS**

					MOLECULAR GENETICS **ECOLOGY** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to describe how exposure to radiation, chemicals and pathogens can increase mutations. (7.1.3) (7.1.4) (6.4.1) **10.7.i**
			X		**MOLECULAR GENETICS** **CELLULAR REPRODUCTION** Students should be able to describe the cell cycle as an orderly process that results in new somatic cells that contain an exact copy of the DNA that make up the genes and chromosomes found in the parent somatic cells. (7.1.5) **10.7.j**
			X	**X**	**MOLECULAR GENETICS** **BIOCHEMISTRY** **ECOSYSTEM STRUCTURE AND DIVERSIRY** Students should be able to explain that mutations in the DNA sequence of a gene may or may not affect the expression of the gene. Students should be able to recognize that mutations may be harmful, beneficial, or have no impact on the survival of the organism. (7.1.3) **10.7.k**
			X		**MENDELIAN GENETICS** **CELLULAR REPRODUCTION** Students should be able to explain how the type of cell (gamete or somatic) in which a mutation occurs determines heritability of the mutation. Students should be able to predict the possible consequences of a somatic cell mutation. (7.1.3) (7.1.4) (6.4.1) **10.7.l**
			X		**CELLULAR REPRODUCTION** Students should be able to explain how the cell cycle contributes to reproduction and maintenance of the cell and/or organism. (7.1.5) **10.7.m**
			X		**MENDELIAN GENETICS** **CELULAR REPRODUCTION** **REPRODUCTION** Students should be able to recognize that during the formation of gametes, or sex cells (meiosis), the number of chromosomes is reduced by one half, so that when fertilization occurs the diploid number is restored. (7.1.6) **10.7.n**
			X		**MENDELIAN GENETICS** Students should be able to explain why sex-linked traits are expressed more frequently in males. (7.1.8) **10.7.o**
			X		**GROWTH AND DEVELOPMENT** Students should be able to compare and contrast the processes of growth (cell division) and development (differentiation). (7.1.9) **10.7.p**
			X		**GROWTH AND DEVELOPMENT** Students should be able to recognize that any environmental factor that influences gene expression or alteration in hormonal balance may have an impact on development. (6.4.1) (7.1.9) **10.7.q**
			X	**X**	**MOLECULAR GENETICS** **EVOLUTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to recognize random mutation (changes in DNA) and recombination within gametes as the sources of heritable variations that give individuals within a species

					survival and reproductive advantage or disadvantage over others in the species. (7.1.3) (7.2.3) (7.3.3) **10.7.r**
			X	X	**ECOLOGY** **EVOLUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to analyze natural selection simulations and use data generated from them to describe how environmentally favored traits are perpetuated over generations resulting in species survival, while less favorable traits decrease in frequency or may lead to extinction. (7.2.3) **10.7.s**
			X	X	**BIOCHEMISTRY** **GROWTH AND DEVELOPMENT** **EVOLUTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain how biochemical evidence, homologous structures, embryological development and fossil evidence support or refute prior hypotheses of common ancestry. (7.2.1) **10.7.t**
			X	X	**EVOLUTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe that evolution involves changes in the genetic make-up of whole populations over time, not changes in the genes of an individual organism. (7.2.1) (7.2.2) **10.7.u**
			X	X	**EVOLUTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain how species evolve through descent with modification, thus allowing them to adapt to different environments. (7.2.2) **10.7.v**
			X	X	**EVOLUTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to discuss how environmental pressure, genetic drift, mutation and competition for resources influence the evolutionary process. Students should be able to recognize that a change in a species over time does not follow a set pattern or timeline. (7.2.4) **10.7.w**
			X	X	**EVOLUTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to compare and contrast the role of sexual selection to the role of natural selection on the evolutionary process. (7.2.4) (7.2.6) **10.7.x**
			X	X	**ECOLOGY** **EVOLOUTION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to relate a population's survival to the reproductive success of adapted individuals in that population. (7.2.2) (7.2.3) **10.7.y**
			X	X	**EVOLUTION** **ECOLOGY**

					ECOSYSTEM STRUCTURE AND DIVERSITY Students should be able to explain the roles of geographical isolation and natural selection on the evolution of new species. (7.2.4) **10.7.z**
			X	**X**	**EVOLUTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to predict possible evolutionary implications for a population due to environmental changes over time (e.g., volcanic eruptions, global climate change, industrial pollution). (1.2.2) (7.2.6) (8.1.4) **10.7.aa**
			X	**X**	**EVOLUTION** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain why homogeneous populations may be more vulnerable to environmental changes than heterogeneous populations. (7.2.6) **10.7.bb**
			X	**X**	**EVOLUTION** **CLASSIFICATION** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain how evolutionary relationships between species are used to group organisms together. (7.2.5) **10.7.cc**
			X	**X**	**CELL STRUCTURE AND FUNCTION** **MOLECULAR GENETICS** **EVOLUTION** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to explain how antibiotic resistance populations evolve from common bacterial populations. (1.3.1) (7.2.7) **10.7.dd**
			X	**X**	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to research how invasive species have genetically altered an indigenous population. (1.2.2) (8.1.3) **10.7.ee**
			X		**MOLECULAR GENETICS** **EVOLUTION** Students should be able to explain how DNA evidence can be used to determine evolutionary relationships. (7.2.5) (7.3.3) **10.7.ff**
			X	**X**	**MOLECULAR GENETICS** **REPRODUCTION** **ECOLOGY** **TECHNOLOGY AND SOCIETY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to investigate how the human ability to manipulate genetic material and reproductive processes can be applied to many areas of medicine, biology, and agriculture. Students should be able to evaluate the risks and benefits of various ethical, social and legal scenarios that arise from this ability. (1.2.1) (1.2.2) (7.3.1) (7.3.2) **10.7.gg**
			X	**X**	**MOLECULAR GENETICS** **REPRODUCTION** **ECOLOGY** **TECHNOLOGY AND SOCIETY**

					ECOSYSTEM STRUCTURE AND DIVERSITY **GLOBAL POLITICS AND ECONOMICS** Students should be able to discuss examples of how genetic engineering technology can be applied in biology, agriculture and medicine in order to meet human wants and needs. (1.3.1) (6.4.2) (6.4.4) (7.3.2) **10.7.hh**
			X	X	**MOLECULAR GENETICS** **REPRODUCTION** **ECOLOGY** **TECHNOLOGY AND SOCIETY** **ENVIRONMENTAL IMPACT AND HUMAN HEALTH** **GLOBAL POLITICS AND ECONOMICS** Students should be able to explain the basic process of bacterial transformation and how it is applied in genetic engineering. (7.3.2) **10.7.ii**
			X	X	**MOLECULAR GENETICS** **BIOCHEMISTRY** **ECOLOGY** **EVOLUTION** **REPRODUCTION** **TECHNOLOGY AND SOCIETY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to explain how developments in technology (e.g. gel electrophoresis) have been used to identify individuals based on DNA as well as to improve the ability to diagnose genetic diseases. (1.2.1) (7.3.3) **10.7.jj**
					GRADE 11
X					Students should be able to identify and form questions that generate a specific testable hypothesis that guide the design and breadth of the scientific investigation. (1.1.1) **11.1.a**
X					Students should be able to design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis. (1.1.2) **11.1.b**
X					Students should be able to collect accurate and precise data through the selection and use of tools and technologies appropriate to the investigations. Display and organize data through the use of tables, diagrams, graphs, and other organizers that allow analysis and comparison with known information and allow for replication of results. (1.1.3) **11.1.c**
X					Students should be able to construct logical scientific explanations and present arguments which defend proposed explanations through the use of closely examined evidence. (1.1.4) **11.1.d**
X					Students should be able to communicate and defend the results of scientific investigations using logical arguments and connections with the known body of scientific information. (1.1.5) **11.1.e**
X					Students should be able to use mathematics, reading, writing and technology when conducting scientific inquiries. (1.1.6) **11.1.f**
		X			**ATOMIC THEORY AND STRUCTURE** **CHEMICAL BONDING** **PERIODIC TABLE** Students should be able to construct models or diagrams (Lewis Dot structures, ball and stick

					models, or other models) of common compounds and molecules (i.e., NaCl, SiO_2, O_2, H_2, CO_2) and distinguish between ionically and covalently bonded compounds. Based on the location of their component elements on the Periodic Table, explain the elements tendency to transfer or share electrons. (1.1.3) (2.1.4) (2.1.6) **11.2.a**
		X			**ATOMIC THEORY AND STRUCTURE** **PERIODIC TABLE** Students should be able to explain why the average atomic mass of an element reflects the relative natural abundance of the element and therefore is not a whole number. (2.1.3) **11.2.b**
		X		X	**NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to explain that unstable isotopes undergo spontaneous nuclear decay, emitting energy or particles and energy. (2.1.3) (2.3.2) (3.1.7) **11.2.c**
		X		X	**NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to compare and contrast the energy released by nuclear reactions to that released by chemical reactions. (2.3.1) (2.3.2) **11.2.d**
		X		X	**NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to describe the composition of alpha, beta, and gamma radiation and the shielding necessary to prevent penetration. (3.1.1) (3.1.7) (3.2.9) **11.2.e**
		X		X	**NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to use the half life of a radioactive isotope to calculate the amount of remaining radioactive substance after an integral number of half-lives. (2.1.3) (2.3.2) **11.2.f**
		X			**GASES** Students should be able to use kinetic molecular theory to explain changes in gas volume, pressure, and temperature. (2.1.8) (2.1.9) (3.1.4) **11.2.g**
		X			**GASES** Students should be able to perform simple calculations to show that if the temperature is held constant, changes in pressure and volume of an enclosed gas have an inverse relationship. (Boyles Law). (1.1.6) (2.1.9) **11.2.h**
		X			**GASES** Students should be able to perform simple calculations to show that if the pressure is held constant, changes in temperature (in Kelvin) and volume of an enclosed gas have a direct relationship. (Charles Law). (1.1.6) (2.1.9) **11.2.i**
		X			**GASES** Students should be able to perform simple calculations to show that if the volume is held constant, changes in pressure and temperature (in Kelvin) of an enclosed gas have a direct relationship (Gay-Lussac's Law). (1.1.6) (2.1.9) **11.2.j**
		X			**PERIODIC TABLE** Students should be able to use the Periodic Table to show trends within periods and groups (families) regarding atomic size, size of ions, ionization energies and electronegativity. (2.1.4) **11.2.k**
		X			**LIQUIDS AND SOLIDS**

					SOLUTIONS Students should be able to express the concentration of various solutions in terms of the amount of solute dissolved in the solvent (molarity). (1.1.6) (2.2.1) **11.2.l**
		X		X	**LIQUIDS AND SOLIDS** **SOLUTIONS** **STOICHIOMETRY** **POLLUTION CONCEPTS** Students should be able to collect data to calculate the unknown concentration of a solution by performing an acid-base titration using an appropriate indicator. Students should be able to describe neutralization reactions using chemical equations. (1.1.3) (2.2.1) **11.2.m**
		X			**STOICHIOMETRY** Students should be able to recognize that one mole is the amount of any substance that contains 6.02×10^{23} (Avogadro's number) representative particles of that substance. This quantity of particles will have the mass equivalent to the molecular weight (molar mass). (1.1.6) (2.3.1) **11.2.n**
		X			**STOICHIOMETRY** Students should be able to express various quantities of matter in terms of moles (e.g., 6.0 g carbon = .50 moles of carbon; 36 g H_2O = 2.0 moles H_2O). (1.1.6) (2.3.1) **11.2.o**
		X		X	**STOICHIOMETRY** **BIOGEOCHEMICAL CYCLES** Students should be able to determine how the mass of the products compares to the mass of the reactants in chemical investigations. Students should be able to show how this comparison links to the appropriate balanced chemical equation. (2.3.1) (2.4.1) **11.2.p**
		X			**REACTION TYPES** **CHEMICAL BONDING** Students should be able to conduct experiments and provide evidence (e.g., formation of a precipitate, evolution of gas, change of color, release/absorption of energy in the form of heat, light, or sound) to determine if a chemical reaction has occurred. (1.1.2) (1.1.3) (2.4.1) **11.2.q**
		X			**CHEMICAL BONDING** Students should be able to identify, name and write formulae for covalent and ionic compounds. (2.1.6) **11.2.r**
		X			**CHEMICAL BONDING** **STOICHIOMETRY** Students should be able to describe chemical reactions using correct chemical formulae and balance the resulting chemical equation. (2.4.1) (2.4.2) **11.2.s**
		X			**REACTION TYPES** Students should be able to classify various reactions as synthesis (combination), single replacement, double replacement, decomposition or combustion. (2.4.2) **11.2.t**
		X			**REACTION TYPES** **CHEMICAL REACTIVITY** Students should be able to explain whether or not a chemical reaction would occur given a set of reactants. Students should be able to predict the product(s) if the reactions would occur. (2.4.2) **11.2.u**
		X			**KINETICS**

					Students should be able to investigate factors (e.g., presence of a catalyst, temperature, concentration) that influence reaction rates. (2.4.3) (2.4.5) **11.2.v**
		X			**REACTION TYPES** **THERMODYNAMICS** Students should be able to analyze reaction diagrams for some common chemical reactions to compare the amount of heat energy absorbed by the reaction to the amount of heat energy released. Students should be able to explain, using the diagrams, that if the products of the reactions are at a higher level than the reactants, the reaction has absorbed heat energy (endothermic), but if the products of the reaction are at a lower level than the reactants, then heat energy has been released (exothermic). (2.4.4) **11.2.w**
		X			**KINETICS** Students should be able to use energy diagrams to explain the effect of a catalyst on activation energy. (2.4.4) **11.2.x**
		X		X	**ORGANIC CHEMISTRY** **CHEMICAL BONDING** **POLLUTION CONCEPTS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to identify polymers as large molecules with a carbon backbone. Students should be able to recognize that polymers are comprised of repeating monomers. Students should be able to investigate synthetic and naturally occurring polymers and relate their chemical structure to their current or potential use. (2.4.6) (2.5.1) **11.2.y**
		X		X	**NUCLEAR CHEMISTRY** **LIQUIDS AND SOLIDS** **ORGANIC CHEMISTRY** **REACTION TYPES** **THERMODYNAMICS** **CHEMICAL REACTIVITY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to research and report on materials that are used in response to human and societal needs. These materials might include but are not limited to synthetic polymers such as Kevlar or Gortex; or radioactive isotopes such as U^{235}, or C^{14}, etc… Students should be able to recognize the intended (and realized) benefits as well as any risks or trade-offs required in their production and use. (2.5.1) **11.2.z**
	X				**CIRCULAR MOTION AND ROTATION – 11TH GRADE** Students should be able to conduct investigations to identify how the rotational kinetic energy of an object depends on the object's mass, angular speed (rpm) and its geometry (for example; solid and hollow spheres, solid and hollow cylinders, rings). (3.1.2) **11.3.a**
	X				**CIRCULAR MOTION AND ROTATION – 11TH GRADE** Students should be able to conduct investigations to show that rolling objects have two kinds of kinetic energy, linear kinetic energy (LKE), and rotational kinetic energy (RKE). For example, a ball released on a ramp from a height, h, will consistently reach the bottom of the ramp with less linear kinetic energy than its GPE at the top of the ramp. The RKE of the rolling object explains the difference (3.1.2) (3.2.2) **11.3.b**
		X			**THERMODYNAMICS** **CHEMICAL BONDING** Students should be able to explain that when a chemical reaction takes place and energy is released, the reaction results in molecules that have a lower chemical energy and if energy must be added for a chemical reaction to take place, the molecules that result from that

					reaction have higher chemical energy. (2.4.4) (3.1.6) **11.3.c**
	X	X		X	**NUCLEAR PHYSICS – 11TH GRADE** **NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to recognize that nuclear energy takes the form of mass, and that energy is released from a nuclear reaction as a consequence of the annihilation of mass. (2.3.2) (3.1.7) **11.3.d**
	X	X		X	**NUCLEAR PHYSICS – 11TH GRADE** **NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to explain why large amounts of energy are released when small amounts of mass are annihilated ($E = mc^2$). (3.1.7) **11.3.e**
	X				**OSCILLATIONS AND GRAVITY – 11TH GRADE** Students should be able to use the inverse square law to describe how the force of gravity changes over long distances (for example, describe the forces acting on the Voyager Space Probes as they moved through the solar system). (1.1.6) (3.2.5) **11.3.f**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to conduct investigations to determine the relative sizes of static and kinetic frictional forces acting between two surfaces. (1.1.3) (3.2.1) (3.3.1) **11.3.g**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to conduct investigations to determine what variables (mass, normal force, surface area, surface texture, etc.) influence the size of frictional forces that act between two objects. (1.1.3) (3.2.1) (3.3.1) **11.3.h**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to give examples in which static friction is a force of propulsion, initiating the motion of an object. Students should be able to use force diagrams to illustrate the forces acting on the object during this propulsion process. (3.2.1) (3.2.2) **11.3.i**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to use force diagrams to describe how static friction can prevent an object (that is subject to another force) from moving. (3.2.1) (3.2.2) **11.3.j**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to draw force diagrams to illustrate the action of friction when it acts to slow-down an object. Students should be able to use an energy argument to describe how friction slows down a moving object. (3.2.1) (3.2.2) **11.3.k**
	X				**ELECTROSTATICS – 11TH GRADE** Students should be able to describe the factors that contribute to the size of an electric force acting between charged particles (i.e., the size of an electric force depends upon the size of the charges involved and the distance between the charges). Students should be able to recognize that the electric force is an inverse square force like the gravitational force. Students should be able to use a sketch of this force to describe how its influence changes as the distance between the charges increases. (3.2.6) **11.3.l**
	X	X			**OSCILLATIONS AND GRAVITY – 11TH GRADE** **ELECTROSTATICS – 11TH GRADE** **ATOMIC THEORY AND STRUCTURE** Students should be able to recognize that the gravitational forces acting between objects the

					size of people or even large trucks is negligible compared to their weight (for example, F_{Grav} acting between two people standing 1m apart on the Earth's surface is less than one billionth the size of their weight). Also recognize that gravitational forces between particles at the molecular level are completely negligible when compared to electric forces that act between these particles ($F_{Grav}/F_{electric}<10^{-30}$). (3.2.5) **11.3.m**
	X	X			**NEWTON'S LAWS OF MOTION – 11TH GRADE** **ELECTROSTATICS – 11TH GRADE** **ATOMIC THEORY AND STRUCTURE** **CHEMICAL BONDING** Students should be able to describe how many of the forces acting between objects (friction and normal forces) and acting within objects (tensions, compressions and elastic forces) are manifestations of the electromagnetic forces that act between atoms and molecules in substances. (3.2.7) **11.3.n**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** **ELECTROSTATICS – 11TH GRADE** Students should be able to use diagrams or models to show how the electric forces acting between molecules can explain the presence of these forces. (3.1.5) (3.2.7) **11.3.o**
	X				**MAGNETIC FIELDS – 11TH GRADE** Students should be able to use diagrams to show the similarities between the magnetic field of a permanent magnet and the magnetic field created by an electric coil. (3.2.8) **11.3.p**
	X			X	**MAGNETIC FIELDS – 11TH GRADE** **ENERGY CONCEPTS** Students should be able to conduct investigations to show how forces acting between permanent magnets and conducting coils carrying electric currents can be used to create electric motors. (3.2.8) **11.3.q**
	X			X	**ELECTROMAGNETISM – 11TH GRADE** **ENERGY CONCEPTS** Students should be able to use diagrams to show how magnets and rotating coils can be used to create electric currents. (3.2.8) **11.3.r**
		X			**ATOMIC THEORY AND STRUCTURE** Students should be able to use vector diagrams to illustrate the forces that act within the nucleus. Students should be able to recognize that the stability of a nucleus depends upon the repulsive electric forces acting between the protons and the attractive nuclear forces acting between all protons and neutrons in the nucleus. (3.2.9) **11.3.s**
		X			**ATOMIC THEORY AND STRUCTURE** **CHEMICAL BONDING** **NUCLEAR CHEMISTRY** Students should be able to use examples of mechanical or chemical systems to explain that the stability of an object is linked to the object's energy, and that stability can be used as an indicator how likely it is that an object will undergo a physical, chemical, or nuclear change. (3.1.6) (3.2.7) (3.2.9) **11.3.t**
		X		X	**NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to identify mid-sized nuclei as the most stable nuclei, and use the concept of stability to explain the basics of nuclear fission, fusion, and radioactive decay. Students should be able to use models and diagrams to illustrate the differences between fission, fusion and radioactive decay. (2.3.2) (3.1.7) (3.2.9) **11.3.u**

	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to use vector diagrams to illustrate how the total force is determined from a group of individual forces. (3.2.2) **11.3.v**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to make vector diagrams of objects moving with a constant velocity, identifying all of the forces acting on the object (for example, a car moving along a straight highway, an aircraft in flight, an elevator ascending at constant speed, etc.). (3.2.1) (3.2.2) **11.3.w**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to reflect on how forces can collectively act on the object and not change its motion (basis of Newton's 1st Law). (3.2.1) **11.3.x**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to conduct investigations to reach qualitative and quantitative conclusions regarding the effects of the size of the total force and the object's mass on its resulting acceleration (Newton's 2nd Law, $a = F_{totat}/m$). (1.1.3) (1.1.4) (1.1.6) (3.2.1) (3.2.2) **11.3.y**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to use examples to illustrate the differences between mass and force and explain why only forces can change the motion of objects. (3.2.2) (3.2.3) **11.3.z**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to explain why an object with a large mass is usually more difficult to start moving than an object with a smaller mass. (3.2.3) **11.3.aa**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to observe how the direction of the acceleration relates to the direction of the total force. (3.2.1) (3.2.2) **11.3.bb**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to use Newton's Second Law to calculate the acceleration of objects that are subject to common forces (for example, gravity, constant pushing or pulling forces and/or friction). (1.1.6) (3.2.1) (3.2.2) **11.3.cc**
	X				**CIRCULAR MOTION AND ROTATION – 11TH GRADE** Students should be able to use vector diagrams to show how the direction of the acceleration (relative to the direction of the velocity) can be used to determine if the speed of the object will increase or decrease and if the direction of motion will change. (1.1.6) (3.2.1) (3.2.2) **11.3.dd**
	X				**KINEMATICS – 11TH GRADE** Students should be able to describe what the size of the acceleration of an object indicates about the object's motion (how quickly the object's velocity will change). Students should be able to give examples of objects having large accelerations (motorcycles starting from rest, vehicles stopping abruptly, cars negotiating sharp curves) and objects having small accelerations (tractor trailers starting from rest, large ships slowing down, and vehicles traveling on long gradual curves on highways). (3.2.1) (3.2.2) (3.2.3) (3.2.4) **11.3.ee**
	X				**KINEMATICS – 11TH GRADE** Students should be able to conduct investigations to show that the acceleration due to gravity is the same for all objects near the surface of the earth. Students should be able to use

					graphical analysis to determine the acceleration due to gravity from experimental data. (3.2.5) **11.3.ff**
	X				**KINEMATICS – 11TH GRADE** Students should be able to use algebraic relationships that relate the acceleration of an object to its speed and position to make predictions about the motion of objects as they move along straight and circular paths. (1.1.6) (3.2.1) (3.2.3) **11.3.gg**
	X				**SYSTEMS OF PARTICLES, LINEAR MOMENTUM – 11TH GRADE** Students should be able to conduct investigations (or demonstrate) that under a variety of conditions when two objects collide they exert equal sized forces on each other. Students should be able to use Newton's 2nd Law to explain why these two objects may react differently to equal sized forces. (3.2.1) (3.2.4) (3.3.1) **11.3.hh**
	X				**NEWTON'S LAWS OF MOTION – 11TH GRADE** Students should be able to use vector diagrams and Newton's 3rd Law to explain how a bathroom scale indirectly indicates your weight. (3.2.1) **11.3.ii**
	X				**SYSTEMS OF PARTICLES, LINEAR MOMENTUM – 11TH GRADE** Students should be able to recognize that momentum of an object is a property of its motion that can be calculated from its mass and its velocity ($P = mv$), and that only forces can change the momentum of an object. (3.2.3) **11.3.jj**
	X				**SYSTEMS OF PARTICLES, LINEAR MOMENTUM – 11TH GRADE** Students should be able to conduct investigations to determine the relationship between the force acting on an object and the change it produces in the object's momentum (i.e., the impulse) ($\Delta P = F_{avg} \cdot \Delta t$). (1.1.3) (3.2.3) **11.3.kk**
	X				**SYSTEMS OF PARTICLES, LINEAR MOMENTUM – 11TH GRADE** Students should be able to use the concept of impulse ($I = F_{avg} \cdot \Delta t$) to make estimates of average forces when the change in an object's momentum is known. For example, explain why collision forces will be reduced when the barriers are flexible (increasing Δt decreases F_{avg}) or how the severity of the injury to a falling athlete will be influenced by the surface the athlete lands on (i.e. turf, hard ground, concrete, etc.). (3.2.3) (3.2.4) **11.3.ll**
	X				**SYSTEMS OF PARTICLES, LINEAR MOMENTUM – 11TH GRADE** Students should be able to recognize that momentum (like energy) is a conserved quantity and describe how this property of momentum makes it a useful tool in problem solving, especially problems involving collisions. (3.2.4) (3.3.1) **11.3.mm**
	X				**WORK, ENERGY, AND POWER – 11TH GRADE** Students should be able to describe that forces transfer energy from one object to another through a process called 'work'. Students should be able to explain how calculating the work done by a force helps us make qualitative and quantitative predictions regarding the motion of objects. Students should be able to use mathematics, graphing calculators and/or graphing analysis programs to investigate the work done by individual forces. (3.2.2) **11.3.nn**
	X				**WORK, ENERGY, AND POWER – 11TH GRADE** Students should be able to give examples of forces doing work to transfer energy to a rotating object (increasing its rotational speed), or doing work to transfer energy away from a rotating object (decreasing its rotational speed). (3.2.2) (3.3.1) **11.3.oo**
	X				**CIRCULAR MOTION AND ROTATION – 11TH GRADE** Students should be able to describe how the concept of torque is used to explain (and

					calculate) the rotational effect that forces have when they act on objects. (3.2.2) **11.3.pp**
	X				**CIRCULAR MOTION AND ROTATION – 11TH GRADE** Students should be able to conduct investigations to identify the factors that determine the torque produced by a force (Torque = force · lever distance). (For example, what conditions must be met to ensure that the sum of all torques acting on an object is zero, leaving the object in rotational equilibrium?) (1.1.6) (3.2.1) (3.2.2) **11.3.qq**
	X				**WORK, ENERGY, AND POWER – 11TH GRADE** Students should be able to use energy chains to trace the flow of energy through systems that involve both static and kinetic friction. (3.3.1) (3.3.2) **11.3.rr**
	X				**PHYSICAL OPTICS – 11TH GRADE** Students should be able to use diagrams to illustrate how the constructive and destructive interference of waves occurs. (3.3.3) (3.3.4) **11.3.ss**
	X			X	**PHYSICAL OPTICS – 11TH GRADE** **THE LITHOSPHERE** Students should be able to give specific examples of how wave interference occurs in earth systems for both mechanical waves and electromagnetic waves. For example, in the case of mechanical waves, demonstrate regions of high volume (constructive interference) and low volume 'dead spots' (destructive interference) in the space surrounding two speakers or consider the effect that wave interference has on the impact of seismic waves produced by earthquakes. In the case of EM waves, observe the colored patterns (fringes) on a soap bubble or in a thin layer of oil on a puddle of water. (3.3.4) **11.3.tt**
	X				**PHYSICAL OPTICS – 11TH GRADE** Students should be able to describe how wave interference is used to create useful devices, such as noise cancellation devices (mechanical waves), window coatings to selectively transmit or reflect IR waves, diffraction gratings for spectroscopy, and lasers (EM waves). (3.3.4) **11.3.uu**
		X			**NUCLEAR CHEMISTRY** Students should be able to use diagrams and energy chains to illustrate and explain the flow and transformations of energy that occur in fission and fusion processes and during radioactive decay. (3.1.7) (3.3.1) **11.3.vv**
	X	X		X	**NUCLEAR PHYSICS – 11TH GRADE** **NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to explain why the Law of Conservation of Energy must be expanded to the Law of the Conservation of Mass/Energy when nuclear energy is involved in a process. (3.1.7) (3.3.1) **11.3.ww**
	X	X		X	**NUCLEAR PHYSICS – 11TH GRADE** **NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to use the concept of stability to explain why energy is released during a fission process and during a fusion process. (3.3.1) **11.3.xx**
	X	X		X	**NUCLEAR PHYSICS – 11TH GRADE** **NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to use diagrams and energy chains to illustrate and explain the flow and transformations of energy that occur in fission and fusion processes, and during

					radioactive decay. (3.1.7) (3.3.1) **11.3.yy**
	X	X		X	**NUCLEAR PHYSICS – 11TH GRADE** **KINETIC THEORY AND THERMODYNAMICS – 11TH GRADE** **NUCLEAR CHEMISTRY** **THERMODYNAMICS** **RENEWABLE ENERGY RESOURCES** Students should be able to use energy chains to describe the flow of energy in a nuclear-fueled electric power facility. Indicate the source of energy of the facility, how and where energy leaves the facility, and in which parts of the facility energy transformations take place. (3.3.1) (3.4.1) **11.3.zz**
	X	X	X	X	**NUCLEAR PHYSICS – 11TH GRADE** **KINETIC THEORY AND THERMODYNAMICS – 11TH GRADE** **NUCLEAR CHEMISTRY** **THERMODYNAMICS** **ECOLOGY** **RENEWABLE ENERGY RESOURCES** **GLOBAL POLITICS AND ECONOMICS** Students should be able to compare and contrast the energy diagram of the nuclear-fueled power plant to a comparable energy diagram for a fossil-fueled electric power plant. (3.4.1) (3.4.2) **11.3.aaa**
	X	X	X	X	**NUCLEAR PHYSICS – 11TH GRADE** **KINETIC THEORY AND THERMODYNAMICS – 11TH GRADE** **NUCLEAR CHEMISTRY** **ECOLOGY** **FOSSIL FUEL RESOURCES** Students should be able to prepare a written report, a poster, or a computer-based presentation that explains the advantages and disadvantages of using fossil fuels, nuclear fuel and alternative energy sources to generate electrical energy. (3.4.2) **11.3.bbb**
				X	**RENEWABLE ENERGY RESOURCES** Describe how nuclear fission reactions change over time and lead to the creation of elements (and the evolution of stars). Explain how the process of nuclear fission in our Sun consumes mass and releases, over billions of years, enormous amounts of energy.
					GRADE 12
X					Students should be able to identify and form questions that generate a specific testable hypothesis that guide the design and breadth of the scientific investigation. (1.1.1) **12.1.a**
X					Students should be able to design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis. (1.1.2) **12.1.b**
X					Students should be able to collect accurate and precise data through the selection and use of tools and technologies appropriate to the investigations. Display and organize data through the use of tables, diagrams, graphs, and other organizers that allow analysis and comparison with known information and allow for replication of results. (1.1.3) **12.1.c**
X					Students should be able to construct logical scientific explanations and present arguments which defend proposed explanations through the use of closely examined evidence. (1.1.4) **12.1.d**
X					Students should be able to communicate and defend the results of scientific investigations

					using logical arguments and connections with the known body of scientific information. (1.1.5) **12.1.e**
X					Students should be able to use mathematics, reading, writing and technology when conducting scientific inquiries. (1.1.6) **12.1.f**
		X		X	**THERMODYNAMICS** **ATOMIC THEORY AND STRUCTURE** **ENERGY CONCEPTS** Students should be able to explain that the quantity of radiant energy delivered to a surface every second can be viewed in two different ways. Students should be able to use the concept of waves to describe that the energy delivered by electromagnetic radiation depends on the amplitude and frequency of the electromagnetic waves. Students should be able to use the particle model of electromagnetic radiation (energy is carried by packets of electromagnetic energy called photons) to explain that the radiant energy delivered depends on the frequency of the radiation and the number of packets striking the surface per second. (3.1.1) (3.3.5) (3.3.6) **12.3.a**
		X			**ATOMIC THEORY AND STRUCTURE** Students should be able to use the model of discrete electronic energy states in an atom to describe how the atom can emit or absorb packets of electromagnetic energy (photons) having specific energies. (3.3.5) (3.3.6) **12.3.b**
		X			**ATOMIC THEORY AND STRUCTURE** Students should be able to demonstrate how prisms, diffraction gratings or other optical devices can be used to analyze the light coming from different substances and how this analysis can be useful in the identification of elements and compounds. (3.3.5) (3.3.6) **12.3.c**
					Students should be able to use diagrams to show how concave reflecting devices and convex lenses can be used to collect and focus EM waves. Students should be able to recognize that the characteristics of these devices are different for different groups of EM waves (radio waves, microwaves, infrared waves, visible waves, etc.). (3.3.4) (3.4.2) **12.3.d**
					Students should be able to create light ray diagrams to illustrate how converging devices are used to collect and focus waves in scientific devices (for example, telescopes and microscopes). (3.3.5) **12.3.e**
		X		X	**NUCLEAR CHEMISTRY** **RENEWABLE ENERGY RESOURCES** Students should be able to describe how nuclear fusion reactions change over time and lead to the creation of elements (and the evolution of stars). (4.1.1) (4.2.1) (4.3.2) **12.4.a**
				X	**ENERGY CONCEPTS** Students should be able to explain how the process of nuclear fusion in our Sun consumes mass and releases, over billions of years, enormous amounts of energy. (3.1.7) (4.1.1) **12.4.b**
					Students should be able to compare and contrast the age, temperature, and size of our Sun to other stars. (4.2.1) (4.3.4) **12.4.c**
					Students should be able to discuss the many ways in which the Sun influences Earth including the role of gravity, coronal mass ejections, and electromagnetic radiation including gamma photons. (4.1.2) **12.4.d**
					Students should be able to use library and internet resources to identify characteristics of the Earth which permit it to support life, and compare those characteristics to properties of other

					planets. Based on the research, debate the possibility of life on other planets. (1.1.4) (6.1.1) **12.4.e**
					Students should be able to describe the relative size differences and distances between planetary systems, stars, multiple-star galaxies, star clusters, galaxies, and galactic groups in the Universe. (4.3.1) (4.3.4) **12.4.f**
					Students should be able to explain why the force of gravity is responsible for many phenomena in the Universe including the formation and life cycle of galaxies, stars, and planetary systems. Students should be able to explain how gravity influences the motion of bodies in the Universe including tides and maintaining orbits of planets. (3.2.5) (4.1.2) (4.3.2) **12.4.g**
					Students should be able to describe how our knowledge of the history of the Universe is based on electromagnetic energy that has traveled vast distances and takes a long period of time to reach us. (4.3.3) **12.4.h**
					Students should be able to explain the life history of stars in terms of luminosity, size and temperature using the Hertzsprung-Russell Diagram. Students should be able to compare and contrast stellar evolution based on mass (black hole, neutron star, white dwarf). (4.3.3) (4.4.1) **12.4.i**
					Students should be able to explain the Big Bang Theory and how it is supported by evidence that includes microwave background radiation and red shift. Students should be able to cite research supporting the Big Bang Theory as the most scientifically accepted theory explaining the formation of the Universe. (1.1.5) ((4.3.6) **12.4.j**
					Students should be able to describe how the composition of stars can be determined by analysis of their spectra. Students should be able to compare the elements that compose stars to those that compose Earth. (4.3.5) (4.4.1) **12.4.k**
					Students should be able to discuss how technology (i.e., telescopes, computers, space probes, radio observatories) assists astronomers in discovering and investigating celestial bodies beyond the limits of our Solar System. (4.4.1) (4.4.2) **12.4.l**
		X	X	X	**EQUILIBRIUM** **BIOCHEMISTRY** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify and measure biological, chemical and physical indicators within a given ecosystem (pH, dissolved oxygen, macro invertebrate and other indicator species, salinity). (1.1.3) (8.1.1) (8.1.4) **12.8.a**
		X	X	X	**EQUILIBRIUM** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Using models, computer simulations, or graphic representations, students should be able to demonstrate how, changes in these indicators may affect interactions within ecosystems. Students should be able to evaluate the current health of the ecosystem and suggest possible interventions for mitigation. (8.1.1) (8.1.4) (8.3.4) **12.8.b**
		X	X	X	**EQUILIBRIUM** **ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain how feedback loops keep an ecosystem (at the local and

					global level) in a state of dynamic equilibrium (e.g., positive and negative feedback loops associated with global climate). (8.2.1) **12.8.c**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain how niches help to increase the diversity within an ecosystem and maximize the number of populations that can live in the same habitat. (8.1.1) (8.1.2) **12.8.d**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Using graphs of population data of a predator and its prey, students should be able to describe the patterns observed. Students should be able to explain how the interactions of predator and prey generate these patterns, and predict possible future trends in these populations. (1.1.6) (8.1.2) (8.1.5) **12.8.e**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **BIOGEOCHEMICAL CYCLES** Students should be able to analyze and explain the short-term impact of a natural disaster on the biological, chemical, and physical components of the affected ecosystem and their associated interrelationships, including geochemical cycles and food webs. (8.1.1) (8.1.3) **12.8.f**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Based on knowledge of populations and interactions in an ecosystem, students should be able to predict the possible long-term outcomes (e.g., extinction, adaptation, succession) of a natural disaster on populations in the ecosystem. (8.1.3) (8.1.4) **12.8.g**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain the significance of the introduction of non-native and invasive species to a stable ecosystem and describe the consequent harm to the native species and the environment (e.g., zebra mussels, purple loosestrife, phragmites, Japanese Beetles). (8.1.3) (8.1.4) (8.1.5) **12.8.h**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to describe how the biotic and abiotic factors can act as selective pressures on a population and can alter the diversity of the ecosystem over time. (8.1.1) (8.1.4) (8.2.1) (8.2.2) **12.8.i**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to identify limiting factors in an ecosystem and explain why these factors prevent populations from reaching biotic potential. Students should be able to predict the effects on a population if these limiting factors were removed. Students should be able to explain why a population reaching unlimited biotic potential can be detrimental to the ecosystem. (8.1.3) (8.1.5) (8.1.6) **12.8.j**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **POPULATION DYNAMICS** Students should be able to determine the carrying capacity for a population in an ecosystem

					using graphical representations of population data. (1.1.6) (8.1.5) **12.8.k**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **POPULATION DYNAMICS** Students should be able to describe how birth rate, death rate, emigration, and immigration contribute to a population's growth rate. (8.1.6) **12.8.l**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **BIOGEOCHEMICAL CYCLES** Students should be able to illustrate how elements on Earth cycle among the biotic and abiotic components of the biosphere. (8.2.1) **12.8.m**
			X	X	**ECOLOGY** **POLLUTION CONCEPTS** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to analyze how an understanding of biomagnification has led to the regulation of chemical use and disposal. (1.2.1) (1.3.1) (8.2.4) (8.2.5) **12.8.n**
			X	X	**ECOLOGY** **BIOGEOCHEMICAL CYCLES** Students should be able to recognize that the amount of matter in a closed ecosystem will remain constant. (8.2.1) **12.8.o**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **ENERGY CONCEPTS** Students should be able to relate an ecosystem's requirement for the continual input of energy to the inefficiency of energy transfer. (3.3.2) (8.2.2) (8.2.3) **12.8.p**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** **ENERGY CONCEPTS** Students should be able to explain how ecosystems that do not rely on radiant energy obtain energy to maintain life.(8.2.2) **12.8.q**
			X	X	**ECOLOGY** **ECOSYSTEM STRUCTURE AND DIVERSITY** Students should be able to explain how the inefficiency of energy transfer determines the number of trophic levels and affects the relative number of organisms at each trophic level in an ecosystem. (3.3.2) (8.2.3) **12.8.r**
			X	X	**CELL STRUCTURE AND FUNCTION** **BIOCHEMISTRY** **ECOLOGY** **POLLUTION CONCEPTS** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to relate a chemical's properties to its accumulation within organisms, such as PCBs in the fatty tissues of fish. (2.5.1) (8.2.4) **12.8.s**
			X	X	**ECOLOGY** **POLLUTION CONCEPTS** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to relate the accumulation of a chemical in an organism to the

					organism's trophic level. Students should be able to explain why bioaccumulation is a greater problem for organisms at higher trophic levels. (8.2.3) (8.2.4) **12.8.t**
			X	X	**ECOLOGY** **POLLUTION CONCEPTS** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** Students should be able to explain how biomagnification has led to unsafe food supplies, such as mercury accumulation in tuna. (8.2.5) **12.8.u**
			X	X	**ECOLOGY** **POPULATION DYNAMICS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to examine and describe how social and biological factors influence the exponential growth of the human population (e.g., economic, cultural, age at reproduction, fertility rate, birth/death rate, and environmental factors). (8.3.1) **12.8.v**
			X	X	**ECOLOGY** **POPULATION DYNAMICS** **GLOBAL POLITICS AND ECONOMICS** Students should be able to examine and describe how the exponential growth of the human population has affected the consumption of renewable and non-renewable resources. (8.1.6) (8.3.2) **12.8.w**
			X	X	**ECOLOGY** **GLOBAL POLITICS AND ECONOMICS** Students should be able to evaluate decisions about the use of resources in one country and how these decisions can impact the diversity and stability of ecosystems globally. (8.3.5) **12.8.x**
			X	X	**ECOLOGY** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** **GLOBAL POLITICS AND ECONOMICS** Students should be able to analyze ways in which human activity (i.e., producing food, transporting materials, generating energy, disposing of waste, obtaining fresh water, or extracting natural resources) can affect ecosystems and the organisms within. (8.3.3) **12.8.y**
			X	X	**ECOLOGY** **TECHNOLOGY AND SOCIETY** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** **GLOBAL POLITICS AND ECONOMICS** Students should be able to research and discuss ways in which humans use technology to reduce the negative impact of human activity on the environment. (e.g., phytoremediation, smokestack scrubbers). (8.3.4) **12.8.z**
			X	X	**ECOLOGY** **ENVIRONMENTAL IMPACTS AND HUMAN HEALTH** **GLOBAL POLITICS AND ECONOMICS** Students should be able to describe how advances in technology can increase the carrying capacity of an ecosystem (i.e., advances in agricultural technology have led to increases in crop yields per acre). (8.3.4) (8.3.5) **12.8.aa**