North Carolina Department of Public Instruction
INSTRUCTIONAL SUPPORT TOOLS
FOR ACHIEVING NEW STANDARDS

This document is designed to help North Carolina educators teach the Essential Standards (Standard Course of Study). NCDPI staff are continually updating and improving these tools to better serve teachers.

Essential Standards: Grade 8 Science ● Unpacked Content

For the Essential Standards that will be effective in all North Carolina schools in the 2012-13 school year.

What is the purpose of this document?
To increase student achievement by ensuring educators understand specifically what the new standards mean a student must know, understand and be able to do.

What is in the document?
Descriptions of what each standard means a student will know, understand and be able to do. The "unpacking" of the standards done in this document is an effort to answer a simple question "What does this standard mean that a student must know and be able to do?" and to ensure the description is helpful, specific and comprehensive for educators.

How do I send Feedback?
We intend the explanations and examples in this document to be helpful and specific. That said, we believe that as this document is used, teachers and educators will find ways in which the unpacking can be improved and made ever more useful. Please send feedback to us at feedback@dpi.state.nc.us and we will use your input to refine our unpacking of the standards. Thank You!

Just want the standards alone?
You can find the standards alone at http://www.ncpublicschools.org/docs/acre/standards/phase1/science/6-8.pdf .

Matter: Properties and Change

Essential Standard and Clarifying Objectives

8.P.1 Understand the properties of matter and changes that occur when matter interacts in an open and closed container.

8.P.1.1 Classify matter as elements, compounds, or mixtures based on how the atoms are packed together in arrangements.

8.P.1.2 Explain how the physical properties of elements and their reactivity have been used to produce the current model of the Periodic Table of elements.

8.P.1.3 Compare physical changes such as size, shape and state to chemical changes that are the result of a chemical reaction to include changes in temperature, color, formation of a gas or precipitate.

8.P.1.4 Explain how the idea of atoms and a balanced chemical equation support the law of conservation of mass.

Unpacking

What does this standard mean a child will know, understand and be able to do?

8.P.1.1

Atoms may link together in well-defined molecules, or may be packed together in crystal patterns. Different arrangements of atoms into groups compose all substances and determine the characteristics properties of substances. Elements are pure substances that cannot be changed into simpler substances. Elements are composed of one kind of atom. Compounds are pure substances that are composed of two or more types of elements that are chemically combined. Compounds can only be changed into simpler substances called elements by chemical changes. (One way that two or more atoms can combine is to form a *molecule*.) Mixtures are composed of two or more different substances that retain their own individual properties and are combined physically (mixed together). Mixtures can be separated by physical means (filtration, sifting, or evaporation). Mixtures may be heterogeneous or homogeneous: (heterogeneous mixture, which is not uniform throughout, the substances are evenly mixed and cannot be visibly distinguished. The particles of the substances are so small that they cannot be easily seen. Another name for the homogeneous mixture is a solution.) *It is not essential for students to know the molecules are the smallest part of covalent compounds or for students to understand isotopes.*

8.P.1.2

The history behind the creation of the Periodic Table begins with humans seeking to impose order on nature so they could better understand it. Looking for and recognizing a pattern in the occurrence of atoms is at the heart of the work of Dmitri Mendeleev. The scientific beauty of the periodic table that he created is largely due to patterns evident in the elements and their relationship to one another. By arranging the elements in a grid, he was able to identify similarities among them. Mendeleev's hypothesized the physical characteristics of the elements repeated in a cyclical manner. The periodic table developed by Mendeleev has remained largely unchanged since he first created it as a description for the periodic nature of the elements. There are groups of elements that have similar properties, including highly reactive metals, less-reactive metals, highly reactive nonmetals (such as chlorine, fluorine, and oxygen), and some almost completely nonreactive gases (such as helium and neon). The Periodic table contains a wealth of information about elements. Horizontal rows are called periods. The vertical columns are called groups. These elements have similar properties. It is convenient to divide the table into 2 groups—metals and nonmetals. The transition metals are generally not as reactive as Groups 1 and 2 and have varied properties. Nonmetals are poor conductors of electricity and have a wide range of properties. Along the staircase line separating the metals and nonmetals are the metalloids. They are not as conductive as metals but are more conducive than nonmetals.

8.P.1.3

Physical properties involve things that can be measured without changing the chemical properties of matter. Matter can undergo physical changes which affect only physical properties. Physical properties include: appearance, texture, color, odor, melting point, boiling point, density, solubility, polarity and many others. Physical changes can involve changes in energy which relate to the three states of matter-solid, liquid and gas. Evidence that a chemical change has occurred generally fits into these categories; gas production (bubbling or an odor), formation of a precipitate, production of heat and a color change. Properties of matter may be either physical or chemical. Chemical reactions form new substances by breaking and making new chemical bonds. Chemical reactions alter arrangement of atoms and the chemical reactions can vary. Chemical reactions describe how matter behaves. All physical and chemical changes involve a change in energy. Students should hypothesize when a physical or chemical change has occurred based on the evidence given above. *Note: Students should not write chemical formulas with reactions but should relate the formula to the concept of whether a physical or chemical change has occurred.*

8.P.1.4

The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how the same atoms are rearranged, then their total mass stays the same. The idea of atoms explains chemical reactions: When substances interact to form new substances, the atoms that make up the molecules of the original substances combine in new ways. The law of conservation of mass states that the total mass of the products of a reaction is equal to the total mass of the reactants. A closed system must be used when studying chemical reactions. When chemicals are reacted in a closed container, it shows that the mass before and after the reaction is the same. In an open container this may not be true.

Energy: Conservation and Transfer

Essential Standard and Clarifying Objectives

8.P.2 Explain the environmental implications associated with the various methods of obtaining, managing and using energy resources.

8.P.2.1 Explain the environmental consequences of the various methods of obtaining, transforming, and distributing energy.

8.P.2.2 Explain the implications of the depletion of renewable and nonrenewable energy resources and the importance of conservation.

Unpacking

What does this standard mean a child will know, understand and be able to do?

8.P.2.1

Different ways of obtaining, transforming, and distributing energy have different environmental consequences. Different types of fuels have different environmental impacts. Some have longer lasting impacts on the environment than others. Transformations and transfers of energy within a system usually result in some energy escaping into its surrounding environment. Some systems transfer less energy to their environment than others during these transformations and transfers. Whenever energy appears in one place, it must have moved from another. Whenever energy appears to be 'lost' from somewhere, it has been transferred somewhere else. Some ways we are attempting to use the energy from the sun are: photovoltaic cells, solar batteries and reflectors. Photovoltaic cells transform solar energy into electric energy. Solar reflectors are used to concentrate solar rays for industrial use and for the generation of electric current. One way to confine the solar energy is heating water by passing it through collectors and keeping it in isolated containers. In some cases it is possible to obtain enough hot water to satisfy a house needs during the day but conventional heaters are required at night. Energy from the sun far exceeds the Earth's energy need, however, we have not found a way to efficiently capture and store it.

8.P.2.2
Some resources are not renewable or renew very slowly. Fuels already accumulated in the earth, for instance, will become more difficult to obtain as the most readily available resources run out. How long the resources will last, however, is difficult to predict. The preservation, management, and care of natural and cultural resources should be practice by all consumers. The ultimate limit may be the prohibitive cost of obtaining them. Energy from the sun (and the wind and water energy derived from it) is available indefinitely. The transfer of energy from these resources are weak and variable, systems are needed to collect, transport and concentrate the energy. This creates some advantages and disadvantages depending on location and the ability to collect.

Earth Systems, Structures and Processes

Essential Standard and Clarifying Objectives

8.E.1 Understand the hydrosphere and the impact of humans on local systems and the effects of the hydrosphere on humans.

8.E.1.1 Explain the structure of the hydrosphere including:
- Water distribution on earth
- Local river basin and water availability

8.E.1.2 Summarize evidence that Earth's oceans are a reservoir of nutrients, minerals, dissolved gases, and life forms:
- Estuaries
- Marine ecosystems
- Upwelling
- Behavior of gases in the marine environment
- Value and sustainability of marine resources
- Deep ocean technology and understandings gained

8.E.1.3 Predict the safety and potability of water supplies in North Carolina based on physical and biological factors, including:

- Temperature
- Dissolved oxygen
- pH
- Nitrates and phosphates
- Turbidity
- Bio-indicators

8.E.1.4 Conclude that the good health of humans requires:

- Monitoring of the hydrosphere
- Water quality standards
- Methods of water treatment
- Maintaining safe water quality
- Stewardship

Unpacking

What does this standard mean a child will know, understand and be able to do?

8.E.1.1

Water is one of the most common substances on Earth. Water is circulated on Earth by a process known as the water cycle. Water is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans. Most of the Earth's water (80% depending on Climate period) is found in the oceans. The majority of fresh water exists in ice caps, glaciers, and aquifers. Surface water moves into river basins from areas called watersheds. The availability of water varies with local geography and allows humans to utilize water as a resource. In a river basin, all of the water eventually flows to the same place (the ocean). Watersheds are the areas of land that water drains in to when the ground is saturated or impermeable. Ground water is one of earth's most valuable resources. The rate of ground water movement varies based on the rock material through which the water is moving. Wells provide the best source of information about an aquifer. The ocean is connected to major lakes, watersheds, and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean. The ocean is the dominant physical feature of our planet. There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian and Arctic.

8.E.1.2

The oceans of the earth are one continuous body of water covering the majority of our planet. The ocean is an integral part of the water cycle and is connected to all of the earth's water reservoirs via evaporation and precipitation processes. The salinity of the open sea is fairly constant, but the ocean consists of several zones with different properties due to variations in temperature, pressure and penetration of light. Many earth materials and geochemical cycles originate in the ocean. Productivity is greatest in the surface layers of the ocean, where sunlight penetrates and photosynthesis occurs. Currents and recycling processes make nutrients, minerals, and gases available to marine life. Upwelling is a type of ocean current in which cold nutrient-rich water rises to the surface from the ocean depths. Microscopic algae serve as the base of open ocean food webs and provide the majority of the world's oxygen. Terrestrial and aquatic food webs are often interconnected and affected by the level of nutrients. Estuaries are places where fresh and salt waters meet. They are partially enclosed bodies where seawater is diluted by fresh water that drains from the land. Estuaries serve as an important habitat for many marine species, buffer zones for pollutants and breeding grounds of many organisms. They also act as a filtering system to remove some chemical elements and compounds from land run off. They provide important and productive nursery areas for many marine and aquatic species. Marine resources are used to provide many important products to humans in addition to food. Although the ocean is large, it is finite and resources are limited. The salt in seawater comes from eroding land, volcanic emissions, reactions at the sea floor, and atmospheric deposition. There are three different marine ecosystems: shore, open ocean and deep ocean. There are many deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life. Deep ocean exploration and technology continues to provide information about new life forms, Earth resources, and geologic processes. Tides, waves and predation cause vertical zonation patterns along the shore, influencing the distribution, diversity and availability of organisms. Use of ocean resources has increased significantly; therefore the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations. The ocean affects every human life. Most rain comes from the ocean and over half of Earth's oxygen. From the ocean we get foods, medicines, minerals, and energy resources. Many organisms spend parts of their life cycle in aquatic and terrestrial surroundings. Most of life in the ocean exists as microbes. Microbes are the most important primary producers in the ocean. Not only are they the most abundant life form in the ocean, they have extremely fast growth rates and life cycles.

8.E.1.3

The health of a water system is determined by the balance between physical, chemical and biological variables. Physical variables include temperature, turbidity, and water movement. Chemical variables include dissolved oxygen and other gases, pH, nitrates, and salinity. Both natural and man-made forces are constantly changing these variables. The health of water systems is dependent on the balance of its many natural systems. Ocean habitats are defined by environmental factors-interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, substrate and circulation. Population diversity provides insights into the health of a water system. Tolerance to water quality conditions varies among organisms. Clear water may contain odorless, tasteless, and colorless harmful contaminants. Water must be tested for specific contaminants such as bacteria, nitrates, arsenic and others. Bio-indicators (insects) are studied to indicate environmental quality such as water flow, pollution, and vegetation. Some play a very important role in stream and pond ecosystems, often serving as a biological indicator of the quality of a water system.

8.E.1.4

Starting in 1914 the USA implemented drinking water standards for wells concerning coliform growth. In 1940 drinking water standards began to apply to municipal (city) drinking water. In 1972, the Clean Water Act was passed in the USA and in 1974 the Safe Drinking Act was formulated. The general principle in the developed world now is that every person has the right to safe drinking water. Starting in 1970, public health concerns shifted from waterborne illnesses caused by disease-causing micro-organisms, to health concerns caused by water pollution such as pesticide residues and industrial sludge and organic chemicals. Regulation now focused on industrial waste and industrial water contamination, and water treatment plants were adapted. Techniques such as aeration, flocculation and active carbon absorption were applied. In the 1980's membrane development for reverse osmosis was added and risk assessments were enabled after 1990. Knowledge about natural systems and informed decision making regarding its use are essential for the maintenance of a life-sustaining planet. The variety of North Carolina coasts and rivers shape the behavior and life cycles of its inhabitants. If chemicals, hazardous wastes, oil, etc. collect on the ground surface, runoff percolating into the soil can transfer these undesired substances into the ground water. Individual and collective actions are needed to effectively manage water resources for all. Much of the world's population lives in the coastal areas. Laws, regulations, and resource management affect what is taken out and put into the ocean. Point and non-point environmental stressors such as urban and/or agricultural runoff, industrial inputs and over-fishing can impact all aquatic populations. Environmental degradation will likely decrease the diversity of a community by eliminating intolerant organisms and increasing the number of tolerant organisms. For centuries humans have used streams, rivers and oceans as depositories of human, industrial and solid wastes. This accelerating toxic influx and nutrient enrichment causes chemical and environmental changes and major shifts in plant and animal life resulting in economic trade-offs. Technological advances have enabled us to collect data about water systems that have led to improvements in developing standards, monitoring water-quality, and providing treatment. The more we understand and respect North Carolina's aquatic systems, the more capable we are of making informed decisions and thus becoming good stewards of the environment. The first step in getting students to move towards stewardship is to create a personal awareness of how they are connected to North Carolina's hydrological system.

Earth History

Essential Standard and Clarifying Objectives

8.E.2 Understand the history of Earth and its life forms based on evidence of change recorded in fossil records and landforms.

8.E.2.1 Infer the age of Earth and relative age of rocks and fossils from index fossils and ordering of rock layers (relative dating and radioactive dating).

8.E.2.2 Explain the use of fossils, ice cores, composition of sedimentary rocks, faults, and igneous rock formations found in rock layers as evidence of the history of the Earth and its changing life forms.

Unpacking

What does this standard mean a child will know, understand and be able to do?

8.E.2.1

Many thousands of layers of sedimentary rock provide evidence for the long history of the earth and for the long history of changing life forms whose remains are found in the rocks. More recently deposited rock layers are more likely to contain fossils resembling existing species. Fossils provide important evidence of how life and environmental conditions have changed. The earth processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. Earth's history is also influenced by occasional catastrophes, such as the impact of an asteroid or comet. Thousands of layers of sedimentary rock confirm the long history of the changing surface of the earth and the changing life forms whose remains are found in successive layers. The youngest layers are not always found on top, because of folding, breaking, and uplift of layers. Fossils that can be used to help determine the relative age of rock layers are called index fossils. Absolute geologic dating and relative geologic dating are two methods by which scientists try to determine the age of geologic evidence. Carbon-14 dating is an example of absolute dating, and the law of superposition is an example of relative dating. Radioactive dating is used to study the uranium in igneous and metamorphic rocks. Uranium is a mildly radioactive substance that breaks down at a slow and steady pace which cannot be altered by temperature or pressure. By looking at different rocks and comparing the amount of uranium still in the rock to the amount of lead that has been formed, scientists can measure the age of the earth. Using this method, scientists have determined that the earth is 4-5 billion years old.

8.E.2.2
Sediments of sand and smaller particles (sometimes containing the remains of organisms) are gradually buried and are cemented together by dissolved minerals to form solid rock again. Sedimentary rock buried deep enough may be re-formed by pressure and heat, perhaps melting and recrystallizing into different kinds of rock. These re-formed rock layers may be forced up again to become land surface and even mountains. Subsequently, this new rock too will erode. Rock bears evidence of the minerals, temperatures, and forces that created it. Rocks, fossils, and ice cores show: 1. Life forms have changed over time and 2. Earth's climate and surface have changed over time. The Law of Superposition states that each undisturbed rock layer is older than the layer above it. This law is used to read rock layers. Thousands of layers of sedimentary rock confirm the long history of the changing surface of the earth and the changing life forms whose remains are found in successive layers. By studying rocks and fossils, scientists have developed a geologic time scale which outlines the major divisions of Earth's history. Geologists have concluded that all rocks of the crust form in one of three ways: Igneous rocks are formed by the cooling and hardening of hot molten rock from inside the Earth. Sedimentary rocks are formed by the hardening and cementing of layers of sediments. The sediments may consist of rock fragments, plant and animal remains, or chemicals that form on a lake and ocean bottom. Metamorphic rocks are formed when rocks that already exist are changed by heat and pressure into new kinds of rocks. A fault is a fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are displaced relative to one another and parallel to the plane of fracture. There are several types of faults.

Structures and Functions of Living Organisms

Essential Standard and Clarifying Objectives

8.L.1 Understand the structure and hazards caused by agents of disease that effect living organisms.

8.L.1.1 Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

8.L.1.2 Explain the difference between epidemic and pandemic as it relates to the spread, treatment and prevention of disease.

Unpacking

What does this standard mean a child will know, understand and be able to do?

8.L.1.1

Microbiology as a basic science explores microscopic organisms including viruses, bacteria, protozoa, parasites, and some fungi and algae. These organisms lack tissue differentiation, are unicellular, and exhibit diversity of form and size. Viruses, bacteria, fungi and parasites may infect the human body and interfere with normal body functions. A person can catch a cold many times because there are many varieties of cold viruses that cause similar symptoms. Viruses are not considered to be alive but they affect living things. Viruses need a host cell. AIDS, influenza, the common cold, polio, chicken pox, small pox, yellow fever, viral meningitis, West Nile and Ebola are caused by viruses. Rabies, Lyme Disease, bacterial meningitis, and Leprosy are caused by bacteria. Bacteria are very small organisms, usually consisting of one cell, that lack chlorophyll. Except for viruses, they are the smallest living things on Earth. Bacteria are found everywhere, in the air, soil, water, and inside of your body and on your skin. They tend to multiply very rapidly under favorable conditions, forming colonies of millions or even billions of organisms within a space as small as a drop of water. Bacteria are generally classified into three groups based on their shape: spherical, rodlike, spiral or corkscrew. We have antibiotics to help with bacterial infections and vaccines to help with taking care of viruses that cause infections.

8.L.1.2

Vectors are mechanisms (other than a person) that spread disease without getting sick itself. Rats, ticks, mosquitoes, and soil are examples of vectors. An infectious disease is one that can be passed from one generation to another. Scientists study microbial pathogens (disease causing agents), to find methods for prevention and treatment of disease. Improvements in public health depend upon state-of-the-art biomedical research to explain how microbes cause infectious diseases in both plants and animals. To analyze data, scientists use various techniques and strategies including computer modeling, cell culture, animal models, and clinical trials in humans. Safe handling and hygiene as well as various antimicrobial chemicals can be used to reduce the risk of and the treatment of these infections. Industrial microbiology involves quality control in preventing growth and contamination of products leading to food spoilage, and the production of pharmaceuticals. The health of humans and earth depends on microbes**.** An epidemic is an outbreak of a disease that affects a disproportionately large number of individuals within a population, community or region at the same time (example-typhoid). Pandemic is an epidemic of an infectious disease that is spreading through human populations across a large region, continent or even worldwide (examples smallpox, tuberculosis, flu of 2009).

Essential Standard and Clarifying Objectives

8.L.2 Understand how biotechnology is used to affect living organisms.

8.L.2.1 Summarize aspects of biotechnology including:

- Specific genetic information available
- Careers
- Economic benefits to North Carolina
- Ethical issues
- Implications for agriculture

Unpacking

What does this standards mean a child will know and be able to do?

8.L.2.1

Understanding of the microbial world has led to the emerging field of biotechnology which has given us many advances and new careers in medicine, agriculture, genetics, and food science. Biotechnology, while it has benefited North Carolina in many ways, has also raised many ethical issues for an informed community to consider. As we increase our knowledge and make advances in technology we are able to reduce the threat of microbial hazards. Biotechnology affects us in every area of our lives: our food, water, medicine and shelter. Uses of modern biotechnology include: making medicine in large quantities (e.g. penicillin) and human insulin for the treatment of diabetes, combating crime through DNA testing and forensic testing, removing pollution from soil and water (bioremediation), and improving the quality of agricultural crops and livestock products. Some new areas such as Genetic Modification (GM) and cloning are controversial.

Ecosystems

Essential Standard and Clarifying Objectives

8.L.3 Understand how organisms interact with and respond to the biotic and abiotic components of their environment.

8.L.3.1 Explain how factors such as food, water, shelter, and space affect populations in an ecosystem.

8.L.3.2 Summarize the relationships among producers, consumers, and decomposers including the positive and negative consequences of such interactions including:

- coexistence and cooperation
- competition (predator/prey)
- parasitism
- mutualism

8.L.3.3 Explain how the flow of energy within food webs is interconnected with the cycling of matter (including water, nitrogen, carbon dioxide, and oxygen).

Unpacking

What does this standard mean a child will know, understand and be able to do?

8.L.3.1

Explain how factors such as food, water, shelter, and space affect populations in an ecosystem. Energy can change from one form to another in living things. Organisms get energy from oxidizing their food, releasing some of its energy as thermal energy. Almost all food energy comes originally from sunlight. In all environments, organisms with similar needs may compete with one another for limited resources, including food, space, water, air, and shelter. A habitat is the place where an organism lives out its life. Organisms of different species use a variety of strategies to live and reproduce in their habitats. Habitats can change, and even disappear, for an area. Each species is unique in satisfying all its needs; each species occupies a niche. A niche is the role and position a species has in its environment—how it meets its needs for food and shelter, how it survives, and how it reproduces. A species' niche includes all its interactions with the biotic and abiotic parts of its habitats.

8.L.3.2

One of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods. Some kinds of organisms, many of them microscopic, cannot be neatly classified as either plants or animals. Animals and plants have a great variety of body parts and internal structures that contribute to their being able to make or find food and reproduce. Similarities among organisms are found in internal anatomical features, which can be used to infer the degree of relatedness among organisms. In classifying organisms, scientists consider details of both internal and external structures. Traditionally, a species has been defined as all organisms that can mate with one another to produce fertile offspring. The cycles continue indefinitely because organisms are decomposed after death to return food materials to the environment. Food provides molecules that serve as fuel and building material for all organisms. Plants can use the food they make immediately or store it for later use. Organisms that eat plants break down the plant structures to produce the materials and energy they need to survive. Then they are consumed by other organisms. Over a long time, matter is transferred from one organism to another repeatedly and between organisms and their physical environment. As in all material systems, the total amount of matter remains constant, even though its form and location change. Energy can change from one form to another in living things. Organisms get energy from oxidizing their food, releasing some of its energy as thermal energy. Almost all food energy comes originally from sunlight. All organisms, including the human species, are part of and depend on two main interconnected global food webs. One includes microscopic ocean plants, the animals that feed on them, and finally the animals that feed on those animals. The other web includes land plants, the animals that feed on them, and so forth. One organism may scavenge or decompose another. The cycles continue indefinitely because organisms are decomposed after death to return food materials to the environment. There are three major kinds of ecosystems. Terrestrial ecosystems are those located on land. Examples include forests, meadows, and deserts. Aquatic ecosystems occur in both fresh and salt water. Freshwater ecosystems include ponds, lakes, and streams. Saltwater ecosystems are called marine ecosystems and make up approximately 75 percent of Earth’s surface. Plants and some microorganisms are producers—they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers. For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organisms in a food web. Populations of various species co-exist (to exist together, at the same time, or in the same place) and cooperate (to work together towards a common end or purpose) within an ecosystem, often having to compete for limited resources of food, water, space and shelter. Predators are animals that kill and eat other animals. The animals that predators eat are called prey. Some species, however, have symbiotic relationships in which interactions benefit long-term survival of one or both species. Symbiosis means living together. Commensalism is a symbiotic relationship in which one species benefits and the other species is neither harmed nor benefited. For example the Peregrine falcon and the red-breasted goose. Sometimes, two species of organisms benefit from living in close association. A symbiotic relationship in which both species benefit is called mutualism. For example, ants and acacia trees living in the sub-tropical regions of the world. The ants protect the tree by attacking any animal that tries to feed on it. The tree provides nectar and a home for the ants. Another symbiotic relationship in which one organism derives benefit at the expense of the other is called parasitism. Parasites have evolved in such a way that they harm, but usually do not kill, the hose. An example of a parasite is a tick and a dog.

8.L.3.3
Ecologists trace the flow of energy through ecological communities to discover nutritional relationships. The ultimate source of the energy is the sun, which supplies the energy that fuels life. Plants use the sun's energy to manufacture food in a process called photosynthesis. Organisms that use energy from the sun or energy stored in chemical compounds to manufacture their own nutrients are called autotrophs. Although plants are the most familiar terrestrial autotrophs, some unicellular organisms also make their own nutrients. Most other organisms depend on autotrophs for nutrients and energy. These are the producers in a food web. The consumer is a heterotrophy which means they are not capable of making their own food so they obtain food for energy by eating other organisms. When you pick a pear from a tree and eat it, you are consuming carbon, nitrogen, and other elements the tree has used to produce the fruit. That pear also contains energy from the sunlight trapped by the tree's leaves while the pear was growing and ripening. Ecologists use food chains and food webs to model the distribution of matter and energy within an ecosystem. Each organism in a food chain represents a feeding level in the passage of energy and materials. A food chain represents only one possible route for the transfer of matter and energy in an ecosystem. Many other routes may exist. A food web is a more realistic model than a food chain because most organisms depend on more than one other species for food. These food webs also show how energy is lost from one level to the next. This energy is lost to the environment as heat generated by the body processes of organisms. Sunlight is the primary source of all this energy, so energy is always being replenished. Matter, in the form of nutrients, also moves though the organisms at each level. But matter cannot be replenished like the energy from sunlight. The atoms of carbon, nitrogen, oxygen and other elements make up the bodies of organisms alive today are the same atoms that have been on Earth since life began. Matter is constantly recycled. Life on Earth depends on water. Even before there was life on Earth, water cycled through stages. Water evaporates from lakes, oceans, ponds, rivers, streams and becomes water vapor in the air. Water vapor then condenses on dust in the air and forms clouds. Further condensation makes small drops that build in size until they fall from the clouds as precipitation. The water falls on Earth and accumulates in oceans and lakes where evaporation continues. Plants and animals need water to live. Plants pull water from the ground and lose water from their leaves though transpiration. This puts water vapor into the air. Animals breathe out water vapor in every breath; when they urinate, water is returned to the environment. Natural processes (breathing and urinating) constantly recycle water throughout the environment. All life on Earth is based on carbon molecules. Atoms of carbon form the framework for proteins, carbohydrates, fats and other important molecules. More than any other element, carbon is the molecule of life. The carbon cycle starts with the autotrophs. During

photosynthesis, energy from the sun is used to convert carbon dioxide gas into energy-rich carbon molecules. Autotrophs use these molecules for growth and energy. Heterotrophs, which feed either directly or indirectly on the autotrophs, also use the carbon molecules for growth and energy. When the autotrophs and heterotrophs use the carbon molecules for energy, carbon dioxide is released and returned to the atmosphere. If you add nitrogen fertilizer to a lawn, houseplants, or garden, you may see that it makes the plants greener, bushier, and taller. Even thought the air is 78% nitrogen, plants seem to do better when they receive nitrogen fertilizer. This is because plants cannot use the nitrogen in the air. They use nitrogen in the soil that has been converted into more usable forms. Lightening and certain bacteria convert the nitrogen in the air into these more usable forms. Chemical fertilizers also give plants nitrogen in a form they can use. Plants use the nitrogen to make important molecules such as proteins. Herbivores eat plants and convert nitrogen-containing plant proteins into nitrogen-containing animal proteins. After you eat your food, you convert the proteins in your food into proteins used in humans. Urine, an animal waste, contains excess nitrogen. When an animal urinates, nitrogen returns to the water or soil. Bacteria in the ground transform much of this nitrogen so that it can be stored in and used by plants, while returning some of it to the air. When organisms die, their nitrogen molecules are recycled.

Evolution and Genetics

Essential Standard and Clarifying Objectives

8.L.4 Understand the evolution of organisms and landforms based on evidence, theories and processes that impact the Earth over time.

8.L.4.1 Summarize the use of evidence drawn from geology, fossils, and comparative anatomy to form the basis for biological classification systems and the theory of evolution.

8.L.4.2 Explain the relationship between genetic variation and an organism's ability to adapt to its environment.

Unpacking

What does this standard mean a child will know, understand and be able to do?

8.L.4.1

Changes in environmental conditions can affect the survival of individual organisms and entire species. Life on Earth, as well as the shape of Earth's surface, has a history of change that is called evolution and can be illustrated using a geologic time scale. A geologic time scale represents a calendar of Earth's history based on evidence found in rocks, fossils and ice cores. Scientists use this information to gain knowledge about ancient climate, geography, geologic events and life forms. The evidence that organisms and landforms change over time is scientifically described using the Theory of Evolution, the Plate Tectonics Theory, and the Law of Superposition. Living things evolve in response to changes in their environment. The movements of Earth's continental and oceanic plates have caused mountains and deep ocean trenches to form and continually change the shape of Earth's crust throughout time. These same movements have caused these plates to pass through different climatic ones. Natural processes and human activities result in environmental challenges. Organisms that were best adapted to deal with climatic, geographic and environmental changes throughout time have survived, while other organisms have become extinct. Sea level changes over time have expanded and contracted continental shelves, created and destroyed inland seas and shaped the surface of land. Sea level changes as plate tectonics cause the volume of the oceans and the height of land to change, as ice caps on land melt or enlarge and/or as sea water expands when ocean water warms and cools. The processes responsible for changes we observe today are similar to the processes that have occurred throughout Earth's history. The evolution of Earth's living things is strongly linked to the movements of the lithospheric plates. Living things evolve in response to changes in their environment. The movements of the plates cause changes in climate, in geographic features such as mountains, and in the types of living things in particular places. Many thousands of layers of sedimentary rock provide evidence for the long history of the earth and for the long history of changing life forms whose remains are found in the rocks (fossils). More recently deposited rock layers are more likely to contain fossils resembling existing species. Biological evolution accounts for the diversity of species developed through gradual processes over many generations. Species acquire many of their unique characteristics through biological adaptation, which involves the selection of naturally occurring variations in populations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment. Similarities among organisms can infer the degree of relatedness: homologous structures—anatomical and cellular, analogous structures--anatomical and cellular, embryological similarities—anatomical and cellular, human developmental patterns are similar to those of other vertebrates. "Fossils" can be compared to one another and to living organisms according to their similarities and differences. Most species that have lived on the earth are now extinct. Extinction of species occurs when the environment changes and the individual organisms of that species do not have the traits necessary to survive and reproduce in the changed environment. Some organisms that lived long ago are similar to existing organisms, but some are quite different. Extinction of organisms is apparent in the fossil record. Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Extinction of species is common; most of the species that have lived on the earth no longer exist. In any particular environment, the growth and survival of organisms depend on physical conditions. Biological classification is a system which is used to organize and codify all life on Earth. There are a number of goals to biological classification, in addition to the obvious need to be able to precisely describe organisms. Creating a system of classification allows scientists to examine the relationships between various organisms, and to construct evolutionary trees to explore the origins of life on Earth and the relationship of modern organisms to historical examples. You may also hear biological classification referred to as "taxonomy."

8.L.4.2
Individual organisms with certain traits are more likely than others to survive and have offspring. Changes in environmental conditions can affect the survival of individual organisms and entire species. Individual organisms with certain traits are more likely than others to survive and produce offspring. There is tremendous genetic diversity within almost all species, including humans. No two individuals have the same DNA sequence, with the exception of identical twins or clones. This genetic variation contributes to phenotypic variation—that is, diversity in the outward appearance and behavior of individuals of the same species. Living organisms have morphological, biochemical, and behavioral features that make them well adapted for life in the environments in which they are usually found. For example, consider the hollow bones and feathers of birds that enable them to fly, or the cryptic coloration that allow many organisms to hide from their predators. These features may give the superficial appearance that organism were designed to live in a particular environment. Evolutionary biology has demonstrated that adaptations arise through selection acting on genetic variation.

Molecular Biology

Essential Standard and Clarifying Objectives

8.L.5 Understand the composition of various substances as it relates to their ability to serve as a source of energy and building materials for growth and repair of organisms.

8.L.5.1 Summarize how food provides the energy and the molecules required for building materials, growth and survival of all organisms (to include plants).

8.L.5.2 Explain the relationship among a healthy diet, exercise, and the general health of the body (emphasis on the relationship between respiration and digestion).

Unpacking

What does this standard mean a child will know, understand and be able to do?

8.L.5.1

Food provides molecules that serve as fuel and building material for all organisms. Organisms get energy by oxidizing their food, releasing some of its energy as thermal energy. All organisms are composed of cells-a group of organelles working together. Most organisms are single cells; other organisms, including humans, are multi-cellular. Cells carry on the many functions needed to sustain life. They grow and divide (mitosis or meiosis), thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs. Cell (Plasma) membrane is selectively permeable, controlling what enters and leaves the cell. Sugars to produce energy for the cell are broken down in a process that uses oxygen and produces carbon dioxide and water. Cells lacking internal membrane-bound structures are called prokaryotic cells. The cells of most unicellular organisms such as bacteria are prokaryotes. Cells that contain membrane-bound structures are called eukaryotic cells. Most of the multi-cellular plants and animals we know have cells containing membrane-bound structures and are therefore called eukaryotes. The membrane-bound structures within eukaryotic cells are called organelles. Each organelle has a specific function for cell survival.

8.L.5.2

Life style choices, environmental factors, and genetics can cause abnormalities to occur during embryonic development as well as later in life. Human activities such as smoking, consumption of alcohol and the use of drugs lead to a variety of adverse conditions within the human body and interfere with the efficient operation of the systems of the body. Technology and medical advances can help us understand how the human body functions and allow us to make informed decisions regarding our health. Toxic substances, some dietary habits, and some personal behavior may be bad for one's health. Some effects show up right away, others years later. Avoiding toxic substances, such as tobacco, and changing dietary habits increases the chance of living longer. The use of tobacco increases the risk of illness. Students should understand the influence of short-term social and psychological factors that lead to tobacco use, and the possible long-term detrimental effects of smoking and chewing tobacco. Alcohol and other drugs are often abused substances. Such drugs change how the body functions and can lead to addiction.