Sixth Grade Science Curriculum

Scientific and Engineering Practices (SOL 6.1) - Ongoing

6.1 The student will demonstrate an understanding of scientific and engineering practices by

a) asking questions and defining problems
- ask questions to determine relationships between independent and dependent variables
- develop hypotheses and identify independent and dependent variables
- offer simple solutions to design problems

b) planning and carrying out investigations
- independently and collaboratively plan and conduct observational and experimental investigations; identify variables, constants, and controls where appropriate, including the safe use of chemicals and equipment
- evaluate the accuracy of various methods for collecting data
- take metric measurements using appropriate tools
- use tools and/materials to design and/or build a device to solve a specific problem

c) interpreting, analyzing, and evaluating data
- organize data sets to reveal patterns that suggest relationships
- construct, analyze, and interpret graphical displays of data
- compare and contrast data collected by different groups and discuss similarities and differences in findings
- use data to evaluate and refine design solutions

d) constructing and critiquing conclusions and explanations
- construct explanations that include qualitative or quantitative relationships between variables
- construct scientific explanations based on valid and reliable evidence obtained from sources (including the students' own investigations)
- generate and compare multiple solutions to problems based on how well they meet the criteria and constraints

e) developing and using models
- use scale models to represent and estimate distance
- use, develop, and revise models to predict and explain phenomena
- evaluate limitations of models

f) obtaining, evaluating, and communicating information
- read scientific texts, including those adapted for classroom use, to obtain scientific and/or technical information
- gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication

- construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning

Vocabulary:

classify – organize by characteristics
Scientific Investigation, Reasoning, and Logic (SOL 6.1) Continued

conclusion – reason for doing an experiment
data – information collected
dependent variable – the part of an experiment that changes on its own
distance – a measurement of length
experiment – a structured test of a hypothesis
hypothesis – an educated guess as to the outcome of an experiment; a good hypothesis has a supporting reason
independent variable – the part of an experiment that you change or alter
inference – to form a conclusion from your observation
observation – using your senses to identify a something
organism – anything living
prediction – a declaration of outcome made in advance based upon observations
procedure – a listing of the steps of a project or experiment
qualitative observation – an observation that does not involvement measurements or numbers
quantitative observation – an observation that involves measurement and numbers
results – what happens in the experiment
scientific method – a way of thinking about nature that involves the use of certain skills to solve problems in an orderly manner
scale – the ratio of proportion to the original
variable – any factor that can change in an experiment
volume – the amount of space that matter occupies

We All Live Downstream
Watersheds (SOL 6.8, 6.6, & 6.9) - 1st Nine Weeks (Weeks 1-9)

6.6 The student will investigate and understand that water has unique physical properties and has a role in the natural and human-made environment. Key ideas include

f) water is important for agriculture, power generation, and public health.

6.8 The student will investigate and understand that land and water have roles in watershed systems. Key ideas include

a) a watershed is composed of the land that drains into a body of water;
b) Virginia is composed of multiple watershed systems which have specific features;
c) the Chesapeake Bay is an estuary that has many important functions; and
d) natural processes, human activities, and biotic and abiotic factors influence the health of a watershed system.

Central Idea: Watershed systems are dynamic and complex; interactions within the system may influence the overall health of the watershed.

6.9 The student will investigate and understand that humans impact the environment and individuals can influence public policy decisions related to energy and the environment. Key ideas include

a) natural resources are important to protect and maintain;
b) renewable and nonrenewable resources can be managed;
c) major health and safety issues are associated with air and water quality;
e) preventive measures can protect land-use and reduce environmental hazards;
f) there are cost/benefit tradeoffs in conservation policies.

Central Idea: Natural resource management and health and safety issues related to the use of resources should be considered in the development of public policy.

Essential Understanding:

All ecosystems, including watershed ecosystems, are affected by complex biotic and abiotic interactions involving exchange in matter and energy.

- An ecosystem is made up of the biotic (living) community and the abiotic (nonliving) factors that affect it. The health of an ecosystem is directly related to water quality. (a)
- A watershed is the land that water flows across or through on its way to a stream, lake, wetland, or other body of water. (a)
- Abiotic factors determine ecosystem type and its distribution of plants and animals as well as the usage of land by people. Abiotic factors include water supply, topography, landforms, geology, soils, sunlight, and air quality/O2 availability. (a)
- Water quality monitoring is the collection of water samples to analyze chemical and/or biological parameters. Simple parameters include pH, temperature, salinity, dissolved oxygen, turbidity, and the presence of macroinvertebrate organisms. (a)
- Areas of higher elevations, such as ridgelines and divides, separate watersheds. (b)
- The watershed systems in Virginia lead to three main bodies of water. These are the Chesapeake Bay, the North Carolina sounds, or the Gulf of Mexico. (b)
- Wetlands form the transition zone between dry land and bodies of water such as rivers, lakes, or bays. Both tidal and non-tidal wetlands perform important water quality functions, including regulating runoff by storing flood waters; reducing erosion by slowing down run-off; maintaining water quality by filtering sediments, trapping nutrients, and breaking down pollutants; and recharging groundwater. They also provide food and shelter for wildlife and fish and nesting and resting areas for migratory birds. (b)
- Estuaries perform important functions, such as providing habitat for many organisms and serving as nurseries for their young. (c)
- The Chesapeake Bay is an estuary where fresh and saltwater meet and are mixed by tides. It is the largest estuary in the contiguous United States and one of the most productive. (c)

Human actions and geologic processes have an effect on the availability of freshwater resources.

- Human activities can alter abiotic components and thus accelerate or decelerate natural processes. (d)

Vocabulary:

abiotic – a nonliving part of the environment
absorb – to take in or suck or swallow up
biotic – a living part of the environment
dissolved oxygen – free O2 molecules in water; important for aquatic animal life
ecosystem – all the communities that live in an area together with the abiotic factors in the environment
erosion – the carrying away of weathered rock sediments and soil by weather and water; a natural process where soil is lost, transported, and reformed
estuaries – a region of water where a freshwater source meets salt water from the ocean
flood – a rising and overflowing of a body of water onto normally dry land
flood plains – a plain built up by stream deposition
groundwater – water contained in the porous or jointed bedrock
habitat – the environment in which a particular species lives
irrigation – to supply with water by artificial means (i.e. bringing water to fields that are not near water or in an area that receives plenty of rainfall)
landforms – feature of the Earth's surface attributable to natural causes
macroinvertebrate – involving large quantities of organisms that lack a spinal column
migratory – animal passes through periodically from one region or climate to another for feeding or breeding
nutrients – substances needed by organisms for energy, growth, repair, or maintenance
organism – all living things (plants, mammals, bacteria, fungi, fish)
PH – the negative logarithm of the effective hydrogen ion concentration or hydrogen-ion activity in gram equivalents per liter used in expressing both acidity and alkalinity on a scale
pollutants – a harmful material that enters the environment
reservoirs – places where water is collected and stored such as in a natural or artificial lake for use as drinking water or to create hydroelectric power
river system – a river and all of its tributaries
runoff – water from rainfall and the melting of ice that runs along the ground.
salinity – a measure of the dissolved salts in a sample of water
sanitary sewer – an underground system meant to collect and transport waste
sediments – small particles (usually rock) that settle to the bottom of a body of water
surface water – the water that is above ground in streams, lakes, rivers, and ponds
tidal – alternate rising and falling of the surface of the water and the area that is affected by water level change
topography – the configuration of a surface that shows the relative positions and changes of elevations

tributary – a stream of water that feeds into a larger stream, river, bay or ocean
turbidity – sediments suspended in water cause the visibility to be obscured
water quality – a measurement of water pureness
watershed – a region or area where water drains ultimately to a particular body of water
wetlands – an ecosystem in which the roots of the plants are submerged under water at least part of the year

The Wonders of Water
Investigating Water (SOL 6.6) - 2nd Nine Weeks (Weeks 1-3.5)

6.6 The student will investigate and understand that water has unique physical properties and has a role in the natural and human-made environment. Key ideas include

a) water is referred to as the universal solvent;
b) water has specific properties;
c) thermal energy has a role in phase changes;
d) water has a role in weathering;
e) large bodies of water moderate climate; and
f) water is important for agriculture, power generation, and public health.

Central Idea: Due to water's properties it is a fundamental compound necessary for Earth's processes.

Essential Understanding:
Water has unique properties that are essential to Earth processes.

- Due to water's structure, a large number of substances will "dissolve" in water. For this reason, water is often called the universal solvent. (a)
- Water is the only compound that commonly exists in all three states (solid, liquid, gas) on Earth. (b)
- Individual water molecules can attract other water molecules like little magnets. In this way, water molecules "stick together" or show adhesion. The structure also allows water to "stick" to other surfaces leading to cohesion. (b)
- Surface tension is the property of the surface of a liquid that allows it to resist an external force. This property is due to the cohesive nature of water molecules. (b)
- Solid water is less dense than liquid water. (b)

Thermal energy added to a system increases the kinetic energy of molecules and results in temperature and phase changes.

- Water is able to absorb thermal energy without showing relatively large changes in temperature. (c, e)
- Large bodies of water act to moderate the climate of surrounding areas by absorbing thermal energy in summer and slowly releasing that energy in the winter. For this reason, the climate near large bodies of water is slightly milder than

areas without large bodies of water. (c, e)

Water shapes landscapes and is a powerful agent in weathering and erosion.

- Water (rain, ice, snow) has shaped our environment by physically and chemically weathering rock and soil and transporting sediments. Freezing water can break rock without any change in the minerals that form the rock (physical weathering). This usually produces small particles and sand. Water with dissolved gases and other chemicals causes the minerals in rocks to be changed, leading to the deterioration of the rock (chemical weathering). (d)

Humans affect the quality, availability, and distribution of Earth's water.

- Most of Earth's water is salt water in the oceans (97 percent). Available fresh water, used by humans and other organisms, makes up less than 1 percent of the water on Earth. (f)
- Water is essential for agriculture and in power generation. (f)
- Accessibility to clean fresh water is critical in maintaining public health. (f)

Vocabulary:

absorb - to take in or suck or swallow up
acidified - to make or become acid
adhesive - to stick by or as if by gluing, suction, grasping, or melting
Celsius - relating to or having a scale for measuring temperature on which the interval between the triple point and the boiling point of water is divided into 99.99 degrees with 0.01°C representing the triple point and 100.00°C the boiling point.
chemical weathering - to expose to the weather by chemical means
cohesive – the action or state of sticking together
contamination – to make impure or unfit for use by adding something harmful of unpleasant
density - the mass of a substance per unit volume <*density* expressed in grams per cubic centimeter
deterioration - to make or become worse or of less value
dissolve - to mix or cause to mix with a liquid so that the result is a liquid that is the same throughout
gas – matter with no definite shape or volume
gravity - the gravitational attraction of the mass of a heavenly body (as the earth) for bodies at or near its surface
ice - frozen water
irrigation - to supply with water by artificial means
liquid - matter with a volume but no definite shape
molecule - the smallest particle of a substance having all the characteristics of the substance <a *molecule* of water>
organism - something having many related parts that function together as a whole
physical weathering - to expose to the weather by physical means
solid - matter with a definite shape and volume
solvent - a usually liquid substance capable of dissolving one or more other substances

states - a condition or stage of the physical makeup of something
surface tension - the attractive force felt by surface molecules of a liquid from the molecules beneath that tends to draw the surface molecules into the mass of the liquid and makes the liquid take the shape having the least surface area
water cycle - the series of conditions through which water naturally passes from water vapor in the atmosphere through precipitation upon land or water surfaces and finally back into the atmosphere as a result of evaporation and transpiration
water vapor - water in a gaseous form especially when below boiling temperature and spread through the atmosphere

Save Today. Survive Tomorrow
Investigating Energy (SOL 6.8, 6.6, & 6.9) - 2nd Nine Weeks (Weeks 3.5-9)

6.4 The student will investigate and understand that there are basic sources of energy and that energy can be transformed. Key ideas include

a) the sun is important in the formation of most energy sources on Earth;
b) Earth's energy budget relates to living systems and Earth's processes
d) energy transformations are important in energy usage

Central Idea: The major source of energy on Earth is solar radiation.

6.6 The student will investigate and understand that water has unique physical properties and has a role in the natural and human-made environment. Key ideas include

f) water is important for agriculture, power generation, and public health.

Central Idea: Due to water's properties it is a fundamental compound necessary for Earth's processes.

6.9 The student will investigate and understand that humans impact the environment and individuals can influence public policy decisions related to energy and the environment. Key ideas include

a) natural resources are important to protect and maintain;
b) renewable and nonrenewable resources can be managed;
f) there are cost/benefit tradeoffs in conservation policies.

Central Idea: Natural resource management and health and safety issues related to the use of resources should be considered in the development of public policy.

Essential Understanding:
All Earth's processes are the result of energy flowing and mass cycling within and between Earth's systems. The energy is derived from the sun and Earth's hot interior.

- Solar radiation is made up of different types of radiation (including infrared, visible light, and ultraviolet). (a)

- Earth receives only a very small portion of the sun's energy, yet this energy is responsible for powering the motion of the atmosphere, the oceans, and many processes at Earth's surface. Earth's surface is heated unequally. (b)
- Earth's energy budget refers to the tracking of how much energy is flowing into and out of the Earth's climate, where the energy is going, and if the energy coming in balances with the energy going out. (b)
- The Earth's energy budget refers to the relationship of solar energy entering and exiting Earth's atmosphere. Excess carbon dioxide and other gases may impact the energy budget, creating a greenhouse effect. (b)
- When air or water is heated, the molecules move faster and farther apart, reducing their density and causing them to rise. Cooler air or water molecules move more slowly and are denser than warm air or water. Warm air or water rising coupled with cooler air or water descending forms a cyclic rising/falling pattern called convection. (c)
- Radiation and convection from Earth's surface transfer thermal energy. This energy powers the global circulation of the atmosphere and the oceans on our planet. (c)

Energy is continuously transferred from one place to another and transformed between its various possible forms.

- Secondary sources of energy, such as electricity, are used to store, move, and deliver energy easily in usable form. (d)
- Thermal and radiant energy can be converted into mechanical energy, chemical energy, and electrical energy and back again. (d)

Humans affect the quality, availability, and distribution of Earth's water.

- Water is essential for agriculture and in power generation. (f)

Natural resources are materials with different properties and suited for different uses. Natural resources are limited and are distributed unevenly around the planet.

- People, as well as other living organisms, are dependent upon the availability of clean water and air and a healthy environment. (a)
- Local, state, and federal governments have significant roles in managing and protecting air, water, plant, and wildlife resources. (b)
- Conservation of resources and environmental protection include individual acts of stewardship. (f)
- Humans' use of resources have a cause and effect impact on Earth systems and on the global economy. (f)

Earth scientists and engineers develop new technologies to extract resources while reducing the pollution, waste, and ecosystem degradation caused by extraction.

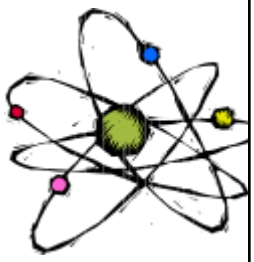
- Regulations, incentives, and voluntary efforts help conserve resources and protect environmental quality. (f)
- Use of renewable (water, air, soil, plant life, animal life) and nonrenewable resources (coal, oil, natural gas, nuclear power, and mineral resources) must be considered in terms of their cost/benefit tradeoffs. (f)
- Pollution prevention and waste management are less costly than cleanup. (f)

Vocabulary:

aqueducts - an artificial channel for water; *especially*: one for carrying a large quantity of flowing water
chemical energy – the energy stored in the bonds between atoms in molecules
cisterns - an artificial reservoir or tank for storing water usually underground
coal – solid form of fossilized plants, consisting of amorphous carbon used as fuel
conservation – controlled use or systematic protection of natural resources
electrical energy – the energy of moving electrons
energy – useable power that has the capacity for doing work
energy budget – a statement or diagram explaining the all of the energy received and given off or used
energy transformation – the change from light and heat to mechanical, chemical, and electrical energy
finite – enduring for a limited time only
force – the strength of a push or pull one body exerts on another
fossil fuels – formed from ancient plants & animals; coal, oil, natural gas
generate - to bring into existence
geothermal – energy obtained from hot magma beneath the Earth's surface
hydro – pertaining to water
hydroelectric - of or relating to production of electricity by waterpower
hydrosphere – all the water of the Earth (usually referring to the oceans)
kinetic energy – moving energy
mechanical energy – the energy involved in the motion of machines
motion – a change of position
natural gas – a mixture of hydrocarbon gases that occurs wit petroleum deposits used as a fuel and in manufacturing organic compounds
nonrenewable energy sources – fossil fuels
nonrenewable resources – a resource, such as oil, coal, or natural gas, that can be used up faster then can be replenished
nuclear power – energy found in the nucleus of an atom
oil – petroleum derivative used for fuel
pollution – contamination of air, soil, or water by the discharge of harmful substances
potential energy – stored energy
renewable energy sources – wood, hydro, geothermal, tidal, and solar
renewable resources – a resource that is inn great abundance and is continually produced, such as wind, sunlight, or lumber that can be replaced naturally if used wisely
reservoirs - a place where something is kept in store; *especially*: an artificial or natural lake where water is collected as a water supply
solar energy – electromagnetic radiation from the sun
thermal energy – the energy of moving and arrangements of molecules in a substance
turbines - an engine whose central driving shaft is fitted with a series of blades spun around by the pressure of a fluid
waste management – the control and regulation of waste

You Matter!
Atoms, Elements, and Compounds (SOL 6.5) - 3rd Nine Weeks (Weeks 1-3.5)

6.5 The student will investigate and understand that all matter is made up of atoms. Key ideas include



a) atoms consist of particles, including electrons, protons, and neutrons;
b) atoms of a particular element are similar but differ from atoms of other elements;
c) elements may be represented by chemical symbols;
d) two or more atoms interact to form new substances, which are held together by electrical forces (bonds);
e) compounds may be represented by chemical formulas;
f) chemical equations can be used to model chemical changes; and
g) a few elements comprise the largest portion of the solid Earth, living matter, the oceans, and the atmosphere.

Essential Understanding:
Atoms are the basic building blocks of all matter. The properties of an atom are based on the number and arrangement of its subatomic particles.

- The basic structural components of a typical atom are electrons, protons, and neutrons. Protons and neutrons comprise the nucleus of an atom. (a)
- An element is a form of matter made up of one type of atom. The atoms of an element have the same number of protons and electrons although the number of neutrons may vary. (b)
- The atoms of one element differ from those of another element in the number of protons. (b)
- Elements can be represented by chemical symbols. (c)

In a chemical process, the atoms that make up the original substance are regrouped into different molecules and the new substances have different properties from those of the reactants.

- Two or more atoms of different elements may combine to form a compound. (d)
- Chemical bonds are the forces that hold atoms together to form molecules and solids and new substances. These bonds are formed with electrons. In covalent bonds, the electrons are shared; ionic bonds electrons are transferred and rearranged. (d) *Students are not responsible for metallic bonding.*
- Compounds can be represented by chemical formulas. Each different element in the compound is represented by its unique symbol. The number of each type of element in the compound (other than 1) is represented by a small number (the subscript) to the right of the element symbol. (e)

Matter is conserved because atoms are conserved in chemical and physical processes.

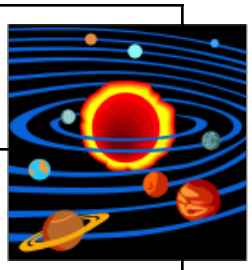
- Chemical equations can be used to model chemical changes, illustrating how elements become rearranged in a chemical reaction. (f) Students are not responsible for balancing equations.

- A limited number of elements form the largest portion of Earth's crust, living matter, the oceans, and the atmosphere. (g)

Vocabulary:

atom – the smallest particle of an element that has the properties of the element and can exist either alone or in combination
atomic structure – number & arrangement of protons, neutrons, & electrons in an atom
chemical change – the change of a substance to a different substance
chemical equation – model of chemical changes illustrating how elements become rearranged in a chemical reaction
chemical formula – shorthand way to represent compounds
chemical reaction – a change in which one or more substances are converted to different substances
chemical symbol – a shorthand way to write the name of an element
compound – substance made of the combined atoms of two or more elements
electron – negatively charged particle that move around the nucleus of an atom
element – substance in which all the atoms in a sample are alike
matter – the substance of the universe: something that occupies space and has mass
neutron – atomic particle with no charge (neutral) that is part of an atom's nucleus
nucleus – the positively charged center of an atom that contains protons and neutrons
proton – atomic particle with a positive charge that is part of an atom's nucleus
subscript – the number of atoms for a particular element represented by a small number to the right of the element's symbol

Our Place in Space
Earth and Space Systems (SOL 6.2, 6.3) - 3rd Nine Weeks (Weeks 3.5-9)



6.2 The student will investigate and understand that the solar system is organized and the various bodies in the solar system interact. Key ideas include

a) matter is distributed throughout the solar system;
b) planets have different sizes and orbit at different distances from the sun;
c) gravity contributes to orbital motion; and
d) the understanding of the solar system has developed over time.

Central Idea: The solar system is a set of interrelated and interdependent elements that are seamlessly connected through the flow of matter and energy.

6.3 The student will investigate and understand that there is a relationship between the sun, Earth, and the moon. Key ideas include

a) Earth has unique properties;
b) the rotation of Earth in relationship to the sun causes day and night;
c) the movement of Earth and the moon in relationship to the sun causes phases of the moon;
d) Earth's tilt as it revolves around the sun causes the seasons; and
e) the relationship between Earth and the moon is the primary cause of

Central Idea: Earth's position in the solar system lead it to have characteristics that support life.

Essential Understanding:
The solar system is a set of interrelated and interdependent elements that are seamlessly connected through the flow of matter and energy. Characteristics of these elements within the solar system are determined by their composition.

- The solar system consists of the sun, moon, Earth, other planets and their moons, meteors, asteroids, and comets. Each body has its own characteristics and features. (a)
- The distance between planets and sizes of the planets vary greatly. The outer "gas" planets are very large, and the four inner planets are comparatively small and rocky. (b)
- Gravitational interactions are attractive and depend on the masses of interacting objects. Gravity is the force that keeps the planets in motion around the sun. Gravity acts everywhere in the universe. (c)

Technological advances, breakthroughs in interpretation, and new observations continuously refine our understanding of Earth and Solar System.

- The invention of the telescope provided powerful and confounding observations that rapidly challenged the Earth-centered model. The development of mathematical physics provided a scientific understanding for the motion of the nearby planets. (d)
- With the development of new technology over the last half-century (e.g., manned and robotic space craft, powerful Earth-based and space telescopes, and computer analyses of huge data sets) our knowledge of the solar system has increased substantially. (d)

The proximity of the Earth to the sun and moon in our solar system impacts Earth systems and enable life to exist on Earth.

- Earth is a rocky planet, extensively covered with large oceans of liquid water and having frozen ice caps in its polar regions. Earth has a protective atmosphere consisting predominantly of nitrogen and oxygen and has a magnetic field. The atmosphere and the magnetic field help shield Earth's surface from harmful solar radiation. (a)
- Scientific evidence indicates that Earth is about 4.5 billion years old. (a)

The interactions and orientations of the Sun, Earth, and Moon lead to patterns that are evidenced in seasons, eclipses, and the phases of the moon.

- As Earth rotates, different sides of Earth face toward or away from the sun, causing day and night, respectively. (b)
- The relative positions of the moon, Earth, and sun give rise to moon phases. (c)
- Seasons are caused by a combination of the tilt of Earth on its axis, the curvature of Earth's surface and the angle at which sunlight strikes the surface of Earth during its annual revolution around the sun. (d)
- Tides are the result of the gravitational pull of the moon and sun on the surface waters of Earth. (e)

Vocabulary:

asteroid – small solid objects made of iron, nickel, stone, or any combination of the three, which orbits the sun; are sometimes called minor planets or planetoids
comet – an icy object orbiting the Sun; has been described as a "dirty snowball"
elliptical – the shape (oval) of the planets' orbits
geocentric theory – a scientific theory based on the idea that the earth is the center of the solar system
gravitational pull – the attraction that one object has for another object due to the invisible force of gravity
gravity – a mutual physical force attracting two bodies
heliocentric theory – a scientific theory based on the idea that the sun is the center of the solar system
meteor – when a meteoroid enters the Earth's atmosphere and begins to burn, causing a streak of light in the sky; also known as a falling or shooting star
meteorite – when a meteor reaches the surface of the Earth
meteoroid – small bits of rock and dust that orbit the Sun
meteor shower – occurs when the Earth passes through a wave of meteoroids and a great number of meteors fall to the Earth
orbit – the curved path that a celestial body follows when revolving around another body
planet – a round ball of rock and/or gas that orbits a star
revolution – one complete orbit around another body
rotation – one spin of a planet on its axis; causes day and night
satellite – a body that revolves around a larger body; can be natural (i.e. moon) or artificial (i.e. man-made)
star – a ball of mostly hydrogen and helium gas that produces its own light through nuclear fusion

Here Comes the Sun; Air, Air Everywhere; & Weather or Not
Solar Energy Distribution (SOL 6.7) - 4th Nine Weeks (Weeks 1-9)

6.4 The student will investigate and understand that there are basic sources of energy and that energy can be transformed. Key ideas include

a) the sun is important in the formation of most energy sources on Earth;
b) Earth's energy budget relates to living systems and Earth's processes;
c) radiation, conduction, and convection distribute energy; and

Central Idea: The major source of energy on Earth is solar radiation.

6.6 The student will investigate and understand that water has unique physical properties and has a role in the natural and human-made environment. Key ideas include

c) thermal energy has a role in phase changes;
e) large bodies of water moderate climate; and

Central Idea: Due to water's properties it is a fundamental compound necessary for Earth's processes.

6.7 The student will investigate and understand that air has properties and that Earth's atmosphere has structure and is dynamic. Key ideas include

a) air is a mixture of gaseous elements and compounds;
b) the atmosphere has physical characteristics;
c) properties of the atmosphere change with altitude;
d) there is a relationship between air movement, thermal energy, and weather conditions;
e) atmospheric measures are used to predict weather conditions; and
f) weather maps give basic information about fronts, systems, and weather measurements.

Central Idea: The Earth's atmosphere is a dynamic system that changes in response to inputs and outflows of energy and matter.

Essential Understanding:

All Earth's processes are the result of energy flowing and mass cycling within and between Earth's systems. The energy is derived from the sun and Earth's hot interior.

- Solar radiation is made up of different types of radiation (including infrared, visible light, and ultraviolet). (a)
- Earth receives only a very small portion of the sun's energy, yet this energy is responsible for powering the motion of the atmosphere, the oceans, and many processes at Earth's surface. Earth's surface is heated unequally. (b)
- Earth's energy budget refers to the tracking of how much energy is flowing into and out of the Earth's climate, where the energy is going, and if the energy coming in balances with the energy going out. (b)
- The Earth's energy budget refers to the relationship of solar energy entering and exiting Earth's atmosphere. Excess carbon dioxide and other gases may impact the energy budget, creating a greenhouse effect. (b)
- When air or water is heated, the molecules move faster and farther apart, reducing their density and causing them to rise. Cooler air or water molecules

move more slowly and are denser than warm air or water. Warm air or water rising coupled with cooler air or water descending forms a cyclic rising/falling pattern called convection. (c)

- Radiation and convection from Earth's surface transfer thermal energy. This energy powers the global circulation of the atmosphere and the oceans on our planet. (c)

Energy is continuously transferred from one place to another and transformed between its various possible forms.

- Secondary sources of energy, such as electricity, are used to store, move, and deliver energy easily in usable form. (d)
- Thermal and radiant energy can be converted into mechanical energy, chemical energy, and electrical energy and back again. (d)

Thermal energy added to a system increases the kinetic energy of molecules and results in temperature and phase changes.

- Water is able to absorb thermal energy without showing relatively large changes in temperature. (c, e)
- Large bodies of water act to moderate the climate of surrounding areas by absorbing thermal energy in summer and slowly releasing that energy in the winter. For this reason, the climate near large bodies of water is slightly milder than areas without large bodies of water. (c, e)

Earth's atmosphere is comprised of interacting and interdependent elements that are subject to change in response to inputs and outflows of energy and matter.

- Air is a mixture of gaseous elements and compounds. These include nitrogen, oxygen, water, argon and carbon dioxide. Nitrogen makes up the largest proportion of air. (a)
- The atmosphere is made up of layers (troposphere, stratosphere, mesosphere, and thermosphere) that have distinct characteristics. (c)
- Naturally occurring ozone is also found in the upper atmosphere and helps to shield Earth from ultraviolet radiation. (c)

The atmosphere is dynamic because of the number of factors that affect the gaseous envelope, such as pressure and temperature, which change with altitude and latitude.

- Air exerts pressure. Air pressure decreases as altitude increases. (b)
- Moisture in the air is called humidity. (b)
- Temperature decreases as altitude increases in the lowest layer of the atmosphere. (b)
- Data such as: barometric pressure, temperature, wind speed and direction, humidity, and dew point can be collected and analyzed and used to predict weather. (b, d)

Thermal energy transfer from the sun or from other geosystems impacts air movement and weather conditions.

- The amounts of thermal energy and water vapor in the air and the pressure of the air largely determine the weather conditions. (d, e)

Models constructed based on patterns in atmospheric conditions are used to predict weather.

- Most of the air that makes up the atmosphere is found in the troposphere (the lowest layer). Virtually all weather takes place there. (c, e)
- Weather maps show much useful information about descriptive air measurements, observations, and boundaries between air masses (fronts). The curved lines showing areas of equal air pressure and temperature are key features of weather maps. Weather maps are important for understanding and predicting the weather. (f)

Vocabulary:

absorption – to take in
alto – prefix used with cloud names to indicate middle height
atmosphere – the gases that surround the Earth
cirro – prefix used with cloud names to indicate very high clouds
cirrus – a thin, feathery white cloud usually of tiny ice crystals formed at altitudes of 6,000 to 12,000 meters
clouds – accumulations of water droplets held in the air because they are too light to fall
cold front – an advancing edge of a cold air mass
climate – the average weather conditions of a particular place or region over a period of years
convection – a method of energy transfer caused by uneven heating
cumulo – prefix used with cloud names to indicate tall fluffy clouds
cumulonimbus – a thunderstorm cloud; usually associated with cold fronts but can develop on hot afternoons
cumulus – a large cloud form having a flat base and rounded outlines often piled up like a mountain; fluffy
currents (ocean) – the movement of water from one place to another (usually caused by convection)
drought – a long period of dry weather
fronts – the boundary between two dissimilar air masses
greenhouse effect – the method by which the atmosphere traps the sun's radiation
hurricane – a cyclone formed in the tropics with winds of 117 kilometers per hour (74 mph) or greater usually accompanied by rain, thunder, and lightning
hydro – pertaining to water
hydrosphere – all the water of the Earth (usually referring to the oceans)
infrared radiation – invisible light with a long wavelength
nimbo – prefix used with cloud names to indicate rain
ozone – a form of oxygen that is a bluish irritating sharp-smelling gas containing three atoms per molecule
precipitation – water or the amount of water that falls to the earth as hail, mist, rain, sleet, or snow
radiation – energy being emitted in the form of waves or particles
reflection – to bounce back

solar energy – electromagnetic radiation from the sun
strato – prefix used with cloud names to indicate clouds that are flat or layered
stratus – a wide flat cloud extending over a large area at an altitude of from 600 to 2100 meters
thunderstorm – a small but powerful storm with strong winds, heavy rain, lightning and a chance of hail or tornadoes (cumulonimbus clouds)
tornadoes – a violent destructive whirling wind accompanied by a funnel-shaped cloud that moves in a narrow path over the land
ultraviolet radiation – invisible light with a short wavelength
visible radiation – wavelengths of light that human eyes can detect
wavelength – the distance from one wave crest to the next
warm front – an advancing edge of a warm air mass
water vapor – water in a gaseous form especially when below boiling temperature and spread through the atmosphere
weather – the state of the atmosphere in regard to heat or cold, wetness or dryness, calm or storm, clearness or cloudiness