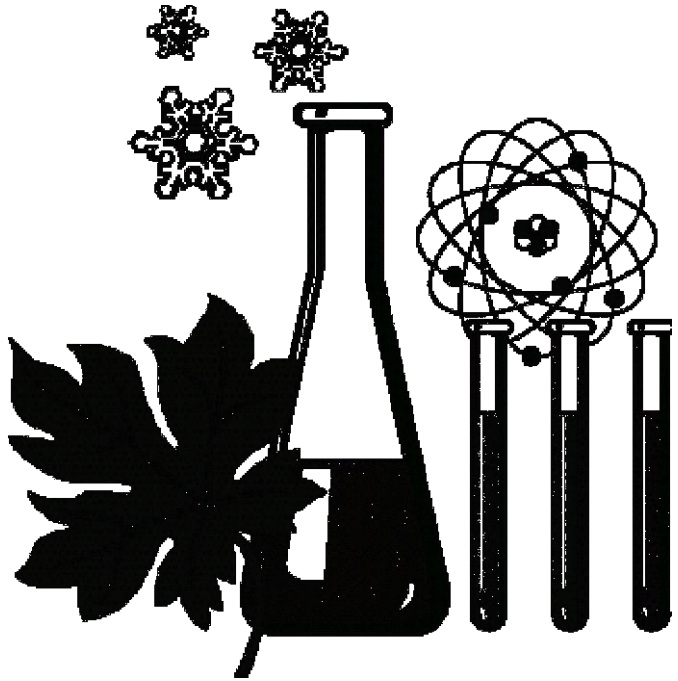
SCIENCE
ALIGNED STANDARDS OF LEARNING CURRICULUM FRAMEWORK

Grade 5



5S-SI 1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which

a) distinctions are made among observations, conclusions, inferences, and predictions;
b) objects or events are classified and arranged according to characteristics or properties;
c) appropriate instruments are selected and used to measure length, mass, volume and temperature in metric units;
d) appropriate instruments are selected and used to measure elapsed time;
e) predictions and inferences are made, and conclusions are drawn based on data from a variety of sources;
f) independent and dependent variables are identified;
g) constants in an experimental situation are identified;
h) hypotheses are developed as cause and effect relationships;
i) data are collected, recorded, analyzed, and displayed using bar and basic line graphs;
j) numerical data that are contradictory or unusual in experimental results are recognized;
k) data are communicated with simple graphs, pictures, written statements, and numbers;
l) models are constructed to clarify explanations, demonstrate relationships, and solve needs.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• The nature of science refers to the foundational concepts that govern the way scientists formulate explanations about the natural world. The nature of science includes the following concepts: a) the natural world is understandable; b) science is based on evidence, both observational and experimental; c) science is a blend of logic and innovation; d) scientific ideas are durable yet subject to change as new data are collected; e) science is a complex social endeavor; and f) scientists try to remain objective and engage in peer review to help avoid bias. In grade four, an emphasis should be placed on concepts a, b, c, d, and e. • Science assumes that the natural world is understandable. Scientific inquiry can provide explanations about nature. This expands students' thinking from just a knowledge of facts to understanding how facts are relevant to everyday life. • Science demands evidence. Scientists develop their ideas based on evidence and they change their ideas when new evidence becomes available or the old evidence is viewed in a different way.	**In order to meet this standard, it is expected that students will** • differentiate among simple observations, conclusions, inferences, and predictions, and correctly apply the terminology in oral and written work. • analyze a set of 20 or fewer objects or pictures. Sort them into categories to organize the data (qualitative or quantitative); and construct bar graphs and line graphs depicting the distribution of those data based on characteristics or properties. • use millimeters, centimeters, meters, kilometers, grams, kilograms, milliliters, liters, and degrees Celsius in measurement. • choose the appropriate instruments, including centimeter rulers, meter sticks, scales, balances, graduated cylinders, beakers, and Celsius thermometers, for making basic metric measures. • measure elapsed time using a stopwatch or a clock. • make predictions, inferences, and draw conclusions using a variety of sources such as picture graphs, bar graphs, and basic line graphs.

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• Science uses both logic and innovation. Innovation has always been an important part of science. Scientists draw upon their creativity to visualize how nature works, using analogies, metaphors, and mathematics. • Scientific ideas are durable yet subject to change as new data are collected. The main body of scientific knowledge is very stable and grows by being corrected slowly and having its boundaries extended gradually. Scientists themselves accept the notion that scientific knowledge is always open to improvement and can never be declared absolutely certain. New questions arise, new theories are proposed, new instruments are invented, and new techniques are developed. • Science is a complex social endeavor. It is a complex social process for producing knowledge about the natural world. Scientific knowledge represents the current consensus among scientists as to what is the best explanation for phenomena in the natural world. This consensus does not arise automatically, since scientists with different backgrounds from all over the world may interpret the same data differently. To build a consensus, scientists communicate their findings to other scientists and attempt to replicate one another's findings. In order to model the work of professional scientists, it is essential for fourth-grade students to engage in frequent discussions with peers about their understanding of their investigations.	• analyze the variables in a simple experiment. Identify the independent variable and the dependent variable. Decide which other variable(s) must be held constant (not allowed to change) in order for the investigation to represent a fair test. • create a plausible hypothesis, stated in terms of cause (if) and effect (then), from a set of basic observations that can be tested. Hypotheses can be stated in terms such as: "If the water temperature is increased, then the amount of sugar that can be dissolved in it will increase." • organize and analyze data from a simple experiment. Construct bar graphs and line graphs depicting the data. • judge which, if any, data in a simple set of results (generally 10 or fewer in number) appear to be contradictory or unusual. • present results of a simple experiment using graphs, pictures, statements, and numbers. • construct a physical model to clarify an explanation, demonstrate a relationship, or solve a need.

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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• An observation is what you see, feel, taste, hear, or smell. Scientists construct knowledge from observations and inferences, not observations alone. To communicate an observation accurately, one must provide a clear description of exactly what is observed and nothing more. Those conducting investigations need to understand the difference between what is seen and what inferences, conclusions, or interpretations can be drawn from the observation. • An inference is a tentative explanation based on background knowledge and available data. • A scientific prediction tells what may happen in some future situation. It is based on the application of scientific principles and factual information. • Accurate observations and evidence are necessary to draw realistic and plausible conclusions. A conclusion is a summary statement based on the results of an investigation. • Conclusions are drawn by making judgments after considering all the information you have gathered. Conclusions are based on details and facts. • Systematic investigations require standard measures (metric), consistent and reliable tools, and organized reporting of data. The way the data are displayed can make it easier to uncover important information. This can assist in making reliable scientific forecasts of future events.	

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UNDERSTANDING THE STANDARD **(Background Information for Instructor Use Only)**	**ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES**
• Elapsed time is the amount of time that has passed between two given times. (*See Grade Four Mathematics Curriculum Framework, Standard 4.9, page 24.*) • An experiment is a fair test driven by a hypothesis. A fair test is one in which only one variable is compared. • A hypothesis is a prediction about the relationship between variables. A hypothesis is an educated guess/prediction about what will happen based on what you already know and what you have already learned from your research. It must be worded so that it is "testable." • In order to conduct an experiment, one must recognize all of the potential variables or changes that can affect its outcome. • An independent variable is the factor in an experiment that is altered by the experimenter. The independent variable is purposely changed or manipulated. • A dependent variable is the factor in an experiment that changes as a result of the manipulation of the independent variable. • The constants in an experiment are those things that are purposefully not changed and remain the same throughout the experiment.	

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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES

- In science, it is important that experiments and the observations recorded are repeatable. There are two different types of data – qualitative and quantitative. Qualitative data deal with descriptions and data that can be observed, but not measured. Quantitative data are data that can be counted or measured and the results can be recorded using numbers. Quantitative data can be represented visually in graphs and charts. Quantitative data define whereas qualitative data describe. Quantitative data are more valuable in science because they allow direct comparisons between observations made by different people or at different times.

Example of Qualitative vs. Quantitative Data

Main Street Elementary School Science Club

Qualitative	Quantitative
• Friendly • Like science • Positive about school	• 10 fourth-grade students and 12 fifth-grade students • 14 girls, 8 boys • 92 percent participated in the divisionwide science fair last year

- It is important for students to apply the science content they have learned to current events and applications.

5S-SI2 The student will demonstrate an understanding of scientific reasoning, logic and the nature of science by planning and conducting investigations in which

- **a) items such as rocks, minerals, and organisms are identified using various classification keys;**
- **b) estimates are made and accurate measurements of length, mass, volume, and temperature are made in metric units using proper tools;**
- **c) estimates are made and accurate measurements of elapsed time are made using proper tools;**
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- **g) data are collected, recorded, analyzed, and communicated using proper graphical representations and metric measurements;**
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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Systematic investigations require standard measures and consistent and reliable tools. Metric measures are a standard way to make measurements and are recognized around the world. • A classification key is an important tool used to help identify objects and organisms. It consists of a branching set of choices organized in levels, with most levels of the key having two choices. Each level provides more specific descriptors, eventually leading to identification. • A hypothesis is an educated guess/prediction about what will happen based on what you already know and what you have already learned from your research. It must be worded so that it is "testable." The hypothesis can be written as an "If…, then…." statement, such as "If all light is blocked from a plant for two weeks, then the plant will die." • An independent variable is the factor in an experiment that is altered by the experimenter. The independent variable is purposely changed or manipulated. • A dependent variable is the factor in an experiment that changes as a result of the manipulation of the independent variable. • The constants in an experiment are those things that are purposefully kept the same throughout the experiment.	

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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• When conducting experiments, data are collected, recorded, analyzed, and communicated using proper graphical representations and metric measurements. • Systematic investigations require organized reporting of data. The way the data are displayed can make it easier to see important patterns, trends, and relationships. Bar graphs and line graphs are useful tools for reporting discrete data and continuous data, respectively. • A scientific prediction is a forecast about what may happen in some future situation. It is based on the application of factual information and principles and recognition of trends and patterns. • Estimation is a useful tool for making approximate measures and giving general descriptions. In order to make reliable estimates, one must have experience using the particular unit. • An inference is a tentative explanation based on background knowledge and available data. • A conclusion is a summary statement based on the results of an investigation. Scientific conclusions are based on verifiable observations (science is empirical).	

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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Scientific modeling is the process of generating abstract, conceptual, graphical and/or mathematical models. It is an approximation or simulation of a real system that omits all but the most essential variables of the system. In order to create a model, a scientist must first make some assumptions about the essential structure and relationships of objects and/or events in the real world. These assumptions are about what is necessary or important to explain the phenomena. • It is important for students to apply the science content that they have learned to current issues and applications.	

5S-FME1 The student will investigate and understand characteristics and interactions of moving objects. Key concepts include

a) motion is described by an object's direction and speed;
b) changes in motion are related to force and mass;
c) friction is a force that opposes motion;
d) moving objects have kinetic energy.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• The position of an object can be described by locating it relative to another object or to the background. • Tracing and measuring an object's position over time can describe its motion. • Speed describes how fast an object is moving. • Energy may exist in two states: kinetic or potential. • Kinetic energy is the energy of motion. • A force is any push or pull that causes an object to move, stop, or change speed or direction. • The greater the force, the greater the change in motion will be. The more massive an object, the less effect a given force will have on the object. • Friction is the resistance to motion created by two objects moving against each other. Friction creates heat. • Unless acted on by a force, objects in motion tend to stay in motion and objects at rest remain at rest.	**In order to meet this standard, it is expected that students will** • describe the position of an object. • collect and display in a table and line graph time and position data for a moving object. • explain that speed is a measure of motion. • interpret data to determine if the speed of an object is increasing, decreasing, or remaining the same. • identify the forces that cause an object's motion. • describe the direction of an object's motion: up, down, forward, backward. • infer that objects have kinetic energy. • design an investigation to test the following hypothesis: "If the mass of an object increases, then the force needed to move it will increase." • design an investigation to determine the effect of friction on moving objects. Write a testable hypothesis and identify the dependent variable, the independent variable, and the constants. Conduct a fair test, collect and record the data, analyze the data, and report the results of the data.

5S-FME2 The student will investigate and understand the characteristics of electricity. Key concepts include

a) conductors and insulators;
b) basic circuits;
c) static electricity;
d) the ability of electrical energy to be transformed into light and motion, and to produce heat;
e) simple electromagnets and magnetism;
f) historical contributions in understanding electricity.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• A continuous flow of negative charges (electrons) creates an electric current. The pathway taken by an electric current is a circuit. Closed circuits allow the movement of electrical energy. Open circuits prevent the movement of electrical energy. • Electrical energy moves through materials that are conductors (metals). Insulators (rubber, plastic, wood) do not conduct electricity well. • Among conducting materials, the rate at which energy flows depends on the material's resistance. • In a series circuit, there is only one pathway for the current, but in a parallel circuit there are two or more pathways for it. • Rubbing certain materials together creates static electricity. • Lightning is the discharge of static electricity in the atmosphere. • Electrical energy can be transformed into light or motion, and can produce thermal energy. • Certain iron-bearing metals attract other such metals (also nickel and cobalt). • Lines of force extend from the poles of a magnet in an arched pattern defining the area over which magnetic force is exerted. • An electric current creates a magnetic field, and a moving magnetic field creates an electric current. • A current flowing through a wire creates a magnetic field. Wrapping a wire around certain iron-bearing metals (iron nail) and creating a closed circuit is an example of a simple electromagnet. • Benjamin Franklin, Michael Faraday, and Thomas Edison made important discoveries about electricity.	**In order to meet this standard, it is expected that students will** • apply the terms insulators, conductors, open and closed in describing electrical circuits. • differentiate between an open and closed electric circuit. • use the dry cell symbols (–) and (+). • create and diagram a functioning series circuit using dry cells, wires, switches, bulbs, and bulb holders. • create and diagram a functioning parallel circuit using dry cells, wires, switches, bulbs, and bulb holders. • differentiate between a parallel and series circuit. • describe the types of energies (i.e., thermal, radiant, and mechanical) that are transformed by various household appliances (e.g., lamp, toaster, fan). • create a diagram of a magnetic field using a magnet. • compare and contrast a permanent magnet and an electromagnet. • explain how electricity is generated by a moving magnetic field. • design an investigation using static electricity to attract or repel a variety of materials. • explain how static electricity is created and occurs in nature. • construct a simple electromagnet using a wire, nail, or other iron- bearing object, and a dry cell.

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- **f) historical contributions in understanding electricity.**

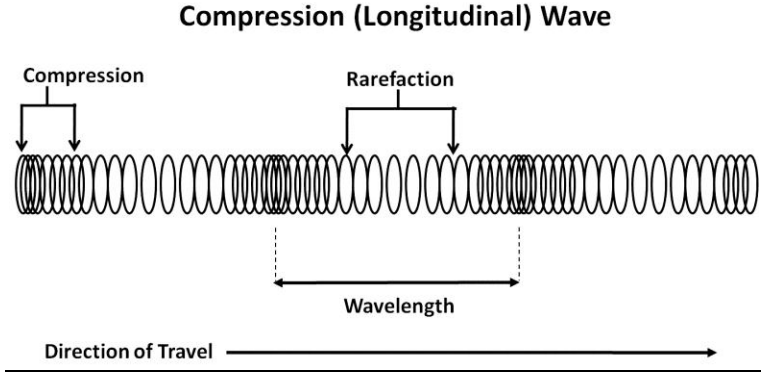
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
	• design and perform an investigation to determine the strength of an electromagnet. (The independent variable could be the number of coils of wire and the dependent variable could be the number of paperclips the magnet can attract.) • describe the contributions of Ben Franklin, Michael Faraday, and Thomas Edison to the understanding and harnessing of electricity.

5S-FME3 The student will investigate and understand how sound is created and transmitted, and how it is used. Key concepts include

a) compression waves;
b) vibration, compression, wavelength, frequency, amplitude;
c) the ability of different media (solids, liquids, and gases) to transmit sound;
d) uses and applications of sound waves.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- Sound is a form of energy produced and transmitted by vibrating matter.
- Sound waves are compression (longitudinal) waves.
- When compression (longitudinal) waves move through matter (solid, liquid, or a gas), the molecules of the matter move backward and forward in the direction in which the wave is traveling. As sound waves travel, molecules are pressed together in some parts (compression) and in some parts are spread out (rarefaction). A child's toy in the form of a coil is a good tool to demonstrate a compression (longitudinal) wave.



- The frequency of sound is the number of wavelengths in a given unit of time.
- The wavelength of sound is the distance between two compressions or between two rarefactions. The wavelength can be measured from any point on a wave as long as it is measured to the same point on the next wave.
- When we talk, sound waves travel in air. Sound also travels in liquids and solids. Sound waves must have a medium through which to travel. In a vacuum sound cannot travel because there is no matter for it to move through.

ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES

In order to meet this standard, it is expected that students will

- use the basic terminology of sound to describe what sound is, how it is formed, how it affects matter, and how it travels.
- create and interpret a model or diagram of a compression wave.
- explain why sound waves travel only where there is matter to transmit them.
- explain the relationship between frequency and pitch.
- design an investigation to determine what factors affect the pitch of a vibrating object. This includes vibrating strings, rubber bands, beakers/bottles of air and water, tubes (as in wind chimes), and other common materials.
- compare and contrast sound traveling through a solid with sound traveling through the air. Explain how different media (solid, liquid, and gas) will affect the transmission of sound.
- compare and contrast the sound (voice) that humans make and hear to those of other animals. This includes bats, dogs, and whales.
- compare and contrast how different kinds of musical instruments make sound. This includes string instruments, woodwinds, percussion instruments, and brass instruments.

5S-FME3 The student will investigate and understand how sound is created and transmitted, and how it is used. Key concepts include

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b) vibration, compression, wavelength, frequency, amplitude;
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• Pitch is determined by the frequency of a vibrating object. Objects vibrating faster have a higher pitch than objects vibrating slower. A change in frequency of sound waves causes an audible sensation—a difference in pitch. • Amplitude is the amount of energy in a compression (longitudinal) wave and is related to intensity and volume. For example, when a loud sound is heard, it is because many molecules have been vibrated with much force. A soft sound is made with fewer molecules being vibrated with less force. • Sound travels more quickly through solids than through liquids and gases because the molecules of a solid are closer together. Sound travels the slowest through gases because the molecules of a gas are farthest apart. • Some animals make and hear ranges of sound vibrations different from those that humans can make and hear. • Musical instruments vibrate to produce sound. There are many different types of musical instruments and each instrument causes the vibrations in different ways. The most widely accepted way to classify musical instruments is to classify them by the way in which the sound is produced by the instrument. The four basic classifications are percussion instruments (e.g., drums, cymbals), stringed instruments (e.g., violin, piano, guitar), wind instruments (e.g., flute, clarinet, trumpet, trombone), and electronic instruments (e.g., electronic organ, electric guitar).	

5S-FME4 The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include

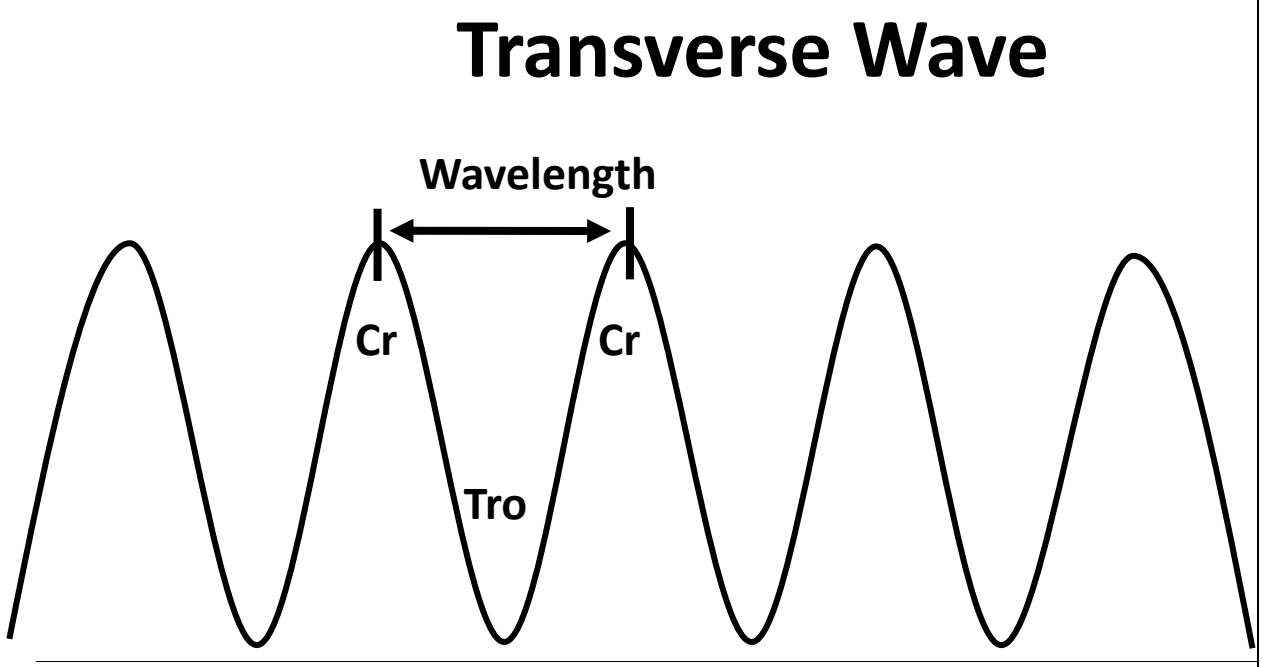
a) traverse waves;
b) the visible spectrum;
c) opaque, transparent, and translucent;
d) reflection of light from reflective surfaces
e) refraction of light through water and prisms.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Light has properties of both a wave and a particle. Recent theory identifies light as a small particle, called a photon. A photon moves in a straight line. In both the light wave and photon descriptions, light is energy. • Because light has both electric and magnetic fields, it is referred to as electromagnetic radiation. Light waves move as transverse waves and travel through a vacuum at a speed of approximately 186,000 miles per second (2.99 x 10^8 meters per second). Compared to sound, light travels extremely fast. It takes light from the sun less than 8½ minutes to travel 93 million miles (150 million kilometers) to reach Earth. • Unlike sound, light waves travel in straight paths called rays and do not need a medium through which to move. A ray is the straight line that represents the path of light. A beam is a group of parallel rays. • Light waves are characterized by their wavelengths and the frequency of their wavelengths • The size of a wave is measured as its wavelength, which is the distance between any two corresponding points on successive waves, usually crest-to-crest or trough-to-trough. The wavelength can be measured from any point on a wave as long as it is measured to the same point on the next wave.	**In order to meet this standard, it is expected that students will** • diagram and label a representation of a light wave, including wavelength, crest, and trough. • explain the relationships between wavelength and the color of light. Name the colors of the visible spectrum. • explain the terms transparent, translucent, and opaque, and give an example of each. • compare and contrast reflection and refraction, using water, prisms, and mirrors. • analyze the effects of a prism on white light and describe why this occurs. • explain the relationship between the refraction of light and the formation of a rainbow.

5S-FME4 The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include

- **a) traverse waves;**
- **b) the visible spectrum;**
- **c) opaque, transparent, and translucent;**
- **d) reflection of light from reflective surfaces**
- **e) refraction of light through water and prisms.**

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES



5S-FME4 The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include

a) traverse waves;
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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Frequency is the number of waves passing a given point every second. The greater the frequency, the greater the amount of energy. • Light waves are waves of energy. The amount of energy in a light wave is proportionally related to its frequency: high frequency light has high energy; low frequency light has low energy. The more wavelengths in a light wave in a given period of time, the higher the energy level. Thus gamma rays have the most energy, and radio waves have the least. Of visible light, violet has the most energy and red the least.	

5S-FME4 The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include

- **a) traverse waves;**
- **b) the visible spectrum;**
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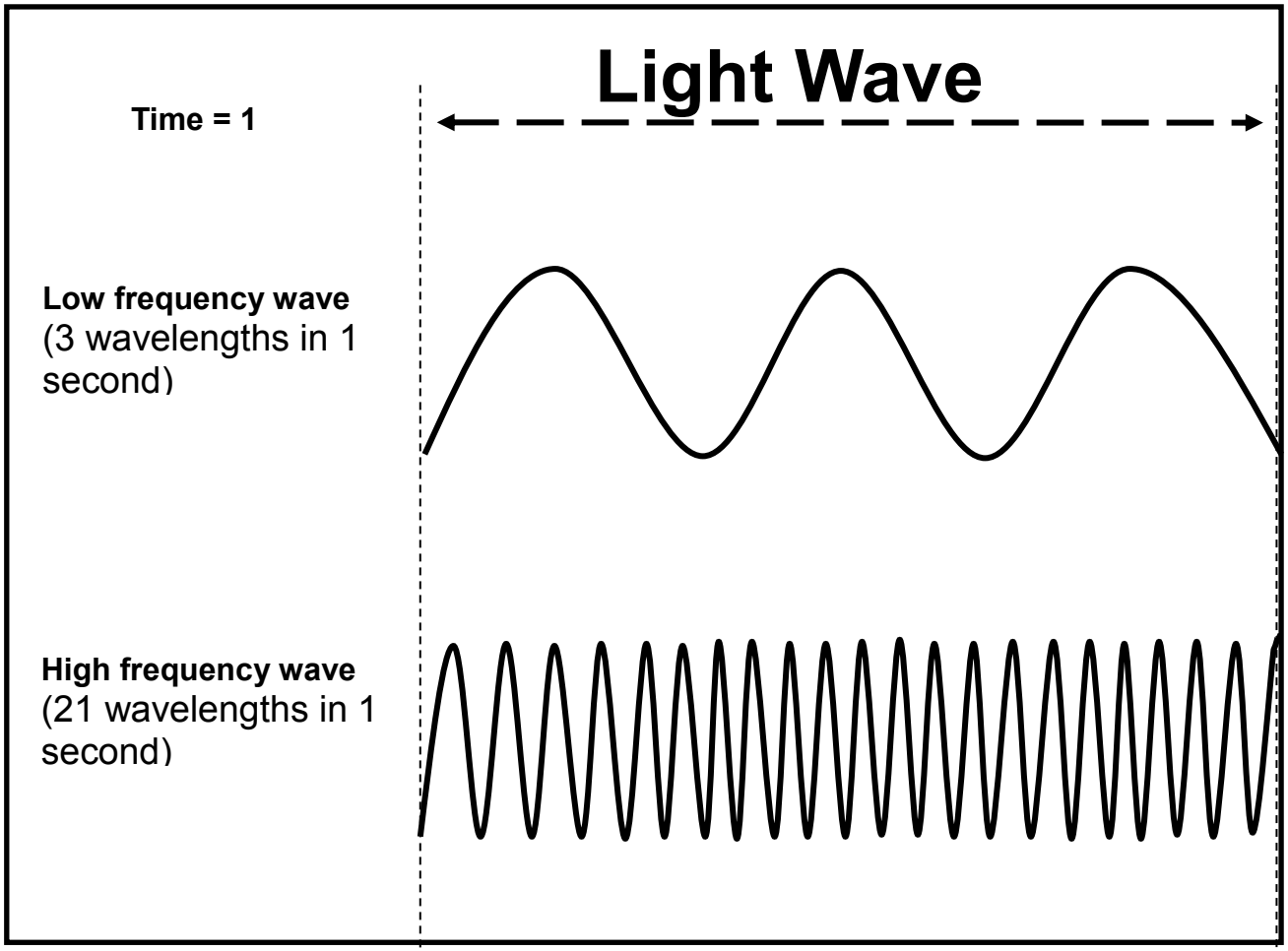
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS



- The entire range of electromagnetic radiation (light) is called the electromagnetic spectrum.

5S-FME4 The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include

- **a) traverse waves;**
- **b) the visible spectrum;**
- **c) opaque, transparent, and translucent;**
- **d) reflection of light from reflective surfaces**
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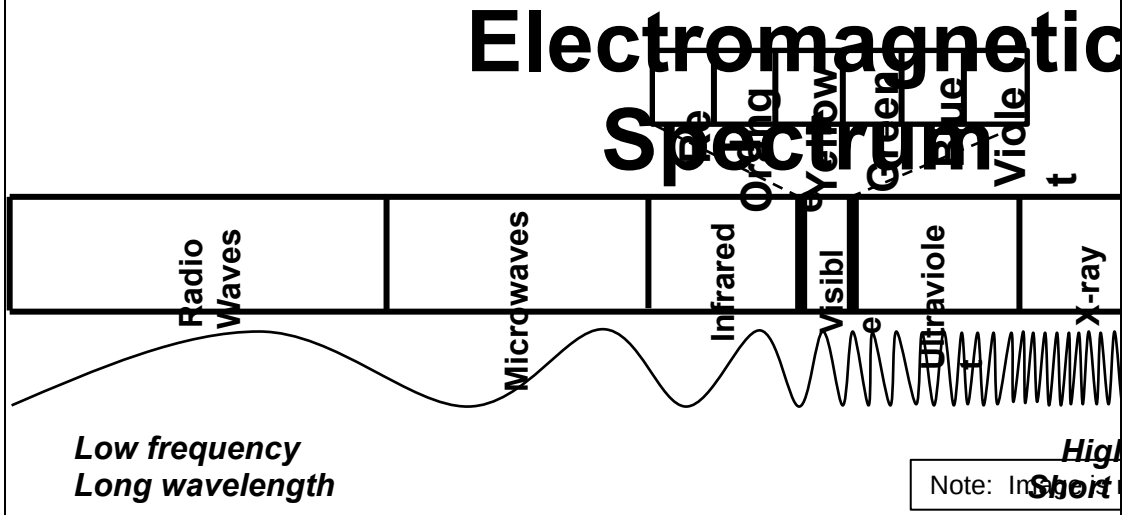
UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES



5S-FME4 The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include

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UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• The only difference between the various types of electromagnetic radiation is the amount of energy. Sunlight consists of the entire electromagnetic spectrum. • We see visible light as the colors of the rainbow. Each color has a different wavelength. Red has the longest wavelength and violet has the shortest wavelength. The colors of the visible spectrum from the longest wavelength to the shortest wavelength are: red, orange, yellow, green, blue, and violet (ROYGBV). Most scientists no longer include the color indigo, which used to be included between blue and violet. • Black and white are not spectral colors. Black is when a material absorbs all the visible light and no light is reflected back. Black is a total absence of reflected light. White is a reflection of all visible light together. • Light travels in straight paths until it hits an object, where it bounces off (is reflected), is bent (is refracted), passes through the object (is transmitted), or is absorbed as heat. • The term reflected light refers to light waves that are neither transmitted nor absorbed, but are thrown back from the surface of the medium they encounter. If the surface of the medium contacted by the wave is smooth and polished (e.g., a mirror), each reflected wave will be reflected back at the same angle as the incident wave. The wave that strikes the surface of the medium (e.g., a mirror) is called the **incident** wave, and the one that bounces back is called the reflected wave. • Refraction means the bending of a wave resulting from a change in its velocity (speed) as it moves from one medium to another (e.g., light moving from the air into water). The frequency of the wave does not change. • The amount of bending of the light wave (refraction) depends on: 1. The density of the material it is entering; 2. The wavelength of the light wave; and 3. The angle at which the original light wave enters the new medium.	

5S-FME4 The student will investigate and understand basic characteristics of visible light and how it behaves. Key concepts include

a) traverse waves;
b) the visible spectrum;
c) opaque, transparent, and translucent;
d) reflection of light from reflective surfaces
e) refraction of light through water and prisms.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Some examples of refraction are when: 1. Refraction causes a setting sun to look flat. 2. A spoon appears to bend when it is immersed in a cup of water. The bending seems to take place at the surface of the water, or exactly at the point where there is a change of density. 3. Shadows on the bottom of a pool are caused because air and water have different densities. 4. A glass prism disperses white light into its individual colors. As visible light exits the prism, it is refracted and separated into a display of colors. • A rainbow is an example of both refraction and reflection. Sunlight is first refracted when it enters the surface of a spherical raindrop, it is then reflected off the back of the raindrop, and once again refracted as it leaves the raindrop. • A prism can be used to refract and disperse visible light. When the different wavelengths of light in visible light pass through a prism, they are bent at different angles (refracted). Dispersion occurs when we see the light separated into a display of colors: ROYGBV. • **Dispersion** is the separation of light. Dispersion occurs with transparent surfaces that are not parallel to each other, such as a prism or gemstone facets. • Light passes through some materials easily (transparent materials), through some materials partially (translucent materials), and through some not at all (opaque materials). The relative terms transparent, translucent, and opaque indicate the amount of light that passes through an object. 1. Examples of transparent materials include clear glass, clear plastic food wrap, clean water, and air. 2. Examples of translucent materials include wax paper, frosted glass, thin fabrics, some plastics, and thin paper. 3. Examples of opaque materials include metal, wood, bricks, aluminum foil, and thick paper.	

5S-FME5 The student will investigate and understand that matter is anything that has mass, and takes up space; and occurs as a solid, liquid or gas. Key concepts include

a) distinguishing properties of each phase of matter;
b) the effect of temperature on the phases of matter;
c) atoms and elements;
d) molecules and compounds;
e) mixtures including solutions.

UNDERSTANDING THE STANDARD
(Background Information for Instructor Use Only)

- Matter is anything that has mass and volume.
- Mass is the amount of matter in an object. The mass of an object does not change. (Weight of an object changes based on the gravitational pull on it. A person will have the same mass on Earth, Mars, and our moon. However, his or her weight on our moon will be 1/6 of what it is on Earth and will be 1/3 as much on Mars.)
- Matter can exist in several distinct forms which are called phases. The three basic phases of matter generally found on Earth are gas, liquid, and solid. (Though other phases of matter have been identified, these are the phases of matter that fifth-grade students are expected to know.)

Characteristics of Gases, Liquids, and Solids

gas	liquid	solid
Assumes the shape of its container	Assumes the shape of its container	Retains a fixed shape
Assumes the volume of its container – no definite volume	Has a definite volume	Has a definite volume
Compressible (lots of free space between particles)	Not easily compressible (little free space between particles)	Not easily compressible (little free space between particles)
Flows easily (particles can move past one another)	Flows easily (particles can move/slide past one another)	Does not flow easily (rigid-particles cannot move/slide past one another)

ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES

In order to meet this standard, it is expected that students will

- construct and interpret a sequence of models (diagrams) showing the activity of molecules in all three basic phases of matter.
- construct and interpret models of atoms and molecules.
- identify substances as being an element or a compound.
- design an investigation to determine how a change in temperature affects the phases of matter (e.g., water). Include in the design ways information will be recorded, what measures will be made, what instruments will be used, and ways the data will be graphed.
- compare and contrast mixtures and solutions.

5S-FME5 The student will investigate and understand that matter is anything that has mass, and takes up space; and occurs as a solid, liquid or gas. Key concepts include

a) distinguishing properties of each phase of matter;
b) the effect of temperature on the phases of matter;
c) atoms and elements;
d) molecules and compounds;
e) mixtures including solutions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• As its temperature increases, many kinds of matter change from a solid to a liquid to a gas. As its temperature decreases, that matter changes from a gas to a liquid to a solid. • All matter, regardless of its size, shape, or color, is made of particles (atoms and molecules) that are too small to be seen by the unaided eye. • There are more than 100 known elements that make up all matter. A few of the more familiar elements include: hydrogen (H), oxygen (O), helium (He), carbon (C), sodium (Na), and potassium (K). The smallest part of an element is an atom. • A mixture is a combination of two or more substances that do not lose their identifying characteristics when combined. A solution is a mixture in which one substance dissolves in another. • When two or more elements combine to form a new substance, it is called a compound. There are many different types of compounds because atoms of elements combine in many different ways (and in different whole number ratios) to form different compounds. Examples include water (H_2O) and table salt (NaCl). The smallest part of a compound is a molecule. • Nanotechnology is the study of materials at the molecular (atomic) scale. Items at this scale are so small they are no longer visible with the naked eye. Nanotechnology has shown that the behavior and properties of some substances at the nanoscale (a nanometer is one-billionth of a meter) contradict how they behave and what their properties are at the visible scale. Many products on the market today are already benefiting from nanotechnology such as sunscreens, scratch-resistant coatings, and medical procedures.	

5S-LPS1 The student will investigate and understand basic plant anatomy and life processes. Key concepts include

a) the structures of typical plants and the function of each structure;
b) processes and structures involved with plant reproduction;
c) photosynthesis;
d) adaptations allow plants to satisfy life needs and respond to the environment.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• For many typical green plants, there are anatomical structures that perform certain basic functions. For example, roots anchor the plants and take water and nutrients from the soil. Plant stems provide support and allow movement of water and nutrients. • Plants can be divided into two general groups: those that produce seeds and those that produce spores. • Many seed-producing plants have roots, stems, leaves, and flowers. • Seeds vary considerably in size. Orchids, for example, produce seeds as small as dust particles. The coconut is one of the largest seeds in the plant kingdom. In many seeds, the protective outer seed coat is resistant to physical damage and may also contain waxes and oils that help prevent water loss. • The embryo within the seed begins as a single cell, the zygote. The basic organs of the plant body can be found in the embryo. In some seeds the embryonic leaves are quite large, filling most of the volume of the seed. The embryonic leaves are a major source of stored food for the embryo. Beans are an example of plants with large embryonic leaves. In many other plants the embryonic leaves are relatively small, and the embryo is nourished by a tissue called endosperm. • Pollination is part of the reproductive process of flowering plants. Pollination is the process by which pollen is transferred from the stamens to the stigma. • The stamen and pistil are reproductive parts of the flower. The sepals are the small leaves that form the housing of the developing flower. • Some plants reproduce with spores. These include ferns and mosses. • Green plants produce their own food through the process of photosynthesis. Green plants use chlorophyll to produce food (sugar), using carbon dioxide, water, enzymes and other chemicals, and sunlight. Leaves are the primary food-producing part of these plants. • Oxygen is released during photosynthesis.	**In order to meet this standard, it is expected that students will** • analyze a common plant: identify the roots, stems, leaves, and flowers, and explain the function of each. • create a model/diagram illustrating the parts of a flower and its reproductive processes. Explain the model/diagram using the following terminology: pollination, stamen, stigma, pistil, sepal, embryo, spore, seed. • compare and contrast different ways plants are pollinated. • explain that ferns and mosses reproduce with spores rather than seeds. • explain the process of photosynthesis, using the following terminology: sunlight, chlorophyll, water, carbon dioxide, oxygen, and sugar. • explain the role of adaptations of common plants to include dormancy, response to light, and response to moisture.

5S-LPS1 The student will investigate and understand basic plant anatomy and life processes. Key concepts include

- **a) the structures of typical plants and the function of each structure;**
- **b) processes and structures involved with plant reproduction;**
- **c) photosynthesis;**
- **d) adaptations allow plants to satisfy life needs and respond to the environment.**

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Plants adapt to changes in their environment in order to survive. Dormancy is a plant adaptation. Dormancy is a period of suspended life processes brought on by changes in the environment.	

5S-LPS2 The student will investigate and understand how plants and animals, including humans, in an ecosystem interact with one another and with the nonliving components in the ecosystem. Key concepts include

a) plant and animal adaptations;
b) organization of populations, communities, and ecosystems and how they interrelate;
c) flow of energy through food webs;
d) habitats and niches;
e) changes in an organism's niche at various stages in its life cycle;
f) influences of human activity on ecosystems.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Organisms have structural adaptations or physical attributes that help them meet a life need. • Organisms also have behavioral adaptations, or certain types of activities they perform, which help them meet a life need. • All the organisms of the same species that live in the same place at the same time are a population. • Populations of species that live in the same place at the same time together make up a community. • The organization of communities is based on the utilization of the energy from the sun within a given ecosystem. The greatest amount of energy in a community is in the producers. • Within a community, organisms are dependent on the survival of other organisms. Energy is passed from one organism to another. • All the populations and the nonliving components in an environment that interact with each other form an ecosystem. • The sun's energy cycles through ecosystems from producers through consumers and back into the nutrient pool through decomposers. • A habitat is the place or kind of place in which an animal or plant naturally lives. An organism's habitat provides food, water, shelter, and space. The size of the habitat depends on the organism's needs. • A niche is the function that an organism performs in the food web of that community. A niche also includes everything else the organism does and needs in its environment. No two types of organisms occupy exactly the same niche in a community.	**In order to meet this standard, it is expected that students will** • distinguish between structural (physical) and behavioral adaptations. • investigate and infer the function of basic adaptations. • understand that adaptations allow an organism to succeed in a given environment. • explain how different organisms use their unique adaptations to meet their needs. • describe why certain communities exist in given habitats. • illustrate the food webs in a local area. • compare and contrast the niches of several different organisms within the community. • compare and contrast the differing ways an organism interacts with its surroundings at various stages of its life cycle. Specific examples include a frog and a butterfly. • differentiate among positive and negative influences of human activity on ecosystems.

5S-LPS2 The student will investigate and understand how plants and animals, including humans, in an ecosystem interact with one another and with the nonliving components in the ecosystem. Key concepts include

- **a) plant and animal adaptations;**
- **b) organization of populations, communities, and ecosystems and how they interrelate;**
- **c) flow of energy through food webs;**
- **d) habitats and niches;**
- **e) changes in an organism's niche at various stages in its life cycle;**
- **f) influences of human activity on ecosystems.**

UNDERSTANDING THE STANDARD **(Background Information for Instructor Use Only)**	**ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES**
• The organization of a community is defined by the interrelated niches within it. • During its life cycle, an organism's role in the community — its niche — may change. For example, what an animal eats, what eats it, and other relationships will change. • Humans can have a major impact on ecosystems.	

5S-LPS3 The student will investigate and understand important Virginia natural resources. Key concepts include
b) animals and plants.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Virginia is rich in a wide variety of natural resources, including forests, arable (farmable) land, coal, sand and aggregates (rocks), wildlife and aquatic organisms, clean water and air, and beautiful scenery. • Virginia has a great variety of plant and animal resources. • Virginia's soil and land support a great variety of life, provide space for many economic activities, and offer a variety of recreational opportunities.	**In order to meet this standard, it is expected that students will** • compare and contrast natural and human-made resources.

5S-LPS4 The student will investigate and understand that organisms are made of one or more cells and have distinguishing characteristics that play a vital role in the organism's ability to survive and thrive in its environment. Key concepts include

a) basic cell structures and functions;

b) classification of organisms using physical characteristics, body structures, and behavior of the organism;

c) traits of organisms that allow them to survive in their environment.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Living things are made of cells. Cells carry out all life processes. New cells come from existing cells. Cells are too small to be seen with the eye alone. By using a microscope, many parts of a cell can be seen. • Though plant and animal cells are similar, they are also different in shape and in some of their parts. Plant cells tend to be rectangular, while animal cells tend to be spherical or at times irregular. • Organisms that share similar characteristics can be organized into groups in order to help understand similarities and differences. • Plants can be categorized as vascular (having special tissues to transport food and water — for example, trees and flowering plants) and nonvascular (not having tissues to transport food and water — for example, moss, liverworts, and hornworts). Most plants are vascular. • Animals can be categorized as vertebrates (having backbones) or invertebrates (not having backbones).	**In order to meet this standard, it is expected that students will** • draw, label, and describe the essential structures and functions of plant and animal cells. For plants, include the nucleus, cell wall, cell membrane, vacuole, chloroplasts, and cytoplasm. For animals, include the nucleus, cell membrane, vacuole, and cytoplasm. • design an investigation to make observations of cells. • compare and contrast plant and animal cells and identify their major parts and functions. • group organisms into categories, using their characteristics: plants (vascular and nonvascular) and animals (vertebrates or invertebrates). Name and describe two common examples of each group. • compare and contrast the distinguishing characteristics of groups of organisms. • identify and explain traits of organisms that allow them to survive in their environment.

5S-ESS1 The student will investigate and understand how weather conditions and phenomena occur and can be predicted. Key concepts include

a) weather phenomena;
b) weather measurements and meteorological tools;
c) use of weather measurements and weather phenomena to make weather predictions.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Temperature is the measure of the amount of thermal energy in the atmosphere. • Air pressure is due to the weight of the air and is determined by several factors including the temperature of the air. • A front is the boundary between air masses of different temperature and humidity. • Cirrus, stratus, cumulus, and cumulo-nimbus clouds are associated with certain weather conditions. • Cumulus clouds are fluffy and white with flat bottoms. They usually indicate fair weather. However, when they get larger and darker on the bottom, they become cumulo-nimbus clouds. Cumulo-nimbus clouds may produce thunderstorms. • Stratus clouds are smooth, gray clouds that cover the whole sky (block out direct sunlight). Light rain and drizzle are usually associated with stratus clouds. • Cirrus clouds are feathery clouds. They are associated with fair weather. Cirrus clouds often indicate that rain or snow will fall within several hours. • Extreme atmospheric conditions create various kinds of storms such as thunderstorms, hurricanes, and tornadoes. • Different atmospheric conditions create different types of precipitation. • Meteorologists gather data by using a variety of instruments. • Meteorologists use data to predict weather patterns. • A barometer measures air pressure. • An anemometer measures wind speed. • A rain gauge measures the amount of precipitation. • A thermometer measures the temperature of the air.	**In order to meet this standard, it is expected that students will** • design an investigation in which a thermometer is used to compare air temperatures over a period of time. • analyze the changes in air pressure occurring over time, using a barometer, and predict what the changes mean in terms of changing weather patterns. • illustrate and label high and low pressures on a map. • differentiate between the types of weather associated with high and low pressure air masses. Illustrate and label high and low pressure air masses and warm and cold fronts. • differentiate between cloud types (i.e., cirrus, stratus, cumulus, and cumulo-nimbus clouds) and the associated weather. • compare and contrast the formation of different types of precipitation (e.g., rain, snow, sleet, and hail). • recognize a variety of storm types, describe the weather conditions associated with each, and explain when they occur (e.g., thunderstorms, hurricanes, and tornadoes). • analyze and report information about temperature and precipitation on weather maps. • measure wind speed, using an anemometer. • measure precipitation with a rain gauge. • design an investigation in which weather data are gathered using meteorological tools and charted to make weather predictions.

5S-ESS2 The student will investigate and understand the organization of the solar system. Key concepts include

a) the planets in the solar system;
b) the order of the planets in the solar system;
c) the relative sizes of the planets.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Our solar system is ancient. Early astronomers believed that Earth was the center of the universe and all other heavenly bodies orbited around Earth. We now know that our sun is the center of our solar system and eight planets, a handful of dwarf planets, 170 named moons, dust, gas, and thousands of asteroids and comets orbit around the sun. • Our solar system is made up of eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. • Mercury, Venus, Earth, and Mars are considered terrestrial planets. Jupiter, Saturn, Uranus, and Neptune are called gas giants. • Mercury is closest to the sun and is a small, heavily cratered planet. Mercury looks like our moon. Since Pluto's reclassification from planet to dwarf planet, Mercury is now the smallest planet in our solar system. • Venus is second from the sun. It is similar to Earth in size and mass, and has a permanent blanket of clouds that trap so much heat that the temperatures on the surface of Venus are hot enough to melt lead. • Earth is third from the sun. Earth's atmosphere, the liquid water found on Earth, and its distance from the sun, among many other factors, make Earth a haven for life. • Mars is fourth from the sun. The atmosphere on Mars is thin and there is a vast network of canyons and riverbeds on the red planet. Scientists hypothesize that Mars once supported a wet, warm Earth-like climate. • Jupiter is fifth from the sun. Jupiter is the largest planet in the solar system and is considered a gas giant. Jupiter has no solid surface. • Saturn is sixth from the sun. Early scientists thought Saturn was the only planet with rings, but we now know that all four gas giants (Jupiter, Saturn, Uranus, and Neptune) have rings. • Uranus is seventh from the sun. Uranus is a gas giant.	**In order to meet this standard, it is expected that students will** • name the eight planets and describe whether they are a terrestrial planet or a gas giant. • sequence the eight planets in the solar system based on their position from the sun. (Mercury is the first from the sun, Venus is the second, etc.) • sequence the eight planets in the solar system based on size (Jupiter is the largest, Saturn is next, etc.) • construct a simple model of the sun and the planets in our solar system.

5S-ESS2 The student will investigate and understand the organization of the solar system. Key concepts include

a) the planets in the solar system;
b) the order of the planets in the solar system;
c) the relative sizes of the planets.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Neptune is eighth from the sun. Neptune appears blue through telescopes and is a gas giant. • The eight planets sorted by size from largest to smallest are: Jupiter, Saturn, Uranus, Neptune, Earth, Venus, Mars, and Mercury. • Pluto is no longer included in the list of planets in our solar system due to its small size and irregular orbit. Many astronomers questioned whether Pluto should be grouped with worlds like Earth and Jupiter. In 2006, this debate led the International Astronomical Union (IAU), the recognized authority in naming heavenly objects, to formally reclassify Pluto. On August 24, 2006, Pluto's status was officially changed from planet to dwarf planet. • A new distinct class of objects called "dwarf planets" was identified in 2006. It was agreed that "planets" and "dwarf planets" are two distinct classes of objects. The first members of the dwarf planet category are Ceres, Pluto and 2003 UB313, given the name Eris. More dwarf planets are expected to be announced by the IAU in the future. • What differentiates a dwarf planet from a planet? For the most part, they are identical, but there is one key difference: A dwarf planet has not "cleared the neighborhood" around its orbit, which means it has not become gravitationally dominant and it shares its orbital space with other bodies of a similar size. • Pluto is smaller than seven of the moons in our solar system and cannot be seen without a telescope.	

5S-ESS3 The student will investigate and understand the relationship among Earth, the moon, and the sun. Key concepts include

a) the motions of Earth, the moon, and the sun;
b) the causes for Earth's seasons;
c) the causes for the phases of the moon;
d) the relative size, position, age, and makeup of Earth, the moon, and the sun;
e) historical contributions in understanding the Earth-moon-sun-system.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Earth completes one revolution around the sun every 365 ¼ days. The moon revolves around Earth about once every month. • Due to its axial tilt, Earth experiences seasons during its revolution around the sun. • The phases of the moon are caused by its position relative to Earth and the sun. The phases of the moon include the new, waxing crescent, first quarter, waxing gibbous, full, waning gibbous, last (third) quarter, and waning crescent. • The sun is an average-sized yellow star, about 110 times the diameter of Earth. The sun is approximately 4.6 billion years old. • Our moon is a small rocky satellite, having about one-quarter the diameter of Earth and one-eightieth its mass. It has extremes of temperature, virtually no atmosphere or life, and very little water. • Earth is one of eight planets that revolve around the sun and comprise the solar system. Earth, the third planet from the sun, is one of the four terrestrial inner planets. It is about 150 million kilometers from the sun. • Earth is a geologically active planet with a surface that is constantly changing. Unlike the other three inner planets (Mercury, Venus, and Mars), it has large amounts of life-supporting water and an oxygen-rich atmosphere. Earth's protective atmosphere blocks out most of the sun's damaging rays. • Our understanding of the solar system has changed from an Earth-centered model of Aristotle and Ptolemy to the sun-centered model of Copernicus and Galileo. • The NASA Apollo missions added greatly to our understanding of the moon. • Our understanding of the sun, moon, and the solar system continues to change with new scientific discoveries.	**In order to meet this standard, it is expected that students will** • differentiate between rotation and revolution. • describe how Earth's axial tilt causes the seasons. • model the formation of the eight moon phases, sequence the phases in order, and describe how the phases occur. • describe the major characteristics of the sun, including its approximate size, color, age, and overall composition. • create and describe a model of the Earth-moon-sun system with approximate scale distances and sizes. • compare and contrast the surface conditions of Earth, the moon, and the sun. • compare and contrast an Earth-centered to the sun-centered model of the solar system. • analyze the differences in what Aristotle, Ptolemy, Copernicus, and Galileo observed and what influenced their conclusions. • describe a contribution of the NASA Apollo missions to our understanding of the moon.

5S-ESS4 The student will investigate and understand important Virginia natural resources. Key concepts include

a) watershed and water resources;
c) minerals, rocks, ores, and energy sources;
d) forests, soil, and land.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Virginia is rich in a wide variety of natural resources, including forests, arable (farmable) land, coal, sand and aggregates (rocks), wildlife and aquatic organisms, clean water and air, and beautiful scenery. • A watershed is an area over which surface water (and the materials it carries) flows to a single collection place. The Chesapeake Bay watershed covers approximately half of Virginia's land area. The other two major watershed systems are the Gulf of Mexico and the North Carolina Sounds. • Virginia's water resources include groundwater, lakes, reservoirs, rivers, bays, and the Atlantic Ocean. • Natural and cultivated forests are a widespread resource in Virginia. • Virginia's soil and land support a great variety of life, provide space for many economic activities, and offer a variety of recreational opportunities.	**In order to meet this standard, it is expected that students will** • compare and contrast natural and human-made resources. • distinguish among rivers, lakes, and bays; describe characteristics of each; and name an example of each in Virginia. • create and interpret a model of a watershed. Evaluate the statement: "We all live downstream." • identify watershed addresses. • recognize the importance of Virginia's mineral resources, including coal, limestone, granite, and sand and gravel. • appraise the importance of natural and cultivated forests in Virginia. describe a variety of soil and land uses important in Virginia.

5S-ESS5 The student will investigate and understand characteristics of the ocean environment. Key concepts include

a) geological characteristics;
b) physical characteristics;
c) ecological characteristics.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Oceans cover about 70 percent of the surface of Earth. • Important features of the ocean floor near the continents are the continental shelf, the continental slope, and the continental rise. These areas are covered with thick layers of sediments (sand, mud, rocks). • The depth of the ocean varies. Ocean trenches are very deep, and the continental shelf is relatively shallow. • Ocean water is a complex mixture of gases (air) and dissolved solids (salts, especially sodium chloride). Marine organisms are dependent on dissolved gases for survival. The salinity of ocean water varies in some places depending on rates of evaporation and amount of runoff from nearby land. • The basic motions of ocean water are the waves, currents, and tides. • Ocean currents, including the Gulf Stream, are caused by wind patterns and the differences in water densities (due to salinity and temperature differences). Ocean currents affect the mixing of ocean waters. This can affect plant and animal populations. Currents also affect navigation routes. • As the depth of ocean water increases, the temperature decreases, the pressure increases, and the amount of light decreases. These factors influence the type of life forms that are present at a given depth. • Plankton are tiny free-floating organisms that live in water. Plankton may be animal-like or plant-like. Animal-like plankton are called zooplankton. Plant-like plankton (phytoplankton) carry out most of the photosynthesis on Earth. Therefore, they provide much of Earth's oxygen. Phytoplankton form the base of the ocean food web. Plankton flourish in areas where nutrient-rich water upwells from the deep.	**In order to meet this standard, it is expected that students will** • create and interpret a model of the ocean floor and label and describe each of the major features. • research and describe the variation in depths associated with ocean features, including the continental shelf, slope, rise, the abyssal plain, and ocean trenches. • design an investigation (including models and simulations) related to physical characteristics of the ocean environment (depth, salinity, formation of waves, causes of tides, and currents, such as the Gulf Stream). • interpret graphical data related to physical characteristics of the ocean. • explain the formation of ocean currents and describe and locate the Gulf Stream. • design an investigation (including models and simulations) related to ecological relationships of the ocean environment. • interpret graphical data related to the ecological characteristics of the ocean, such as the number of organisms vs. the depth of the water. • analyze how the physical characteristics (depth, salinity, and temperature) of the ocean affect where marine organism can live. • create and interpret a model of a basic marine food web, including floating organisms (plankton), swimming organisms, and organisms living on the ocean floor.

5S-ESS6 The student will investigate and understand how Earth's surface is constantly changing. Key concepts include

a) identification of rock types;
b) the rock cycle and how transformations including between rocks occur;
c) Earth history and fossil evidence;
d) the basic structure of Earth's interior;
e) changes in Earth's crust due to plate tectonics;
f) weathering, erosion, and deposition;
g) human impact.

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Rocks have properties that can be observed, tested, and described. Composition, grain size and textural features, color, and the presence of fossils help with identification. Classification keys (5.1) can aid this process. • Rocks move and change over time due to heat and pressure within Earth and due to weathering, erosion, and deposition at the surface. These and other processes constantly change rock from one type to another. • Depending on how rocks are formed, they are classified as sedimentary (layers of sediment cemented together), igneous (melted and cooled, e.g., lava and magma), and metamorphic (changed by heat and pressure). • Scientific evidence indicates Earth is ancient — approximately 4.6 billion years old. The age of many rocks can be determined very reliably. Fossils provide information about life and conditions of the past. • Scientific evidence indicates that Earth is composed of four concentric layers — crust, mantle, outer core, and inner core — each with its own distinct characteristics. The outer two layers are composed primarily of rocky material. The innermost layers are composed mostly of iron and nickel. Pressure and temperature increase with depth beneath the surface. • Earth's thermal energy causes movement of material within Earth. Large continent-size blocks (plates) move slowly about Earth's surface, driven by that thermal energy. • Most earthquakes and volcanoes are located at the boundaries of the plates (faults). Plates can move together (convergent boundaries), apart (divergent boundaries), or slip past each other horizontally (transform boundaries, also called strike-slip or sliding boundaries).	**In order to meet this standard, it is expected that students will** • apply basic terminology to explain how Earth's surface is constantly changing. • draw and label the rock cycle and describe the major processes and rock types involved. • compare and contrast the origin of igneous, sedimentary, and metamorphic rocks. • identify rock samples (granite, gneiss, slate, limestone, shale, sandstone, and coal), using a rock classification key. • make plausible inferences about changes in Earth over time based on fossil evidence. This includes the presence of fossils of organisms in sedimentary rocks of Virginia found in the Appalachian Mountains, Piedmont, and Coastal Plain/Tidewater. • describe the structure of Earth in terms of its major layers — crust, mantle, and outer core and inner core — and how Earth's interior affects the surface. • differentiate among the three types of plate tectonic boundaries (divergent, convergent, and transform) and how these relate to the changing surface of Earth and the ocean floor (5.6). • compare and contrast the origin of earthquakes and volcanoes and how they affect Earth's surface. • differentiate between weathering, erosion, and deposition.

5S-ESS6 The student will investigate and understand how Earth's surface is constantly changing. Key concepts include

- **h) identification of rock types;**
- **i) the rock cycle and how transformations including between rocks occur;**
- **j) Earth history and fossil evidence;**
- **k) the basic structure of Earth's interior;**
- **l) changes in Earth's crust due to plate tectonics;**
- **m) weathering, erosion, and deposition;**
- **n) human impact.**

UNDERSTANDING THE STANDARD (Background Information for Instructor Use Only)	ESSENTIAL KNOWLEDGE, SKILLS AND PROCESSES
• Geological features in the oceans (including trenches and mid-ocean ridges) and on the continents (mountain ranges, including the Appalachian Mountains) are caused by current and past plate movements. • Rocks and other materials on Earth's surface are constantly being broken down both chemically and physically. The products of weathering include clay, sand, rock fragments, and soluble substances. • Materials can be moved by water and wind (eroded) and deposited in new locations as sediment (deposition). • Humans have varying degrees of impact on Earth's surface through their everyday activities. With careful planning, the impact on the land can be controlled.	• design an investigation to locate, chart, and report weathering, erosion, and deposition at home and on the school grounds. Create a plan to solve erosion and/or deposition problems that may be found. • describe how people change Earth's surface and how negative changes can be controlled.