

# K-12 Science

## Grade-Level Indicators

### Earth and Space Sciences

Students demonstrate an understanding about how Earth systems and processes interact in the geosphere resulting in the habitability of Earth. This includes demonstrating an understanding of the composition of the universe, the solar system and Earth. In addition, it includes understanding the properties and the interconnected nature of Earth's systems, processes that shape Earth and Earth's history. Students also demonstrate an understanding of how the concepts and principles of energy, matter, motion and forces explain Earth systems, the solar system and the universe. Finally, they grasp an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with Earth and space sciences.

### Kindergarten

#### *The Universe*

1. Observe that the sun can be seen only in the daytime, but the moon can be seen sometimes at night and sometimes during the day.

#### *Processes That Shape Earth*

2. Explore that animals and plants cause changes to their surroundings.
3. Explore that sometimes change is too fast to see and sometimes change is too slow to see.
4. Observe and describe day-to-day weather changes (e.g., today is hot, yesterday we had rain).
5. Observe and describe seasonal changes in weather.

### Grade One

#### *Earth Systems*

1. Identify that resources are things that we get from the living (e.g., forests) and nonliving (e.g., minerals, water) environment and that resources are necessary to meet the needs and wants of a population.
2. Explain that the supply of many resources is limited but the supply can be extended through careful use, decreased use, reusing and/or recycling.

*Processes That  
Shape Earth*

3. Explain that all organisms cause changes in the environment where they live; the changes can be very noticeable or slightly noticeable, fast or slow (e.g., spread of grass cover slowing soil erosion, tree roots slowly breaking sidewalks).

## **Grade Two**

*The Universe*

1. Recognize that there are more stars in the sky than anyone can easily count.
2. Observe and describe how the sun, moon and stars all appear to move slowly across the sky.
3. Observe and describe how the moon appears a little different every day but looks nearly the same again about every four weeks.

*Earth Systems*

4. Observe and describe that some weather changes occur throughout the day and some changes occur in a repeating seasonal pattern.
5. Describe weather by measurable quantities such as temperature and precipitation.

## **Grade Three**

*Earth Systems*

1. Compare distinct properties of rocks (e.g., color, layering and texture).
2. Observe and investigate that rocks are often found in layers.
3. Describe that smaller rocks come from the breakdown of larger rocks through the actions of plants and weather.
4. Observe and describe the composition of soil (e.g., small pieces of rock and decomposed pieces of plants and animals, and products of plants and animals).
5. Investigate the properties of soil (e.g., color, texture, capacity to retain water, ability to support plant growth).
6. Investigate that soils are often found in layers and can be different from place to place.

## **Grade Four**

*Earth Systems*

1. Explain that air surrounds us, takes up space, moves around us as wind, and may be measured using barometric pressure.
2. Identify how water exists in the air in different forms (e.g., in clouds, fog, rain, snow and hail).
3. Investigate how water changes from one state to another (e.g., freezing, melting, condensation and evaporation).
4. Describe weather by measurable quantities such as temperature, wind direction, wind speed, precipitation and barometric pressure.
5. Record local weather information on a calendar or map and describe changes over a period of time (e.g., barometric pressure, temperature, precipitation symbols and cloud conditions).
6. Trace how weather patterns generally move from west to east in the United States.
7. Describe the weather which accompanies cumulus, cumulonimbus, cirrus and stratus clouds.

*Processes That Shape Earth*

8. Describe how wind, water and ice shape and reshape Earth's land surface by eroding rock and soil in some areas and depositing them in other areas producing characteristic landforms (e.g., dunes, deltas and glacial moraines).
9. Identify and describe how freezing, thawing and plant growth reshape the land surface by causing the weathering of rock.
10. Describe evidence of changes on Earth's surface in terms of slow processes (e.g., erosion, weathering, mountain building and deposition) and rapid processes (e.g. volcanic eruptions, earthquakes and landslides).

**Grade Five**

*The Universe*

1. Describe how night and day are caused by Earth's rotation.
2. Explain that Earth is one of several planets to orbit the sun, and that the moon orbits Earth.
3. Describe the characteristics of Earth and its orbit about the sun (e.g., three-fourths of Earth's surface is covered by a layer of water [some of it frozen], the entire planet surrounded by a thin blanket of air, elliptical orbit, tilted axis and spherical planet).
4. Explain that stars are like the sun, some being smaller and some larger, but so far away that they look like points of light.

*Earth Systems*

5. Explain how the supply of many non-renewable resources is limited and can be extended through reducing, reusing and recycling but cannot be extended indefinitely.
6. Investigate ways Earth's renewable resources (e.g., fresh water, air, wildlife and trees) can be maintained.

## **Grade Six**

*Earth Systems*

1. Describe the rock cycle and explain that there are sedimentary, igneous and metamorphic rocks that have distinct properties (e.g., color, texture) and are formed in different ways.
2. Explain that rocks are made of one or more minerals.
3. Identify minerals by their characteristic properties.

## **Grade Seven**

## *Earth Systems*

1. Explain the biogeochemical cycles which move materials between the lithosphere (land), hydrosphere (water) and atmosphere (air).
2. Explain that Earth's capacity to absorb and recycle materials naturally (e.g., smoke, smog and sewage) can change the environmental quality depending on the length of time involved (e.g. global warming).
3. Describe the water cycle and explain the transfer of energy between the atmosphere and hydrosphere.
4. Analyze data on the availability of fresh water that is essential for life and for most industrial and agricultural processes. Describe how rivers, lakes and groundwater can be depleted or polluted becoming less hospitable to life and even becoming unavailable or unsuitable for life.
5. Make simple weather predictions based on the changing cloud types associated with frontal systems.
6. Determine how weather observations and measurements are combined to produce weather maps and that data for a specific location at one point in time can be displayed in a station model.
7. Read a weather map to interpret local, regional and national weather.
8. Describe how temperature and precipitation determine climatic zones (biomes) (e.g., desert, grasslands, forests, tundra and alpine).
9. Describe the connection between the water cycle and weather-related phenomenon (e.g., tornadoes, floods, droughts and hurricanes).

## **Grade Eight**

### *The Universe*

1. Describe how objects in the solar system are in regular and predictable motions that explain such phenomena as days, years, seasons, eclipses, tides and moon cycles.
2. Explain that gravitational force is the dominant force determining motions in the solar system and in particular keeps the planets in orbit around the sun.
3. Compare the orbits and composition of comets and asteroids with that of Earth.
4. Describe the effect that asteroids or meteoroids have when moving through space and sometimes entering planetary atmospheres (e.g., meteor-"shooting star" and meteorite).
5. Explain that the universe consists of billions of galaxies that are classified by shape.
6. Explain interstellar distances are measured in light years (e.g., the nearest star beyond the sun is 4.3 light years away).
7. Examine the life cycle of a star and predict the next likely stage of a star.
8. Name and describe tools used to study the universe (e.g., telescopes, probes, satellites and spacecraft).

### *Earth Systems*

9. Describe the interior structure of Earth and Earth's crust as divided into tectonic plates riding on top of the slow moving currents of magma in the mantle.
10. Explain that most major geological events (e.g., earthquakes, volcanic eruptions, hot spots and mountain building) result from plate motion.
11. Use models to analyze the size and shape of Earth, its surface and its interior (e.g., globes, topographic maps, satellite images).
12. Explain that some processes involved in the rock cycle are directly related to thermal energy and forces in the mantle that drive plate motions.
13. Describe how landforms are created through a combination of destructive (e.g., weathering and erosion) and constructive processes (e.g., crustal deformation, volcanic eruptions and deposition of sediment).
14. Explain that folding, faulting and uplifting can rearrange the rock layers so the youngest is not always found on top.

15. Illustrate how the three primary types of plate boundaries (transform, divergent and convergent) cause different landforms (e.g., mountains, volcanoes and ocean trenches).

### **Life Sciences**

Students demonstrate an understanding of how living systems function and how they interact with the physical environment. This includes an understanding of the cycling of matter and flow of energy in living systems. An understanding of the characteristics, structure and function of cells, organisms and living systems will be developed. Students will also develop a deeper understanding of the principles of heredity, biological evolution, and the diversity and interdependence of life. Students demonstrate an understanding of different historical perspectives, scientific approaches and emerging scientific issues associated with the life sciences.

### **Kindergarten**

#### *Characteristics and Structure of Life*

1. Explore differences between living and non-living things (e.g., plant-rock).
2. Discover that stories (e.g., cartoons, movies, comics) sometimes give plants and animals characteristics they really do not have (e.g., talking flowers).

*Heredity*

3. Describe how plants and animals usually resemble their parents.
4. Investigate variations that exist among individuals of the same kind of plant or animal.

*Diversity and  
Interdependence of  
Life*

5. Investigate observable features of plants and animals that help them live in different kinds of places.
6. Investigate the habitats of many different kinds of local plants and animals and some of the ways in which animals depend on plants and each other in our community.

## **Grade One**

*Characteristics and  
Structure of Life*

1. Explore that organisms, including people, have basic needs which include air, water, food, living space and shelter.
2. Explain that food comes from sources other than grocery stores (e.g., farm crops, farm animals, oceans, lakes and forests).
3. Explore that humans and other animals have body parts that help to seek, find and take in food when they are hungry (e.g., sharp teeth, flat teeth, good nose and sharp vision).

*Diversity and  
Interdependence of  
Life*

4. Investigate that animals eat plants and/or other animals for food and may also use plants or other animals for shelter and nesting.
5. Recognize that seasonal changes can influence the health, survival or activities of organisms.

## **Grade Two**

*Characteristics and  
Structure of Life*

1. Explain that animals, including people, need air, water, food, living space and shelter; plants need air, water, nutrients (e.g., minerals), living space and light to survive.
2. Identify that there are many distinct environments that support different kinds of organisms.
3. Explain why organisms can survive only in environments that meet their needs (e.g., organisms that once lived on Earth have disappeared for different reasons such as natural forces or human-caused effects).



*Heredity*

4. Compare similarities and differences among individuals of the same kind of plants and animals, including people.

*Diversity and  
Interdependence of  
Life*

5. Explain that food is a basic need of plants and animals (e.g., plants need sunlight to make food and to grow, animals eat plants and/or other animals for food, food chain) and is important because it is a source of energy (e.g., energy used to play, ride bicycles, read, etc.).

6. Investigate the different structures of plants and animals that help them live in different environments (e.g., lungs, gills, leaves and roots).

7. Compare the habitats of many different kinds of Tennessee plants and animals and some of the ways animals depend on plants and each other.

8. Compare the activities of Tennessee's common animals (e.g., squirrels, chipmunks, deer, butterflies, bees, ants, bats and frogs) during the different seasons by describing changes in their behaviors and body covering.

9. Compare Tennessee plants during the different seasons by describing changes in their appearance.

## Grade Three

*Heredity*

1. Compare the life cycles of different animals including birth to adulthood, reproduction and death (e.g., egg-tadpole-frog, egg-caterpillar-chrysalis-butterfly).

*Diversity and  
Interdependence of  
Life*

2. Relate animal structures to their specific survival functions (e.g., obtaining food, escaping or hiding from enemies).

3. Classify animals according to their characteristics (e.g., body coverings and body structure).

4. Use examples to explain that extinct organisms may resemble organisms that are alive today.

5. Observe and explore how fossils provide evidence about animals that lived long ago and the nature of the environment at that time.

6. Describe how changes in an organism's habitat are sometimes beneficial and sometimes harmful.

## Grade Four

*Heredity*

1. Compare the life cycles of different plants including germination, maturity, reproduction and death.

*Diversity and  
Interdependence of  
Life*

2. Relate plant structures to their specific functions (e.g., growth, survival and reproduction).
3. Classify common plants according to their characteristics (e.g., tree leaves, flowers, seeds, roots and stems).
4. Observe and explore that fossils provide evidence about plants that lived long ago and the nature of the environment at that time.
5. Describe how organisms interact with one another in various ways (e.g., many plants depend on animals for carrying pollen or dispersing seeds).

## **Grade Five**

*Diversity and  
Interdependence of  
Life*

1. Describe the role of producers in the transfer of energy entering ecosystems as sunlight to chemical energy through photosynthesis.
2. Explain how almost all kinds of animals' food can be traced back to plants.
3. Trace the organization of simple food chains and food webs (e.g., producers, herbivores, carnivores, omnivores and decomposers).
4. Summarize that organisms can survive only in ecosystems in which their needs can be met (e.g., food, water, shelter, air, carrying capacity and waste disposal). The world has different ecosystems and distinct ecosystems support the lives of different types of organisms.
5. Support how an organism's patterns of behavior are related to the nature of that organism's ecosystem, including the kinds and numbers of other organisms present, the availability of food and resources, and the changing physical characteristics of the ecosystem.
6. Analyze how all organisms, including humans, cause changes in their ecosystems and how these changes can be beneficial, neutral or detrimental (e.g., beaver ponds, earthworm burrows, grasshoppers eating plants, people planting and cutting trees and people introducing a new species).

## Grade Six

### *Characteristics and Structure of Life*

1. Explain that many of the basic functions of organisms are carried out by or within cells and are similar in all organisms.
2. Explain that multicellular organisms have a variety of specialized cells, tissues, organs and organ systems that perform specialized functions.
3. Identify how plant cells differ from animal cells (e.g., cell wall and chloroplasts).

### *Heredity*

4. Recognize that an individual organism does not live forever; therefore reproduction is necessary for the continuation of every species and traits are passed on to the next generation through reproduction.
5. Describe that in asexual reproduction all the inherited traits come from a single parent.
6. Describe that in sexual reproduction an egg and sperm unite and some traits come from each parent, so the offspring is never identical to either of its parents.
7. Recognize that likenesses between parents and offspring (e.g., eye color, flower color) are inherited. Other likenesses, such as table manners are learned.

### *Diversity and Interdependence of Life*

8. Describe how organisms may interact with one another.

## Grade Seven

### *Characteristics and Structure of Life*

1. Investigate the great variety of body plans and internal structures found in multicellular organisms.

*Diversity and  
Interdependence of  
Life*

2. Investigate how organisms or populations may interact with one another through symbiotic relationships and how some species have become so adapted to each other that neither could survive without the other (e.g., predator-prey, parasitism, mutualism and commensalism).
3. Explain how the number of organisms an ecosystem can support depends on adequate biotic (living) resources (e.g., plants, animals) and abiotic (non-living) resources (e.g., light, water and soil).
4. Investigate how overpopulation impacts an ecosystem.
5. Explain that some environmental changes occur slowly while others occur rapidly (e.g., forest and pond succession, fires and decomposition).
6. Summarize the ways that natural occurrences and human activity affect the transfer of energy in Earth's ecosystems (e.g., fire, hurricanes, roads and oil spills).
7. Explain that photosynthetic cells convert solar energy into chemical energy that is used to carry on life functions or is transferred to consumers and used to carry on their life functions.

*Evolutionary  
Theory*

8. Investigate the great diversity among organisms.

## **Grade Eight**

*Heredity*

1. Describe that asexual reproduction limits the spread of detrimental characteristics through a species and allows for genetic continuity.
2. Recognize that in sexual reproduction new combinations of traits are produced which may increase or decrease an organism's chances for survival.

*Evolutionary  
Theory*

3. Explain how variations in structure, behavior or physiology allow some organisms to enhance their reproductive success and survival in a particular environment.

4. Explain that diversity of species is developed through gradual processes over many generations (e.g., fossil record).
5. Investigate how an organism adapted to a particular environment may become extinct if the environment, as shown by the fossil record, changes.

### **Physical Sciences**

Students demonstrate an understanding of the composition of physical systems and the concepts and principles that describe and predict physical interactions and events in the natural world. This includes demonstrating an understanding of the structure and properties of matter, the properties of materials and objects, chemical reactions and the conservation of matter. In addition, it includes understanding the nature, transfer and conservation of energy; motion and the forces affecting motion; and the nature of waves and interactions of matter and energy. Students demonstrate an understanding of the historical perspectives, scientific approaches and emerging scientific issues associated with the physical sciences.

### **Kindergarten**

*Nature of Matter*

1. Demonstrate that objects are made of parts (e.g., toys, chairs).
2. Examine and describe objects according to the materials that make up the object (e.g., wood, metal, plastic and cloth).
3. Describe and sort objects by one or more properties (e.g., size, color and shape).

*Forces and Motion*

4. Explore that things can be made to move in many different ways such as straight, zigzag, up and down, round and round, back and forth, or fast and slow.
5. Investigate ways to change how something is moving (e.g., push, pull).

## **Grade One**

*Nature of Matter*

1. Classify objects according to the materials they are made of and their physical properties.
2. Investigate that water can change from liquid to solid or solid to liquid.
3. Explore and observe that things can be done to materials to change their properties (e.g., heating, freezing, mixing, cutting, wetting, dissolving, bending and exposing to light).
4. Explore changes that greatly change the properties of an object (e.g., burning paper) and changes that leave the properties largely unchanged (e.g., tearing paper).

*Forces and Motion*

5. Explore the effects some objects have on others even when the two objects might not touch (e.g., magnets).
6. Investigate a variety of ways to make things move and what causes them to change speed, direction and/or stop.

*Nature of Energy*

7. Explore how energy makes things work (e.g., batteries in a toy and electricity turning fan blades).
8. Recognize that the sun is an energy source that warms the land, air and water.
9. Describe that energy can be obtained from many sources in many ways (e.g., food, gasoline, electricity or batteries).

## **Grade Two**

*Forces and Motion*

1. Explore how things make sound (e.g., rubber bands, tuning fork and strings).
2. Explore and describe sounds (e.g., high, low, soft and loud) produced by vibrating objects.
3. Explore with flashlights and shadows that light travels in a straight line until it strikes an object.

## **Grade Three**

*Forces and Motion*

1. Describe an objects position by locating it relative to another object or the background.
2. Describe an objects motion by tracing and measuring its position over time.
3. Identify contact / noncontact forces that affect motion of an object (e.g., gravity, magnetism and collision).
4. Predict the changes when an object experiences a force (e.g., a push or pull, weight and friction).

## **Grade Four**

*Nature of Matter*

1. Identify characteristics of a simple physical change (e.g., heating or cooling can change water from one state to another and the change is reversible).
2. Identify characteristics of a simple chemical change. When a new material is made by combining two or more materials, it has chemical properties that are different from the original materials (e.g., burning paper, vinegar and baking soda).
3. Describe objects by the properties of the materials from which they are made and that these properties can be used to separate or sort a group of objects (e.g., paper, glass, plastic and metal).
4. Explain that matter has different states (e.g., solid, liquid and gas) and that each state has distinct physical properties.

*Nature of Energy*

5. Compare ways the temperature of an object can be changed (e.g., rubbing, heating and bending of metal).

## **Grade Five**

*Nature of Energy*

1. Define temperature as the measure of thermal energy and describe the way it is measured.
2. Trace how thermal energy can transfer from one object to another by conduction.
3. Describe that electrical current in a circuit can produce thermal energy, light, sound and /or magnetic forces.
4. Trace how electrical current travels by creating a simple electric circuit that will light a bulb.
5. Explore and summarize observations of the transmission, bending (refraction) and reflection of light.
6. Describe and summarize observations of the transmission, reflection, and absorption of sound.
7. Describe that changing the rate of vibration can vary the pitch of a sound.

**Grade Six**

*Nature of Matter*

1. Explain that equal volumes of different substances usually have different masses.
2. Describe that in a chemical change new substances are formed with different properties than the original substance (e.g., rusting, burning).
3. Describe that in a physical change (e.g., state, shape and size) the chemical properties of a substance remain unchanged.
4. Describe that chemical and physical changes occur all around us (e.g., in the human body, cooking and industry).



*Nature of Energy*

5. Explain that the energy found in nonrenewable resources such as fossil fuels (e.g., oil, coal and natural gas) originally came from the sun and may renew slowly over millions of years.
6. Explain that energy derived from renewable resources such as wind and water is assumed to be available indefinitely.
7. Describe how electric energy can be produced from a variety of sources (e.g., sun, wind and coal).
8. Describe how renewable and nonrenewable energy resources can be managed (e.g., fossil fuels, trees and water).

## **Grade Seven**

*Nature of Matter*

1. Investigate how matter can change forms but the total amount of matter remains constant.

*Nature of Energy*

2. Describe how an object can have potential energy due to its position or chemical composition and can have kinetic energy due to its motion.
3. Identify different forms of energy (e.g., electrical, mechanical, chemical, thermal, nuclear, radiant and acoustic).
4. Explain how energy can change forms but the total amount of energy remains constant.
5. Trace energy transformation in a simple closed system (e.g., a flashlight).

## **Grade Eight**

*Forces and Motion*

1. Describe how the change in the position (motion) of an object is always judged and described in comparison to a reference point.
2. Explain that motion describes the change in the position of an object (characterized by a speed and direction) as time changes.
3. Explain that an unbalanced force acting on an object changes that object's speed and/or direction.

*Nature of Energy*

4. Demonstrate that waves transfer energy.

5. Demonstrate that vibrations in materials may produce waves that spread away from the source in all directions (e.g., earthquake waves and sound waves).

### **Science and Technology**

Students recognize that science and technology are interconnected and that using technology involves assessment of the benefits, risks and costs. Students should build scientific and technological knowledge, as well as the skill required to design and construct devices. In addition, they should develop the processes to solve problems and understand that problems may be solved in several ways.

## **Kindergarten**

### *Understanding Technology*

1. Explore that objects can be sorted as "natural" or "man-made".
2. Explore that some materials can be used over and over again (e.g., plastic or glass containers, cardboard boxes and tubes).

*Abilities To Do  
Technological  
Design*

3. Explore that each kind of tool has an intended use, which can be helpful or harmful (e.g., scissors can be used to cut paper but they can also hurt you).

## **Grade One**

*Understanding  
Technology*

1. Explore that some kinds of materials are better suited than others for making something new (e.g., the building materials used in the *Three Little Pigs*).
2. Explain that when trying to build something or get something to work better, it helps to follow directions and ask someone who has done it before.
3. Identify some materials that can be saved for community recycling projects (e.g., newspapers, glass and aluminum).
4. Explore ways people use energy to cook their food and warm their homes (e.g., wood, coal, natural gas and electricity).
5. Identify how people can save energy by turning things off when they are not using them (e.g., lights and motors).

*Abilities To Do  
Technological  
Design*

6. Investigate that tools are used to help make things and some things cannot be made without tools.
7. Explore that several steps are usually needed to make things (e.g., building with blocks).
8. Investigate that when parts are put together they can do things that they could not do by themselves (e.g., blocks, gears and wheels).

## **Grade Two**

*Understanding  
Technology*

1. Explain that developing and using technology involves benefits and risks.
2. Investigate why people make new products or invent new ways to meet their individual wants and needs.
3. Predict how building or trying something new might affect other people and the environment.

*Abilities To Do  
Technological  
Design*

4. Communicate orally, pictorially, or in written form the design process used to make something.

## **Grade Three**

*Understanding  
Technology*

1. Describe how technology can extend human abilities (e.g., to move things and to extend senses).
2. Describe ways that using technology can have helpful and/or harmful results.
3. Investigate ways that the results of technology may affect the individual, family and community.

*Abilities To Do  
Technological  
Design*

4. Use a simple design process to solve a problem (e.g., identify a problem, identify possible solutions and design a solution).
5. Describe possible solutions to a design problem (e.g., how to hold down paper in the wind).

## **Grade Four**

*Understanding  
Technology*

1. Explain how technology from different areas (e.g., transportation, communication, nutrition, healthcare, agriculture, entertainment and manufacturing) has improved human lives.
2. Investigate how technology and inventions change to meet peoples' needs and wants.

*Abilities To Do  
Technological  
Design*

3. Describe, illustrate and evaluate the design process used to solve a problem.

## **Grade Five**

*Understanding  
Technology*

1. Investigate positive and negative impacts of human activity and technology on the environment.

*Abilities To Do  
Technological  
Design*

2. Revise an existing design used to solve a problem based on peer review.
3. Explain how the solution to one problem may create other problems.

## **Grade Six**

*Understanding  
Technology*

1. Explain how technology influences the quality of life.
2. Explain how decisions about the use of products and systems can result in desirable or undesirable consequences (e.g., social and environmental).
3. Describe how automation (e.g., robots) has changed manufacturing including manual labor being replaced by highly-skilled jobs.
4. Explain how the usefulness of manufactured parts of an object depend on how well their properties allow them to fit and interact with other materials.

*Abilities To Do  
Technological  
Design*

5. Design and build a product or create a solution to a problem given one constraint (e.g., limits of cost and time for design and production, supply of materials and environmental effects).

## **Grade Seven**

*Understanding  
Technology*

1. Explain how needs, attitudes and values influence the direction of technological development in various cultures.
2. Describe how decisions to develop and use technologies often put environmental and economic concerns in direct competition with each other.
3. Recognize that science can only answer some questions and technology can only solve some human problems.

*Abilities To Do  
Technological  
Design*

4. Design and build a product or create a solution to a problem given two constraints (e.g., limits of cost and time for design and production or supply of materials and environmental effects).

## **Grade Eight**

*Understanding  
Technology*

1. Examine how science and technology have advanced through the contributions of many different people, cultures and times in history.
2. Examine how choices regarding the use of technology are influenced by constraints caused by various unavoidable factors (e.g., geographic location, limited resources, social, political and economic considerations).

*Abilities To Do  
Technological  
Design*

3. Design and build a product or create a solution to a problem given more than two constraints (e.g., limits of cost and time for design and production, supply of materials and environmental effects).
4. Evaluate the overall effectiveness of a product design or solution.

### **Scientific Inquiry**

Students develop scientific habits of mind as they use the processes of scientific inquiry to ask valid questions and to gather and analyze information. They understand how to develop hypotheses and make predictions. They are able to reflect on scientific practices as they develop plans of action to create and evaluate a variety of conclusions. Students are also able to demonstrate the ability to communicate their findings to others.

## **Kindergarten**

*Doing Scientific  
Inquiry*

1. Ask "what if" questions.
2. Explore and pursue student-generated "what if" questions.
3. Use appropriate safety procedures when completing scientific investigations.
4. Use the five senses to make observations about the natural world.
5. Draw pictures that correctly portray features of the item being described.
6. Recognize that numbers can be used to count a collection of things.
7. Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers and other appropriate tools).
8. Measure the lengths of objects using non-standard methods of measurement (e.g., teddy bear counters and pennies).
9. Make pictographs and use them to describe observations and draw conclusions.
10. Make new observations when people give different descriptions for the same thing.

## Grade One

### *Doing Scientific Inquiry*

1. Ask "what happens when" questions.
2. Explore and pursue student-generated "what happens when" questions.
3. Use appropriate safety procedures when completing scientific investigations.
4. Work in a small group to complete an investigation and then share findings with others.
5. Create individual conclusions about group findings.
6. Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, timers and simple balances and other appropriate tools).
7. Make estimates to compare familiar lengths, weights and time intervals.
8. Use oral, written and pictorial representation to communicate work.
9. Describe things as accurately as possible and compare with the observations of others.

## Grade Two

*Doing Scientific Inquiry*

1. Ask "how can I/we" questions.
2. Ask "how do you know" questions (not "why" questions) in appropriate situations and attempt to give reasonable answers when others ask questions.
3. Explore and pursue student-generated "how" questions.
4. Use appropriate safety procedures when completing scientific investigations.
5. Use evidence to develop explanations of scientific investigations. (What do you think? How do you know?)
6. Recognize that explanations are generated in response to observations, events and phenomena.
7. Use appropriate tools and simple equipment/instruments to safely gather scientific data (e.g., magnifiers, non-breakable thermometers, timers, rulers, balances and calculators and other appropriate tools).
8. Measure properties of objects using tools such as rulers, balances and thermometers.
9. Use whole numbers to order, count, identify, measure and describe things and experiences.
10. Share explanations with others to provide opportunities to ask questions, examine evidence and suggest alternative explanations.

## **Grade Three**

*Doing Scientific Inquiry*

1. Select the appropriate tools and use relevant safety procedures to measure and record length and weight in metric and English units.
2. Discuss observations and measurements made by other people.
3. Read and interpret simple tables and graphs produced by self/others.
4. Identify and apply science safety procedures.
5. Record and organize observations (e.g., journals, charts and tables).
6. Communicate scientific findings to others through a variety of methods (e.g., pictures, written, oral and recorded observations).

## **Grade Four**



*Doing Scientific Inquiry*

1. Select the appropriate tools and use relevant safety procedures to measure and record length, weight, volume, temperature and area in metric and English units.
2. Analyze a series of events and/or simple daily or seasonal cycles, describe the patterns and infer the next likely occurrence.
3. Develop, design and conduct safe, simple investigations or experiments to answer questions.
4. Explain the importance of keeping conditions the same in an experiment.
5. Describe how comparisons may not be fair when some conditions are not kept the same between experiments.
6. Formulate instructions and communicate data in a manner that allows others to understand and repeat an investigation or experiment.

## **Grade Five**

*Doing Scientific Inquiry*

1. Select and safely use the appropriate tools to collect data when conducting investigations and communicating findings to others (e.g., thermometers, timers, balances, spring scales, magnifiers, microscopes and other appropriate tools).
2. Evaluate observations and measurements made by other people and identify reasons for any discrepancies.
3. Use evidence and observations to explain and communicate the results of investigations.
4. Identify one or two variables in a simple experiment.
5. Identify potential hazards and/or precautions involved in an investigation.
6. Explain why results of an experiment are sometimes different (e.g., because of unexpected differences in what is being investigated, unrealized differences in the methods used or in the circumstances in which the investigation was carried out, and because of errors in observations).

## **Grade Six**

*Doing Scientific Inquiry*

1. Explain that there are not fixed procedures for guiding scientific investigations; however, the nature of an investigation determines the procedures needed.
2. Choose the appropriate tools or instruments and use relevant safety procedures to complete scientific investigations.
3. Distinguish between observation and inference.
4. Explain that a single example can never prove that something is always correct, but sometimes a single example can disprove something.

## **Grade Seven**

*Doing Scientific Inquiry*

1. Explain that variables and controls can affect the results of an investigation and that ideally one variable should be tested at a time; however it is not always possible to control all variables.
2. Identify simple independent and dependent variables.
3. Formulate and identify questions to guide scientific investigations that connect to science concepts and can be answered through scientific investigations.
4. Choose the appropriate tools and instruments and use relevant safety procedures to complete scientific investigations.
5. Analyze alternative scientific explanations and predictions and recognize that there may be more than one good way to interpret a given set of data.
6. Identify faulty reasoning and statements that go beyond the evidence or misinterpret the evidence.
7. Use graphs, tables and charts to study physical phenomena and infer mathematical relationships between variables (e.g., speed and density).

## **Grade Eight**

*Doing Scientific Inquiry*

1. Choose the appropriate tools or instruments and use relevant safety procedures to complete scientific investigations.
2. Describe the concepts of sample size and control and explain how these affect scientific investigations.
3. Read, construct and interpret data in various forms produced by self and others in both written and oral form (e.g., tables, charts, maps, graphs, diagrams and symbols).
4. Apply appropriate math skills to interpret quantitative data (e.g., mean, median and mode).

**Scientific Ways of Knowing**

Students realize that the current body of scientific knowledge must be based on evidence, be predictive, logical, subject to modification and limited to the natural world. This includes demonstrating an understanding that scientific knowledge grows and advances as new evidence is discovered to support or modify existing theories, as well as to encourage the development of new theories. Students are able to reflect on ethical scientific practices and demonstrate an understanding of how the current body of scientific knowledge reflects the historical and cultural contributions of women and men who provide us with a more reliable and comprehensive understanding of the natural world.

**Kindergarten**

*Nature of Science*

1. Recognize that scientific investigations involve asking open-ended questions. (How? What if?)
2. Recognize that people are more likely to accept your ideas if you can give good reasons for them.

*Ethical Practices*

3. Interact with living things and the environment in ways that promote respect.

*Science and Society*

4. Demonstrate ways science is practiced by people everyday (children and adults).

**Grade One**

- Nature of Science*
1. Discover that when a science investigation is done the same way multiple times, one can expect to get very similar results each time it is performed.
  2. Demonstrate good explanations based on evidence from investigations and observations.
- Science and Society*
3. Explain that everybody can do science, invent things and have scientific ideas no matter where they live.

## **Grade Two**

- Nature of Science*
1. Describe that scientific investigations generally work the same way under the same conditions.
  2. Explain why scientists review and ask questions about the results of other scientists' work.
- Ethical Practices*
3. Describe ways in which using the solution to a problem might affect other people and the environment.
- Science and Society*
4. Demonstrate that in science it is helpful to work with a team and share findings with others.

## **Grade Three**

- Nature of Science*
1. Describe different kinds of investigations that scientists use depending on the questions they are trying to answer.
- Ethical Practices*
2. Keep records of investigations and observations and do not change the records that are different from someone else's work.
- Science and Society*
3. Explore through stories how men and women have contributed to the development of science.
  4. Identify various careers in science.
  5. Discuss how both men and women find science rewarding as a career and in their everyday lives.

## **Grade Four**

*Nature of Science*

1. Differentiate fact from opinion and explain that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.
2. Record the results and data from an investigation and make a reasonable explanation.
3. Explain discrepancies in an investigation using evidence to support findings.

*Ethical Practices*

4. Explain why keeping records of observations and investigations is important.

## **Grade Five**

*Nature of Science*

1. Summarize how conclusions and ideas change as new knowledge is gained.
2. Develop descriptions, explanations and models using evidence to defend/support findings.
3. Explain why an experiment must be repeated by different people or at different times or places and yield consistent results before the results are accepted.
4. Identify how scientists use different kinds of ongoing investigations depending on the questions they are trying to answer (e.g., observations of things or events in nature, data collection and controlled experiments).

*Ethical Practices*

5. Keep records of investigations and observations that are understandable weeks or months later.

*Science and Society*

6. Identify a variety of scientific and technological work that people of all ages, backgrounds and groups perform.

## **Grade Six**

*Nature of Science*

1. Identify that hypotheses are valuable even when they are not supported.

- Ethical Practices* 2. Describe why it is important to keep clear, thorough and accurate records.
- Science and Society* 3. Identify ways scientific thinking is helpful in a variety of everyday settings.
4. Describe how the pursuit of scientific knowledge is beneficial for any career and for daily life.
5. Research how men and women of all countries and cultures have contributed to the development of science.

## **Grade Seven**

- Ethical Practices* 1. Show that the reproducibility of results is essential to reduce bias in scientific investigations.
2. Describe how repetition of an experiment may reduce bias.
- Science and Society* 3. Describe how the work of science requires a variety of human abilities and qualities that are helpful in daily life (e.g., reasoning, creativity, skepticism and openness).

## **Grade Eight**

- Nature of Science* 1. Identify the difference between description (e.g., observation and summary) and explanation (e.g., inference, prediction, significance and importance).
- Ethical Practices* 2. Explain why it is important to examine data objectively and not let bias affect observations.