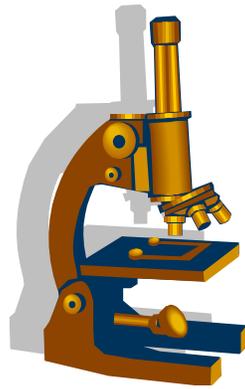


# SCIENCE CURRICULUM



## Sioux County Schools

Grades K-12

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“Science literacy for all,” “less is more,” and “first in the world in math and science achievement,” are the catch phrases for improving science education in our nation’s schools. Since 1989, Nebraska science educators have been aware of and involved with national reform efforts such as the National Science Teachers Association’s “Scope, Sequence, and Coordination Project,” and the American Association for the Advancement of Science’s “Project 2061.” The National Research Council released the National Science Standards in December of 1995. In 1998, the Nebraska Department of Education published the Nebraska Science Standards. Now science educators and curriculum developers have numerous resources to use as they decide what science knowledge and processes students need to know and how do they best learn those concepts.

The influx of all of these documents has overwhelmed science educators as they develop classroom curriculum guides. Questions are being asked such as “Which is the best one to use?” and “Is the content and philosophy of one document in conflict with another document?” However, the most pressing question Nebraska educators are asking is “How does all of this information translate into a meaningful science curriculum for our schools?” This Sample K-12 Articulated Curriculum provides Nebraska school districts with an example of a K-12 science curriculum guide to ensure science literacy for all students. It reflects a consensus of the content standards included in all of the recent science improvement efforts.

Because Nebraska has a strong tradition of local control, this is a sample resource, not a state mandate. It is intended to give science educators an idea of how the National Science Education Standards and Nebraska Science Standards could be implemented in local curriculum guides. Nebraska educators who have been involved with various science improvement efforts throughout the state are the authors. Care was taken not to include specific lessons to meet the content standards included in this sample. Each Nebraska district is still responsible to determine what curriculum materials to use in their schools. After reviewing this guide, local district curriculum developers may decide to closely follow this guide in the development of their district’s science curriculum. Districts have the option of changing the sequence of these science standards. The content standard on life cycles in third grade could be moved to the second or fourth grade or the seventh grade standard on evidence, models, and explanation could be moved up or down a grade level. More detail about each of the content standards may be found in National Science Standards and Project 2061’s Benchmarks for Science Literacy.

Teachers from every grade level must be directly involved in the creation of their district’s K-12 science curriculum. A look at the Table of Contents reveals an articulated science curriculum for grades K-10. Because Nebraska is a local control state, each district determines the amount of science credit a student must earn to graduate from high school. In most schools there is a two-year requirement. Enrollment figures for Nebraska reveal that most students meet complete science requirements during their freshman and sophomore years. Many students do not have a science course during their last two years of school. High schools may wish to develop integrated (life, earth, physical) science courses to ensure that all students learn the processes and

concepts of all science content standards in this sample curriculum. This includes standards in the familiar areas of physical, life, and earth, as well as standards for unifying concepts, inquiry, science and technology, personal and social perspectives, and the history and nature of science.

Senior high teachers of traditional content courses such as biology, chemistry, and physics should use both the ninth and tenth grade curriculum examples when developing their classroom curriculum guides. This will ensure that the subject area content is included, as well as unifying themes, inquiry, science and technology, personal and social perspectives, history and nature of science, and connections with other science disciplines.

Science literacy is necessary for all citizens to make choices in everyday life, to participate in public discussions, to function in today's work force, and to enjoy our natural world. A K-12 science curriculum should ensure that all students have the opportunity to learn what is essential for scientific literacy. Nebraska schools are among the best in the nation. The Sample K-12 Science Curriculum is a resource to make the best even better.

STAR Standards: Fourth Grade—are indicated for districts opting to report at fourth grade level.  
Fifth Grade—are indicated for districting opting to report at fifth grade level (rather than at fourth grade).  
Eighth Grade—is indicated.

## **KINDERGARTEN**

### **Unifying Concepts and Processes in Science**

#### **Systems, order, and organization:**

- Observe and describe objects sorted according to their properties using one or more of the five senses. 1.1.1a
- Sort objects by their characteristics. 1.1.1b

#### **Evidence, models, and explanation:**

- Describe the ways that many of the toys children play with are like real things. 1.1.2a

#### **Constancy, change, and measurement:**

- Things stay the same in some ways and change in some ways. 1.1.3b
- Compare objects using direct comparisons (e.g. shorter, longer, taller, heavier) and nonstandard units of measurement (e.g. string and paper clips). 1.1.3c

#### **Form and function:**

NOT DEVELOPMENTALLY APPROPRIATE.

#### **Evolution and equilibrium:**

NOT DEVELOPMENTALLY APPROPRIATE.

### **Science as Inquiry**

#### **Abilities necessary to do scientific inquiry:**

- Ask questions about objects, organisms, and events in the student's environment. 1.2.1a
- Observe, manipulate, and describe objects in the student's environment using the five senses and simple tools. 1.2.1 b, c
- Share questions, observations, and findings with other. 1.2.1d

### **Physical Science**

#### **Characteristics of objects and materials:**

- Observe and describe characteristics of common materials (e.g., paper, fabric, metals). 1.3.1a

### **Life Science**

#### **Characteristics of living things:**

- Begin to differentiate between living and nonliving. 1.4.1a
- Identify the basic needs of organisms (food, water, air, shelter or habitat). 1.4.1b
- Compare and contrast animals by specific characteristics (e.g. body covering, diet, locomotion). 1.4.1d
  - Examples, Observations, and Phenomena: Different types of organisms live in different places.

#### **Life cycles of organisms:**

- Describe how plants and animals closely resemble their parents. 1.4.2b

**Earth and Space Science****Characteristics of earth materials:**

- Describe color and texture properties of different soils and rocks. 1.5.1a

**Objects in the sky:**

- Recognize and identify objects that can be observed in the sky. 1.5.2a
- Distinguish between objects that can be seen in the daytime and the night time. 1.5.2a
  - Examples, Observations, and Phenomena: The sun can be seen only in the daytime, whereas the moon can be seen sometimes at night and sometimes during the day.

**Changes in earth and sky:**

- Record weather changes from day to day. 1.5.3a
- Classify clothing and activity choices based on daily weather. 1.5.3a

**Science and Technology****Understanding about science and technology:**

NOT DEVELOPMENTALLY APPROPRIATE.

**Science in Personal and Social Perspectives****Personal health:**

- Identify safety rules for home and school. 1.7.1a
- Begin to identify features of a healthy diet. 1.7.1c

**Understanding of resources:**

- Identify examples of reduce, reuse, and recycle in the child's environment. 1.7.2a

**History and Nature of Science****Science as a human endeavor:**

- Conduct a simple investigation as part of a team. 1.8.1b

**Center ideas to extend learning in science:**

- Exploration with magnets
- Exploration with toys that represent real objects
- Sand table play
- Water stations and various containers (sink/float; direct comparisons and nonstandard measurement)
- Different tools (keep safety considerations in mind!)
- Observation and measurement stations (including hand lens, balances, nonstandard measurement tools such as paper clips and blocks)
- Nonfiction literature picture books

**FIRST GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Observe and describe objects using senses and comparative measurements (lighter, heavier, longer). 1.1.1a
- Sort objects by one characteristic and resort using a different characteristic. 1.1.1b

**Evidence, models, and explanation:**

- Compare similarities and differences between a model and the object, living thing, or event it represents. 1.1.2a

**Constancy, change, and measurement:**

- Use nonstandard and standard units of measurement to measure change (e.g. distance an object moved, mass, temperature, height). 1.1.3a, d
- Use appropriate measurement tools for different purposes. 1.1.3e

**Form and function:**

NOT DEVELOPMENTALLY APPROPRIATE.

**Science as Inquiry****Abilities necessary to do scientific inquiry:**

- Ask questions related to a topic of study with some teacher guidance. 1.2.1a
- Make observations directly related to the investigation using either qualitative or quantitative observations. 1.2.1b
- Select and use tools appropriately with minimal assistance. 1.2.1c
- Describe and compare things in terms of characteristics, relative order, or motion. 1.2.1e
- Communicate observations. 1.2.1d

**Physical Science****Characteristics of objects and materials:**

- Observe and describe properties of common materials (e.g., float or sink, dissolve or not dissolve). 1.3.1b
- Observe and classify materials as a solid, liquid, or a gas. 1.3.1c

**Life Science****Characteristics of living things:**

- Describe the different functions of a plant's roots, stems, and leaves. 1.4.1
- Observe and match organisms to their distinct habitats. 1.4.1e
  - Exclusion: Ecosystems

**Life cycles of organisms:**

- Observe and describe how living things change as they grow. 1.4.2a

**Earth and Space Science****Characteristics of earth materials:**

- Identify soils, rocks, and water as earth materials. 1.5.1a
- Identify earth materials needed by plants for growth. 1.5.1b

**Objects in the sky:**

- Describe the sun's location in the sky. 1.5.2a
  - Examples, Observations, and Phenomena: The fact that the sun consistently rises and sets as opposed to the path the sun travels.
- Investigate that the sun provides heat and light. 1.5.2b

**Changes in earth and sky:**

- Observe and record weather changes from season to season. 1.5.3b
- Classify clothing and activity choices based on seasonal weather. 1.5.3b

**Science and Technology****Understanding about science and technology:**

- Identify and describe science tools used in exploration include balances, magnifiers, thermometers, and other measuring instruments. 1.6.2a
- Identify the technology used in different occupations. 1.6.2b

**Science in Personal and Social Perspectives****Personal health:**

- Identify personal health and safety habits that will maintain and improve health. 1.7.1b
- Identify substances and personal health and safety habits that can damage the way the body functions. 1.7.1d

**Understanding of resources:**

- Describe how the practices of reduce, reuse, and recycle help our environment. 1.7.2a

**History and Nature of Science****Science as a human endeavor:**

- Recognize that men and women from many places contribute to science. 1.8.1a

**SECOND GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Describe the parts that make up a system. 4.1.1a

**Evidence, models, and explanation:**

- Explain and answer questions about a model and how it represents an object, living thing, or an event. 4.1.2c

**Constancy, change, and measurement:**

- Describe and measure an observable change (e.g., speed, pattern, shape, position, and size). 4.1.3a

**Form and function:**

- Demonstrate how the shape of an object is frequently related to use. 4.1.4a

**Science as Inquiry****Abilities necessary to do scientific inquiry:**

- Ask a question related to a topic of study with teacher guidance. 4.2.1a
- Make either qualitative or quantitative observations directly related to the investigation. 4.2.1a, c
- Begin to plan in investigation to answer a testable question. 4.2.1b
- Begin to use observations to draw conclusions. 4.2.1d
- Communicate investigation and results. 4.2.1e

**Physical Science****Characteristics of objects and materials:**

- Classify objects by observable characteristics. 4.3.1a
- Use simple tools (e.g., rulers, scales, thermometers, hand lenses) to quantify characteristics. 4.3.1b
- Identify the different states of matter. 4.3.1c

**Position and motion of objects:**

- Describe the position of an object using reference points. 4.3.2a
- Describe an object's motion by tracing its position over time. 4.3.2b

**Light, heat, electricity, and magnetism:**

- Investigate and describe the properties of magnets. 4.3.3f
  - Examples, Observations, and Phenomena: Magnets attract and repel each other and certain kinds of other materials.

**Life Science****Characteristics of living things:**

- Describe the differences between plants and animals. 4.4.1a
  - Exclusion: Vertebrates (technical vocabulary)

**Life cycles of living things:**

- Describe the life cycles of plants and animals that include birth, growth, reproduction, and death. 4.4.2a

**Living things and environments:**

- All animals depend on plants.

**Earth and Space Science****Characteristics of earth materials:**

- Identify characteristics of soils, water, and rocks. 4.5.1a
  - Examples, Observations, and Phenomena: Rocks come in all sizes from boulders to grains of sand.
  - Examples, Observations, and Phenomena: Soils differ in their capacity to retain water.
  - Examples, Observations, and Phenomena: Soil contains many living things.
- Explain how soil, water, and rocks are used by humans. 4.5.1b

**Objects in the sky:**

- Observe and describe the patterns of movement of the sun and clouds. 4.5.2a
- Compare differences in shadow location and size during different times of the day. 4.5.2a

**Changes in earth and sky:**

- Identify the change in the pattern of the sun's movement over the seasons. 4.5.3b
- Describe and measure changes in weather (e.g., temperature, precipitation, wind direction and speed). 4.5.3b
  - Exclusion: terms related to pressure, humidity, and long-term climate change trends

**Science and Technology****Understanding about science and technology:**

- Develop the ability to work collaboratively and to use suitable science tools. 4.6.2 a, b

**Understanding of technological design:**

- Work as a class or a group to identify a simple problem. 4.6.1a
- Propose and implement a solution. 4.6.1 b, d

**Science in Personal and Social Perspectives****Personal health:**

- Describe how a balanced diet contributes to good health. 4.7.1a

**Types of resources:**

- List examples of resources which are basic materials (e.g., air, water, soil). 4.7.2a

**Environmental changes:**

CONCEPT IS NOT TAUGHT IN THIS GRADE.

**History and Nature of Science****Science as a human endeavor:**

- Identify how science is used in different careers. 4.8.1b

**THIRD GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Describe how the parts of a system affect the whole system. 4.1.1b

**Evidence, models, and explanation:**

- Create a model, graph, or illustration that represents an object, living thing, or an event. 4.1.2b

**Constancy, change, and measurement:**

- Cause a change in speed, pattern, shape, position, and size). Describe and measure these change using standard units of measurement. 4.1.3a

**Form and function:**

- Relate the shape of a tool to its use (e.g. the flat head of a hammer is good for pounding nails; the tines on a fork help us pick up food). 4.1.4a

**Science as Inquiry****Abilities necessary to do scientific inquiry:**

- Pose a testable question that can be investigated with teacher guidance. 4.2.1a
- Plan and conduct a simple investigation with teacher guidance. 4.2.1b
- Choose and appropriately use measuring tools. 4.2.1c
- Collect and record data. 4.2.1c
- Use data to construct reasonable explanations. 4.2.1d
- Communicate results. 4.2.1e

**Physical Science****Characteristics of objects and materials:**

- Classify objects by more than one observable characteristic. 4.3.1a
- Compare common materials using simple tools (e.g., rulers, scales, thermometers, hand lenses) to quantify characteristics. 4.3.1b
- Demonstrate a change in water from solid to liquid to gas by heating and from gas to liquid to solid by cooling. 4.3.1c
- Observe and describe changes in water as it cools and freezes or as it heats. 4.3.1c
  - Exclusion: precise temperatures for when liquid water freezes or becomes water vapor

**Position and motion of objects:**

- Demonstrate that the position and motion of objects can be changed by pushing or pulling. 4.3.2c
- Measure the change in the position of an object after being pushed or pulled. 4.3.2c

**Light, heat, electricity, and magnetism:**

- Distinguish between reflection and refraction of light. 4.3.3a
  - Examples, Observations, and Phenomena: Light travels in a straight line until it strikes an object.
  - Examples, Observations, and Phenomena: Light can be reflected by a mirror, refracted by a lens, or absorbed by an object.
- Identify ways that heat can be produced (e.g., burning, rubbing, mixing one substance with another). 4.3.3b
- Demonstrate that heat can flow from one object to another by conduction. 4.3.3c

**Life Science****Characteristics of living things:**

- Describe the various structures of plants necessary for survival and reproduction. 4.4.1b
  - Exclusion: Cells and cellular functions
- Investigate and describe how external stimuli (e.g., environmental changes) affect plants. 4.4.1c

**Life cycles of living things:**

- Identify the similarities and differences between plants grown from the same seed, cutting or root and plants grown from different seed, cuttings or roots. 4.4.2b

**Living things and environments:**

- Investigate and describe how environmental changes affect the survival of plants. 4.4.3b
  - Exclusion: The process by which plants use light in photosynthesis

**Earth and Space Science****Characteristics of earth materials:**

- Describe how soil is formed. 4.5.1a
  - Examples, Observations, and Phenomena: Smaller rocks come from breakage and the weathering of bedrock and larger rocks.
- Identify characteristics of the atmosphere. 4.5.1a
  - Exclusion: Carbon dioxide and other specific component gases of the atmosphere
- Identify earth materials used for a specific human purpose (e.g., marble—building, clay—pottery, coal—heat). 4.5.1c

**Objects in the sky:**

- Observe, record, and describe the position and movements of the moon and stars. 4.5.2a
  - Exclusion: Technical terms related to moon phases (e.g., waning, waxing, gibbous)
  - Exclusion: Ecliptic (use term such as “path of the sun”)

**Changes in earth and sky:**

- Investigate and describe the slow processes of erosion and weathering. 4.5.3a
  - Exclusion: Names of the processes “erosion” and “weathering”. The focus should be on the processes themselves. It is not important that student distinguish between erosion and weathering.
  - Exclusion: Changes not easily observable that take place over very long stretches of time (e.g., Grand Canyon formation, tectonic mountain building, soil development)
- Collect data and generalize weather patterns. 4.5.3b
  - Exclusion: terms related to pressure, humidity, and long-term climate change trends
- Describe the observable shape of the moon which changes from day to day in a cycle that lasts about a month. 4.5.2

**Science and Technology****Understanding of science and technology:**

- Develop the ability to work collaboratively to solve a problem. 4.6.2b

**Understanding of technological design:**

- Work in a group to identify a simple problem, with teacher's guidance. 4.6.1a
- Propose and implement a solution. 4.6.1b, c
- Evaluate the implemented solution. 4.6.1d

**Abilities to distinguish between natural objects and objects made by humans:**

- Classify objects as either natural or of human design. 4.6.3a

**Science in Personal and Social Perspectives****Personal health:**

- Explain how the body uses food. 4.7.1a
- Explain how different nutrients in food specifically contribute to health. 4.7.1a

**Types of resources:**

- List examples of resources produced from basic materials (e.g., food, fuel, and building materials). 4.7.2b
- List examples of resources which are intangible materials (e.g., beauty, security, and quiet places). 4.7.2c

**Environmental changes:**

CONCEPT IS NOT TAUGHT IN THIS GRADE.

**History and Nature of Science****Science as a human endeavor:**

- Research and report on how current scientific discoveries illustrate that science is an ongoing process. 4.8.1c

**FOURTH GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Construct a model, identify the system and the parts of the system. 4.1.1a, b
  - Examples, Observations, and Phenomena: A small part of something may be special in some way, yet not give an accurate picture of the whole.

**Evidence, models, and explanation:**

- Use evidence gathered from an investigation to develop a scientific explanation. 4.1.2a
- Explain procedures or ideas in more than one way (e.g. sketches, charts, and graphs). 4.1.2d

**Constancy, change, and measurement:**

- Measure a change using appropriate tools and units of measurement. 4.1.3b

**Form and function:**

- Explain how specific characteristics of living things influence how they interact with their environment (e.g., how the long neck of the giraffe and webbed feet on a duck help it swim efficiently). 4.1.4

**Science as Inquiry****Abilities necessary to do scientific inquiry: (STAR)**

- Ask a testable question. 4.2.1a
- Plan and conduct a simple investigation. 4.2.1b
- Use simple equipment and tools to gather data and extend the senses. 4.2.1c
- Use data to develop reasonable explanations. 4.2.1d
- Communicate procedures, results, and explanations of an investigation. 4.2.1e

**Physical Science****Characteristics of objects and materials: (STAR)**

- Classify objects by more than one observable characteristic. 4.3.1a
- Compare and contrast common materials using simple tools (e.g., rulers, scales, thermometers, hand lenses) to quantify characteristics. 4.3.1b
- Using common liquids (e.g., water, salt water, soda) investigate and identify the temperatures at which materials change from solid to liquid to gas by heating and from gas to liquid to solid by cooling. 4.3.1c
  - Exclusion: Unusual substances and mixtures such as mud that cannot be clearly classified as solid or liquid
  - Exclusion: Precise temperatures for when liquid water freezes or becomes water vapor
  - Exclusion: Classification of viscous fluids such as glass and obsidian
  - Exclusion: Plasma
- Identify real life examples of evaporation and condensation. 4.3.1c

**Position and motion of objects: (STAR)**

- Demonstrate how vibrating objects produce sound. 4.3.2d
- Investigate the relationship between the pitch of sound and the rate of vibration. 4.3.2e

**Light, heat, electricity, and magnetism: (STAR)**

- Construct complete electrical circuits that will light a bulb or run a small motor. 4.3.3e
- Distinguish between electrical circuits that are and are not complete. Identify “fixes” for incomplete electrical circuits. 4.3.3e
- Use electricity to produce light, heat, and sound. 4.3.3
- Use electricity to produce magnetic effects (e.g. electromagnets or telegraphs). 4.3.3d

**Life Science****Characteristics of living things: (STAR)**

- Describe the various structures of animals necessary for survival and reproduction. 4.4.1b
  - Exclusion: Internal structures and functions in plants and animals
  - Exclusion: Cells, cell organelles
- Investigate and describe how internal stimuli (e.g., hunger) and external stimuli (e.g., environmental changes) affect behavior of animals. 4.4.1c

**Life cycles of organisms: (STAR)**

- Identify inherited characteristics of living things (e.g., color and number of eyes). 4.4.2b
  - Exclusion: Technical vocabulary—traits, species
- Identify learned characteristics of living things (e.g., language or hunting for food). 4.4.2c

**Living things and environments: (STAR)**

- Diagram a food chain. 4.4.3a
  - Examples, Observations, and Phenomena: All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat plants for food.
- Describe how humans and other living things cause both positive and negative changes in their environment. 4.4.3c
- Investigate and describe how environmental changes affect behavior and survival of animals. 4.4.3b

**Earth and Space Science****Characteristics of earth materials: (STAR)**

- Identify characteristics of common, specific rocks and minerals. 4.5.1a
- Classify earth materials with their use. 4.5.1b
  - Examples, Observations, and Phenomena: Earth materials are useful in industry and as sources of fuel.
- Compare a fossil with plants and animals that lived long ago. 4.5.1d

**Objects in the sky: (STAR)**

- Create general statements of the patterns of movement of the sun, moon, and stars based on observation and collected data. 4.5.2a
  - Exclusion: Technical terms related to moon phases (e.g., waning, waxing, gibbous)
  - Exclusion: Ecliptic (use term such as “path of the sun”)
  - Exclusion: The space perspective in explaining patterns such as moon phases, sun’s path across the sky, seasons, eclipses
  - Exclusion: Relative distances of sun, moon, earth

**Changes in earth and sky: (STAR)**

- Identify rapid processes (e.g., earthquakes, volcanoes) that change the earth's surface. 4.5.3a
- Identify changes to the earth's surface cause by rapid processes (e.g., earthquakes, volcanoes). 4.5.3a
  - Exclusion: Slow mountain building resulting from plate tectonics
  - Exclusion: Names of intrusive magma bodies (e.g., batholith)
  - Exclusion: Names of extrusive lava bodies (e.g., sills, dikes)

**Science and Technology****Understanding of science and technology:**

- Develop the ability to work individually or collaboratively to solve a problem. 4.6.2b
  - Examples, Observations, and Phenomena: Engineers and scientists work together, using technology to help explain and solve today's problems.

**Understanding of technological design:**

- Identify a simple problem. 4.6.1a
- Propose a solution to a simple problem. 4.6.1b
- Implement the proposed solution. 4.6.1c
- Evaluate the implementation. 4.6.1d
- Communicate the problem, design, and solution. 4.6.1e

**Science in Personal and Social Perspectives****Personal health:**

- Investigate and explain how personal choices can directly affect a persons' health (e.g., exercise, nutrition, and use of drugs). 4.7.1b

**Types of resources:**

- Research and report on the supply of various resources. 4.7.2d
  - Examples, Observations, and Phenomena: Some resources are basic materials, such as air and water; some are produced from basic resources, such as food and fuel; and some resources are non-material, such as beauty and security.
  - Examples, Observations, and Phenomena: The supply of many resources is limited.

**Environmental changes:**

CONCEPT IS NOT TAUGHT IN THIS GRADE.

**History and Nature of Science****Science as a human endeavor:**

- Research and report on the contribution to science and technology throughout history by men and women science of diverse cultures. 4.8.1a

**FIFTH GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Recognize key parts and functions of any system. 8.1.1a
- Use classification schemes to determine how objects and events can be related using multiple characteristics. 8.1.1c

**Evidence, models, and explanation:**

- Collect data from an experiment. 8.1.2a
- Observe and develop physical models. 8.1.2b
- Describe results of experimentation. 8.1.2c

**Constancy, change, and measurement:**

- Use English and metric systems of measurements in the classroom and in everyday situations. 8.1.3c

**Form and function:**

- Construct a device to perform a simple task and explain how the form of a specific part affects the function of the device. 8.1.4

**Science as Inquiry****Abilities necessary to do scientific inquiry: (STAR)**

- Ask testable questions. 5.2.1a
- Plan and conduct a replicable investigation. 5.2.1b
- Choose and accurately use appropriate tools and equipment. 5.2.1c
- Use math to gather, record and organize data. 5.2.1d, e
- Communicate reasonable explanations based on analyzed data. 5.2.1d

**Physical Science****Properties and changes of properties in matter:**

- Describe characteristic properties of substances (e.g., density, boiling point). 8.3.1a
- Describe chemical and physical properties of matter. 8.3.1b
- Describe compounds and mixtures. 8.3.1c
  - Examples, Observations, and Phenomena: Mixtures of substances can be separated using the characteristic properties of each.
  - Examples, Observations, and Phenomena: There are more than 100 known elements which may combine to form compounds.

**Motions and forces: (STAR)**

- Investigate and describe the motion of an object by its position, direction of motion, and speed. 8.3.2a
  - Examples, Observations, and Phenomena: An object in motion continues in a straight line unless acted upon.
  - Examples, Observations, and Phenomena: Change in force applied to an object in motion will change the speed or direction of that object.
  - Exclusions: velocity (technical vocabulary)

**Transfer of energy:**

- Investigate and demonstrate how energy is transferred using simple machines. 8.3.3b

**Life Science****Structure and function in living systems: (STAR)**

- Investigate and describe the human body systems (skin, skeletal and muscular) and how they interact. 5.4.1a, 8.4.1e
- Investigate and explain how disease affects the structure and/or function of an organism. 5.4.1b, 8.4.1f

**Reproduction and heredity:**

- Describe how some organisms reproduce through asexual reproduction. 8.4.2a
  - Examples, Observations, and Phenomena: Reproduction is a characteristic of all living systems.

**Regulation and behavior:**

- Investigate and explain how organisms' behaviors enhance their abilities to obtain and use resources, grow, and reproduce. 8.4.3a

**Populations and ecosystems:**

- Investigate and describe that a population consists of all individuals of a species at a given place and time. 8.4.4a
  - Examples, Observations, and Phenomena: All populations living together and the physical factors with which they interact compose an ecosystem.
  - Examples, Observations, and Phenomena: Populations of organisms can be categorized as producers and consumers by the function they serve in the ecosystem.

**Earth and Space Science****Structure of the earth system: (STAR)**

- Investigate and describe the crust, mantle, and core of the earth. 5.5.1a (8.5.1a)
  - Examples, Observations, and Phenomena: The solid earth is layered with a lithosphere, hot, convecting mantle, and dense metallic core.
  - Examples, Observations, and Phenomena: Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crust deformation, volcanic eruptions, and deposition of sediment; destructive forces include weathering and erosion.
  - Examples, Observations, and Phenomena: Lithospheric plates, the size of continents and oceans constantly move at a rate of centimeters per year in response to the movement of the mantle.
  - Examples, Observations, and Phenomena: Major geological events, such earthquakes, volcanic eruptions, and mountain building result from these plate movements.
  - Exclusion: Names of intrusive magma bodies (e.g., batholith)
  - Exclusion: Names of extrusive lava bodies (e.g., sills, dikes)
  - Investigate and describe the rock cycle. 5.5.1b, 8.5.1b, c
  - Examples, Observations, and Phenomena: Old rocks at the earth's surface weather, forming sediments that are buried, then compacted, heated, and often re-crystallized into new rock.
  - Examples, Observations, and Phenomena: New rocks may be brought to the surface by the forces that drive plate motion thus continuing the rock cycle.

**Earth in the solar system:**

- Investigate and list the components of the solar system. 8.5.3a
  - Examples, Observations, and Phenomena: The earth is the third planet from the sun in a system that includes the moon, sun, eight other planets, and smaller objects such as asteroids and comets.
  - Examples, Observations, and Phenomena: The sun, an average star, is the central and largest body in the solar system.
  - Examples, Observations, and Phenomena: Stars are innumerable, unevenly dispersed, and of unequal brightness.

**Science and Technology****Understanding of science and technology:**

- Describe how science and technology are reciprocal. 8.6.2b

**Understanding of technological design:**

- Identify problems for technological design. 8.6.1a
- Design a solution or product. 8.6.1b
- Implement a proposed design. 8.6.2c
- Evaluate completed technological designs or products. 8.6.2d
- Communicate the process of technological design. 8.6.2e

**Science in Personal and Social Perspectives****Personal health:**

- Describe how different substances (e.g., tobacco, alcohol, and drugs) can damage the body and alter how it functions. 4.7.1b

**Populations, resources, and environments:**

CONCEPT IS NOT TAUGHT IN THIS GRADE.

**Environmental changes:**

- Describe components of student environments as the space, conditions, and factors around an individual. 4.7.3a

**Science and technology in local challenges:**

- Identify ideas and inventions that continue to affect people. 4.7.4a

**History and Nature of Science****Science as a human endeavor:**

- Investigate and understand that women and men of various social and ethnic backgrounds, working alone or in teams, engage in the activities of science, engineering, and related fields. 8.8.1a

**Nature of Science:**

- Formulate and test a hypothesis using observations, experiments, and models. 8.8.2a
  - Examples, Observations, and Phenomena: Scientific understanding changes when new experimental evidence does not match existing explanations.

**History of science:**

CONCEPT IS NOT TAUGHT IN THIS GRADE.

**SIXTH GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Recognize and describe key parts and functions of any system. 8.1.1a
- Analyze the interactions within a system. 8.1.1b
- Create, use, and relate classification systems using multiple characteristics. 8.1.1c

**Evidence, models, and explanation:**

- Collect and interpret data from an experiment. 8.1.2a
- Describe and explain results of experimentation. 8.1.2c

**Constancy, change, and measurement:**

- Select and use appropriate measurement units in the classroom and in everyday situations. 8.1.3a
- Quantify changes in systems (e.g., scale, rate, and pattern). 8.1.3b

**Form and function:**

- Describe how the design of an object makes it possible for that object to perform a specialized task (e.g., a bicycle or an artificial heart). 8.1.4a

**Science as Inquiry****Abilities necessary to do scientific inquiry:**

- Identify a testable question that can lead to a scientific investigation. 8.2.1a
- Begin to form a hypothesis with adult help. 8.2.1a
- Design and conduct an investigation; begin to identify variables. 8.2.1b
- Collect and record objective data, correctly use equipment and techniques with guidance. 8.2.1c
- Develop descriptions and explanations based on evidence gathered. 8.2.1d
- Begin to identify relationships between evidence and explanations. 8.2.1e
- Communicate scientific procedures and conclusions. 8.2.1g
- Identify where mathematics can be used in scientific inquiry. 8.2.1h

**Physical Science****Properties and changes of properties in matter:**

- Investigate with characteristic properties of substances (e.g., density, boiling point). 8.3.1a
  - Exclusion: Classification of viscous fluids such as class and obsidian
  - Exclusion: Plasma
- Observe and describe chemical and physical properties of matter. 8.3.1b
  - Examples, Observations, and Phenomena: Chemical elements do not break down during normal chemical reactions.
  - Exclusion: Colloids and isotopes
- Investigate compounds and mixtures. 8.3.1c

**Motions and forces:**

- Investigate, measure, and describe the effect of the force of friction on an object's motion. 8.3.2a, b
  - Examples, Observations, and Phenomena: Motion of an object can be described by its position, direction, and speed.
  - Examples, Observations, and Phenomena: The force of friction may slow down or stop an object's motion.

**Transfer of energy:**

- Investigate and describe the transfer of light energy, including energy from the sun. 8.3.3a
  - Examples, Observations, and Phenomena: Light interacts with matter by transmission, absorption, or scattering.
  - Examples, Observations, and Phenomena: The sun's energy arrives as infrared, ultraviolet, or visible light.
  - Examples, Observations, and Phenomena: Visible light is a narrow range of wavelengths in the electromagnetic spectrum.
- Investigate and describe the properties and transfer of sound energy. 8.3.3d

**Life Science****Structure and function in living systems:**

- Investigate and describe the human body systems (circulatory {heart, arteries, veins, capillaries} and respiratory {lungs}) and how they interact. 8.4.1e
- Investigate and describe the levels of organizations: cells, tissues, organs, organ systems, whole organisms, and ecosystems. 8.4.1a

**Reproduction and heredity:**

- Describe how some organisms reproduce through sexual reproduction. 8.4.2a
- Investigate and describe that in many species, offspring receive hereditary information from the female (eggs) and male (sperm). 8.4.2b
  - Exclusion: Details of reproduction and development (e.g., gamete, zygote, alternation of generations)

**Regulation and behavior:**

- Investigate and examine how an organism senses change in its internal or external environment and responds to keep conditions within a required range. 8.4.3b
  - Examples, Observations, and Phenomena: Behavior is one kind of response an organism can make to an internal or environmental stimulus.
  - Examples, Observations, and Phenomena: Behavior evolves through environmental adaptation.
  - Examples, Observations, and Phenomena: Regulation of an organism's internal environment involves sensing its internal environment and changing physiological activities to keep conditions within the range required to survive.

**Populations and ecosystems:**

- Investigate and analyze the living and nonliving factors that determine the number of organisms an ecosystem can support. 8.4.4b

**Diversity and adaptation of organisms:**

- Investigate and explain how organisms adapt to living and nonliving factors in a biome. 8.4.5b

**Earth and Space Science****Structure of the earth system:**

- Investigate and describe the composition of soils. 8.5.1c
  - Examples, Observations, and Phenomena: Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria.
  - Examples, Observations, and Phenomena: Soils are often found in layers, with each having a different composition and texture.
  - Exclusion: Names of soils
- Investigate and describe the water cycle. 8.5.1d

- Examples, Observations, and Phenomena: Water, a solvent, passes through the water cycle dissolving minerals and gases and carrying them to the oceans.
- Examples, Observations, and Phenomena: Water, which carves the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle.

**Earth in the solar system:**

- Investigate and describe the sun as the major source of energy that influences the atmosphere and the earth's surface. 8.5.3d
- Examples, Observations, and Phenomena: The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle.

**Earth's history:**

NOT COVERED IN THIS GRADE.

**Science and Technology****Understanding of science and technology:**

- Distinguish between scientific inquiry (asking questions about the natural world) and technological design (using science to solve practical problems). 8.6.2a

**Understanding of technological design:**

- Identify problems for technological design. 8.6.1a
- Design a solution or product. 8.6.1b
- Implement a proposed design. 8.6.2c
- Evaluate completed technological designs or products. 8.6.2d
- Communicate the process of technological design. 8.6.2e

**Science in Personal and Social Perspectives****Personal health:**

- Identify the potential for accidents and the existence of hazards which imposes the need for injury prevention.

**Populations, resources, and environments:**

CONCEPT IS NOT TAUGHT IN THIS GRADE.

**Environmental changes:**

- Identify human influenced environmental changes. 4.7.3a

**Science and technology in local challenges:**

- Research and report on how science and technology affect the quality of life. 4.7.4a

**Natural hazards:**

CONCEPT IS NOT TAUGHT IN THIS GRADE.

**Risks and benefits:**

CONCEPT IS NOT TAUGHT IN THIS GRADE.

**History and Nature of Science****Science as a human endeavor:**

- Scientists formulate and test their explanations using observation, experiments, and theoretical and mathematical models.

**Nature of Science:**

- Use questioning, response to criticism, and open communication when defending a conclusion. 8.8.2b

**History of science:**

**CONCEPT IS NOT TAUGHT IN THIS GRADE.**

**SEVENTH GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Analyze and predict the interactions within a system and between systems. 8.1.1b
- Use classification schemes with multiple criteria for membership in that class. 8.1.1c
- Interpret cause and effect relationships within a system. 8.1.1d

**Evidence, models, and explanation:**

- Collect, interpret, and manipulate data from an experiment. 8.1.2a
- Observe and develop physical, mental, and mathematical models. 8.1.

**Constancy, change, and measurement:**

- Investigate changes in terms of scale, rate, and pattern. Quantify changes using appropriate measurement units. 8.1.3d, b, a

**Form and function:**

**NOT COVERED IN THIS GRADE.**

**Science as Inquiry****Abilities necessary to do scientific inquiry:**

- Identify a testable question that can lead to a scientific investigation. 8.2.1a
- Form a hypothesis based on a testable question. 8.2.1a
- Design and conduct an investigation and identify variables. 8.2.1b
- Collect and record objective data, correctly use equipment and techniques. 8.2.1c
- Develop descriptions, explanations, and predictions based on evidence gathered. 8.2.1d
- Identify and describe relationships between evidence and explanations. 8.2.1e
- Begin to recognize alternative explanations and predictions. 8.2.1f
- Communicate scientific procedures and conclusions. 8.2.1g
- Use mathematics in scientific inquiry. 8.2.1h

**Physical Science****Properties and changes of properties in matter:**

- Investigate the characteristic properties of substances (e.g., density, boiling point, solubility) classifying by reaction. 8.3.1a
  - Exclusion: Classification of viscous fluids such as glass and obsidian
  - Exclusion: Plasma
- Observe, describe, and measure chemical and physical properties of matter. 8.3.1b
- Describe and list common elements. 8.3.1c
  - Clarification: Periodic Table can be used to show the logical organization of elements according to observable properties. The use of the Periodic Table for predictions (e.g., properties, reactivity) is a 9-10 concept.
- Investigate combining elements to form compounds. 8.3.1c
- Describe new properties created in chemical reactions. 8.3.1d
  - Exclusion: Colloids and isotopes

**Motions and forces:**

- Investigate, measure, and graph collected data showing changes in an objects motion by its position, direction of motion, and speed. 8.3.2a
  - Exclusions: velocity (technical vocabulary)

**Transfer of energy:**

- Investigate and describe how heat is transferred from a warmer object to a cooler object until both reach the same temperature. 8.3.3c

**Life Science****Structure and function in living systems:**

- Investigate and describe the human body systems (digestive {esophagus, stomach, intestines, colons}) and how they interact. 8.4.1e
- Investigate and demonstrate that all living things are composed of cells. 8.4.1b
- Investigate and explain how cells sustain life through functions (e.g., growth and nutrition). 8.4.1c

**Reproduction and heredity:**

- Investigate and explain that chromosomes contain genes which influence heredity. 8.4.2c
  - Examples, Observations, and Phenomena: Selective breeding causes small differences between parents and offspring to accumulate in successive generations so that descendants are very different from their ancestors.
  - Exclusion: Mendelian genetics (e.g., dominant, recessive, punnet squares)
  - Exclusion: Details of reproduction and development (e.g., gamete, zygote, alternation of generations)

**Regulation and behavior:**

- Investigate and explain how behavior is a response to internal and external stimuli determined by heredity and experience. 8.4.3c

**Populations and ecosystems:**

- Describe an organism by the function it serves in an ecosystem (e.g., producer, consumer, and decomposer). 8.4.4c

**Diversity and adaptation of organisms:**

- Investigate and explain how environmental changes created by nature and by humans may cause species extinction. 8.4.5c

**Earth and Space Science****Structure of the earth system:**

- Investigate and describe the composition of the atmosphere at different altitudes. 8.5.1e
  - Examples, Observations, and Phenomenas: The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor.
  - Examples, Observations, and Phenomena: The atmosphere has different properties at different levels.
  - Exclusion: Names of atmosphere layers in addition to troposphere and stratosphere (e.g., thermosphere, ionosphere)
- Investigate and describe the effect of living organisms on weathering and the atmosphere. 8.5.1g

**Earth in the solar system:**

- Investigate and describe the influence of gravity on objects in the solar system. 8.5.3c
  - Examples, Observations, and Phenomena: Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system.
  - Exclusion: Inverse square relationship of gravitation and distance measurement

**Earth's history:**

- Investigate and describe how earth processes that occur today (e.g., volcanism, weather, and erosion) are similar to those that occurred in the past. 8.5.2a
  - Examples, Observations, and Phenomena: Folding, breaking, and uplifting change the sedimentary sequence.

**Science and Technology****Understanding of science and technology:**

- Assess the avoidable and unavoidable limits of a technological design. 8.6.2c

**Understanding of technological design:**

- Identify problems for technological design. 8.6.1a
- Design a solution or product. 8.6.1b
- Implement a proposed design. 8.6.2c
- Evaluate completed technological designs or products. 8.6.2d
- Communicate the process of technological design. 8.6.2e

**Science in Personal and Social Perspectives****Personal health:**

- Understand that nutrition requirements vary with body weight, age, gender, activity, and body functioning.

**Populations, resources, and environments:**

- Investigate and describe how population levels affect resources and the environment. 8.7.2a

**Environmental changes:**

- Identify natural environmental changes. 4.7.3a

**Science and technology in society:**

- Explain why science cannot answer all questions and technology cannot solve all human problems or meet all human needs. 8.7.5b

**Natural hazards:**

- Investigate and describe human activities (e.g., urban growth, land use, and waste disposal) which can accelerate many natural changes. 8.7.3b

**Risks and benefits:**

- Analyze a type of hazard (e.g., natural, chemical, or biological) to evaluate the options for reducing or eliminating human risk. 8.7.4a

**History and Nature of Science****Science as a human endeavor:**

- Explain the need for ethical codes followed by scientists (e.g., humane treatment of animals and truth in reporting). 8.8.1c

**Nature of Science:**

- Evaluate the results of scientific investigations, experiments, observations, theoretical models, and the explanations proposed by other scientists. 8.8.2c

**History of science:**

- Describe the idea that many individuals have contributed to the traditions of science. 8.8.3a

**EIGHTH GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Create and use classification schemes containing multiple criteria for determining membership in a class. 8.1.1c
- Interpret cause and effect relationships within and between systems. 8.1.1d

**Evidence, models, and explanation:**

- Collect, interpret, and manipulate data from an experiment. 8.1.2a
- Observe and develop physical, mental, and mathematical models as well as computer simulations. 8.1.2b
- Analyze whether or not investigative procedures and conclusions are reasonable. 8.1.2d

**Constancy, change, and measurement:**

- Investigate and describe changes in terms of scale, rate, and pattern. Quantify changes using appropriate measurement units. 8.1.3d, b, a
- Identify the degree of precision needed prior to measuring.

**Form and function:**

- Demonstrate how the design of an object makes it possible for that object to perform a specialized task (e.g., a bicycle or an artificial heart). 8.1.4a

**Science as Inquiry****Abilities necessary to do scientific inquiry: (STAR)**

- Form a testable question and hypothesis that can lead to a scientific investigation. 8.2.1a
- Design and conduct an investigation. 8.2.1b
- Identify and control most variables. 8.2.1b
- Collect and record objective data, correctly use equipment and techniques. 8.2.1c
- Analyze and interpret data from investigation. 8.2.1c
- Develop descriptions, explanations, predictions, and models based on evidence gathered. 8.2.1d
- Show relationships between evidence and explanations. 8.2.1e
- Identify and analyze alternative explanations and predictions. 8.2.1f
- Communicate scientific procedures and conclusions. 8.2.1g
- Accurately and appropriately use mathematics in scientific inquiry. 8.2.1h

**Physical Science****Properties and changes of properties in matter: (STAR)**

- Investigate and demonstrate that the characteristic properties of substances (e.g., density, boiling point, solubility) do not depend on the amount of the substance. 8.3.1a
- Observe, describe, and measure chemical and physical properties of matter. 8.3.1b
  - Exclusion: Classification of viscous fluids such as class and obsidian
  - Exclusion: Plasma
- Explain that all matter is composed of elements which may combine to form compounds. 8.3.1c
  - Examples, Observations, and Phenomena: Compounds form when chemical reactions occur.
  - Exclusion: Colloids and isotopes
- Investigate and explain that in chemical reactions new properties are created and total mass is conserved. 8.3.1d

**Motions and forces: (STAR)**

- Investigate, measure, and graph collected data showing changes in an objects motion by its position, direction of motion, and speed. 8.3.2a
- Investigate and describe the changes in speed and/or direction of an object when force is applied to that object. 8.3.2b
  - Exclusions: velocity (technical vocabulary)

**Transfer of energy: (STAR)**

- Investigate and describe the transfer of energy from electrical and magnetic sources to different energy forms (e.g., heat, light, sounds, and chemical). 8.3.3e
  - Examples, Observations, and Phenomena: Energy cannot be created or destroyed
- Describe components of the electromagnetic spectrum.
  - Examples, Observations, and Phenomena: Visible light is a narrow range of wavelengths in the electromagnetic spectrum.

**Life Science****Structure and function in living systems: (STAR)**

- Investigate and describe the human body systems (urinary {kidneys, bladder}) and how they interact. 8.4.1e
- Investigate and describe the specialized function performed by specialized cells (e.g., muscular and skeletal) in multicellular organisms. 8.4.1d
  - Exclusion: drawings of parts of cells (cellular organelles)

**Reproduction and heredity: (STAR)**

- Describe the effects of inherited traits and environmental influences on an organism's characteristics. 8.4.2d
  - Exclusion: Mendelian genetics (e.g., dominant, recessive, punnet squares)
  - Exclusion: Details of reproduction and development (e.g., gamete, zygote, alternation of generations)

**Regulation and behavior: (STAR)**

- Investigate and explain how environmental adaptation affects the behavior of organisms. 8.4.3d

**Populations and ecosystems: (STAR)**

- Investigate and explain how energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and that energy then passes from organism to organism in food webs. 8.4.4d
  - Exclusion: Although the statements describe the general process of photosynthesis and cellular respiration, these terms are not included, nor is the word chlorophyll

**Diversity and adaptation of organisms: (STAR)**

- Explain how internal structures, similarity of chemical processes, (e.g., photosynthesis and respiration) and evidence of common ancestry demonstrate unity among organisms. 8.4.5a
  - Exclusion: Although the statements describe the general process of photosynthesis and cellular respiration, these terms are not included, nor is the word chlorophyll

**Earth and Space Science****Structure of the earth system: (STAR)**

- Investigate and describe how a combination of constructive and destructive forces create land forms. 8.5.1b
- Investigate and describe the influence of topography, location, and oceans on climate. 8.5.1f

**Earth in the solar system: (STAR)**

- Investigate and describe the motion of objects in the solar system that support the concepts of day, year, eclipses, and phases of the moon. 8.5.3b
  - Examples, Observations, and Phenomena: Most objects in the solar system are in regular and predictable motion.
  - Examples, Observations, and Phenomena: Predictable motions explain such phenomena as the day, phases of the moon, and eclipses.
  - Exclusion: Use of mathematical formulation of Kepler's laws or the equations for elliptical orbits or parabolic trajectories
  - Exclusion: Technical terms nonessential for conceptual understanding, such as apogee and perigee
- Investigate and describe the effect of the tilt of the earth's axis on seasons. 8.5.3e
  - Exclusion: Precession of the equinoxes and the Coriolis Effect
- Gravity alone holds us to the earth's surface and explains the phenomena of the tides.

**Earth's history: (STAR)**

- Investigate and use the fossil record to provide evidence and explain how environmental conditions have changed. 8.5.2b
  - Clarification: Students are better able to grasp large spans of time
  - Clarification: Evidence (e.g., fossils, rock sequences that enable scientists to "read" Earth history
  - Examples, Observations, and Phenomena: Layers of sedimentary rock confirm the long history of the earth and its changing life forms.
  - Exclusion: Names of extinct animals identified by third fossils, except for the most common such as trilobites and better known dinosaurs
  - Exclusion: Names of geologic eras, periods, and epochs
  - Exclusion: Names of the processes (focus should be on the processes themselves). For examples students should be expected to understand and apply but not name "Law of Superposition"
  - Exclusion: Names of physical mechanisms that caused past environmental changes

**Science and Technology****Understanding of science and technology:**

- Recognize that solutions have intended and unintended consequences. 8.6.2d

**Understanding of technological design:**

- Identify problems for technological design. 8.6.1a
- Design a solution or product. 8.6.1b
- Implement a proposed design. 8.6.2c
- Evaluate completed technological designs or products. 8.6.2d
- Communicate the process of technological design. 8.6.2e

**Science in Personal and Social Perspectives****Personal health:**

- Identify and research substances harmful to human beings in the natural environment (e.g., radon, lead, and nitrates). 8.7.1a

**Populations, resources, and environments:**

- Investigate and understand that the causes of environmental degradation and resource depletion vary locally and globally. 8.7.2b

**Environmental changes:**

- Distinguish between the consequences of natural environmental changes and human influenced environmental changes. 4.7.3a

**Science and technology in society:**

- Explain that the effect of science on society is neither entirely beneficial nor entirely detrimental. 8.7.5a

**Natural hazards:**

- Investigate and describe the effect of natural hazards on the environment (e.g., earthquakes, landslides, wildfires, floods, and storms). 8.7.3a

**Risks and benefits:**

- Describe how perceptions of risks and benefits influence personal and social decision (e.g., seat belt usage and waste disposal procedures). 8.7.4b

**History and Nature of Science****Science as a human endeavor:**

- Investigate and understand that science require different abilities, based on the type of inquiry and relies upon basic human qualities and scientific habits of mind. 8.8.1b

**Nature of Science:**

- Understand that scientific theories are based on observations, governed by rules of reasoning, and used to predict events. 8.8.2d

**History of science:**

- Research and describe the difficulties experience by scientific innovators who had to overcome commonly held beliefs of their times to reach conclusions that we now take for granted. 8.8.3a

**NINTH GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Predict and evaluate how change within a system affects that system. 12.1.1a

**Evidence, models, and explanation:**

- Understand that a correlation between two variables doesn't mean that either one causes the other. 12.1.2f
- Create a physical, mental, or mathematical model to show how objects and processes are connected. 12.1.2a
- Understand the way data are displayed affects interpretation. 12.1.2c

**Constancy, change, and measurement:**

- Use powers of ten to represent large and small numbers. 12.1.3a
- Compare data for two groups by using averages and ranges of values. 12.1.3b
- Understand that measurement errors may have effects on calculations. 12.1.3c
- Describe rate of change by comparing one measured quantity to another measured quantity. 12.1.3d

**Form and function:**

- Explain function by referring to form and explain form by referring to function. 12.1.4a

**Evolution and equilibrium:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Science as Inquiry****Abilities necessary to do scientific inquiry:**

- Formulate a testable hypothesis and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment.
- Design and conduct a scientific experiment in which they use evidence, apply logic, and construct an argument for their proposed explanation.
- Formulate physical, conceptual, and mathematical models.

**Physical Science****Structure of atoms:**

- Investigate and describe the structure of atoms, focusing on properties of subatomic particles. 12.3.1a
- Investigate and explain the types of nuclear reactions. 12.3.1b
- Investigate and describe the effect of electrical and nuclear forces which hold atoms together. 12.3.1c

**Structure and properties of matter:**

- Investigate and understand that atoms interact with one another by transferring or sharing electrons. 12.3.2a
- Investigate and explain the periodic table of elements in terms of repeating patterns of physical and chemical properties. 12.3.2b
- Investigate and describe how the structure of an atom determines the chemical properties of an element. 12.3.2c
- Investigate and explain how the interactions among the molecules of a compound determine its physical and chemical properties. 12.3.2d
- Investigate and use changes in energy to explain the differences among the state of matter. 12.3.2e

**Chemical reactions:**

- Investigate and describe common chemical reactions. 12.3.3a
- Investigate and describe the change of energy as a result of chemical reactions. 12.3.3b

**Motions and forces:**

- Investigate and understand the effect of forces on motion of objects. 12.3.4a
- Investigate and understand gravity as an attractive force that each mass exerts on any other mass. 12.3.4b
- Investigate and understand electrical force as a force that exists between any two charged objects. 12.3.4c
- Investigate and describe an electric field, a magnetic field, and the interaction between them. 12.3.4d

**Conservation of energy and increase in disorder:**

- Understand that the total energy in the universe is constant and can never be destroyed. 12.3.5a
- Investigate and distinguish between kinetic energy and potential energy. 12.3.5.b
- Investigate and describe heat transfer in terms of conduction, convection, and radiation. 12.3.5c
- Investigate and give examples of how systems tend to become more disorderly over time. 12.3.5d

**Interactions of energy and matter:**

- Investigate and understand that all waves possess and transfer energy. 12.3.6a
- Understand that electromagnetic waves result when a charged object accelerates. 12.3.6b
- Investigate and illustrate how wavelength and frequency of waves are inversely related. 12.3.6c
- Investigate and understand that the energy of waves can be changed into other forms of energy, just as other forms of energy can be transformed into wave energy. 12.3.6d
- Investigate and understand that atoms or molecules can be identified by spectral analysis. 12.3.6e
- Investigate and describe how the composition and temperature of a material affect electron flow. 12.3.6f

**Life Science****The cell:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Molecular basis of heredity:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Biological evolution:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Interdependence of organisms:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Matter, energy, and organization in living systems:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Behavior of organisms:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Earth and Space Science****Energy in the earth's system:**

- Distinguish between internal sources of energy, (e.g., radioactive decay and gravitational energy) and external sources of energy (e.g., the sun) and explaining how both provide energy to the earth systems. 12.5.1a
- Investigate and explain how the outward transfer of earth's internal heat drives convection in the mantle that propels the plates comprising the earth's surface. 12.5.1b
- Investigate and explain how global climate is determined by energy transfer from the sun and is influenced by dynamic processes (e.g., cloud formation and the earth's rotation) and static conditions (e.g., the position of mountain ranges and oceans). 12.5.1c

**Geochemical cycles:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Origin and evolution of the earth system:**

- Compare and contrast time change intervals in geological history. 12.5.3
- Predict when rocks were formed by using known decay rates of radioactive isotopes in rocks. 12.5.3c
  - Exclusion: Detailed mechanism of radioactive decay (emphasis should instead be on its use to solve geologic puzzles)

**Origin and evolution of the universe:**

- Describe and analyze various theories on the origin of the universe. 12.5.4a
  - Exclusion: Details of the "big bang" such as "inflation"
- Describe various theories on the formation of galaxies. 12.5.4b
- Describe the life cycle of a star. 12.5.4c
- Understand the speed at which light travels. 12.5.4

**Science and Technology****Understanding of science and technology:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Abilities of technological Design:**

- Identify problems or needs to change and improve current technology as needed.
- Use models and simulations in planning solutions.
- Use computer software and manipulation skills to implement solutions.
- Re-evaluate solutions for continued study.
- Use models, diagrams, and demonstrations to present their results.

**Science in Personal and Social Perspectives****Personal and community health:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Natural resources:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Environmental quality:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Population growth:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Science and technology in local, national, and global challenges:**

- Understand that science and technology are essential social enterprises that indicate what could happen, but not what should happen. 12.7.6c

**Natural and human-induced hazards:**

- Investigate and describe the effect of natural hazards on the environment (e.g., earthquakes, landslides, wildfires, floods, and storms). 873a

**History and Nature of Science****Science as a human endeavor:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Nature of scientific knowledge:**

CONCEPT IS TAUGHT IN TENTH GRADE.

**Historical perspectives:**

CONCEPT IS TAUGHT IN TENTH GRADE.

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**TENTH GRADE****Unifying Concepts and Processes in Science****Systems, order, and organization:**

- Design solutions to problems identified within a system. 12.1.1b

**Evidence, models, and explanation:**

- Test the usefulness of a model by comparing its predictions to actual observations. 12.1.2b
- Understand that larger well-chosen samples produce more accurate estimate of the characteristics of the total population. 12.1.2e
- Evaluate the reasonableness of answers to problems. 12.1.2d

**Constancy, change, and measurement:**

- Investigate and describe how different characteristics, properties, or relationships within a system change as their dimensions increase or decrease. 12.1.3e
- Use computer spreadsheets, graphs, and databases to assist in quantitative analysis. 12.1.3

**Evolution and equilibrium:**

- Identify the series of changes that occur in objects, organism, and natural and human designed systems. 12.1.5a
- Explain how a system at equilibrium is affected by change. 12.1.5b

**Science as Inquiry****Abilities necessary to do scientific inquiry:**

1. Engage in Scientifically Oriented Questions
  - a. Questioning
  - b. Predicting
  - c. Forming Hypotheses
2. Respond to Questions using Evidence
  - a. Identifying Variables
  - b. Designing Experiments
    - Understand that larger well-chosen samples produce more accurate estimates of the characteristics of the total population. (12.1.2)
  - a. Making Qualitative and Quantitative Observations
    - Understand that measurement errors may affect results of calculations. (12.1.3)
  - b. Recording Data
3. Formulate Explanations from Evidence
  - a. Organizing Data
    - Understand that the way data are displayed affects interpretation. (12.1.2)
      - 1) Graphs
      - 2) Tables
      - 3) Calculations
        - Uses of powers of ten to represent large and small numbers. (12.1.3)
      - 4) Schematics
  - a. Manipulating Data
  - b. Interpreting Evidence
    - Evaluate the reasonableness of answers to problems. (12.1.2)
    - Understand that a correlation between two variables does not mean that either one causes the other. (12.1.2)

- Compare data for two groups by using averages and ranges of values. (12.1.3)
- Describe rate of change by comparing one measured quantity to another measured quantity. (12.1.3)
- Investigate and describe how different characteristics, properties, or relationships within a system change as their dimensions increase or decrease. (12.1.3)
- c. Creating Models
  - Create a physical, mental, or mathematical model to show how objects and processes are connected (12.1.2)
- 4. Connect Explanations to Scientific Knowledge
  - a. Inferring
  - b. Connecting to Existing Models
    - Test the usefulness of the model by comparing its predictions to actual observations. (12.1.2)
  - c. Defending Findings
    - Evaluate the reasonableness of answers to problems. (12.1.2)
- 5. Communicate and Justify Explanations
  - a. Communicating Explanations
  - b. Defending Explanations
  - c. Publishing
  - d. Determining Applications
  - e. Asking Further Questions

### **Physical Science**

#### **Structure of atoms:**

CONCEPT IS TAUGHT IN NINTH GRADE.

#### **Structure and properties of matter:**

- Understand that carbon atoms can bond together in chains, rings, and other structures producing large molecules essential to life. 12.3.2

#### **Chemical reactions:**

- Investigate and describe how electrons are involved in BOD formation during chemical reactions. 12.3.3c
- Investigate and describe the factors influencing the rates of chemical reactions, including catalysts. 12.3.3d
- Understand that radical (polyatomic ion) reactions control many environmentally important processes (ozone, greenhouse effect, and fossil fuel use). 12.3.3

#### **Motions and forces:**

CONCEPT IS TAUGHT IN NINTH GRADE.

#### **Conservation of energy and increase in disorder:**

CONCEPT IS TAUGHT IN NINTH GRADE.

#### **Interactions of energy and matter:**

CONCEPT IS TAUGHT IN NINTH GRADE.

**Life Science****The cell:**

- Investigate and describe the form and function of subcellular structures that regulate cell activities. 12.4.1a
- Investigate and describe cell functions (e.g., photosynthesis, respiration, cell division). 12.4.1b
  - Exclusion: Calvin cycle, Krebs cycle, glycolysis, or intermediate products in respiration and photosynthesis
- Investigate and understand that complex multi cellular organisms are formed as highly organized arrangements of differentiated cells. 12.4.1c

**Molecular basis of heredity:**

- Investigate and describe how DNA carries the genetic code. 12.4.2a
- Investigate and understand that genetic variation occurs when genetic information is transmitted during sexual reproduction. 12.4.2b
- Investigate and explain how some mutations could help, harm or have no effect on individual organisms. 12.4.2c
- Investigate and explain how mutations in sex cells but not in body cells, could be passed on to offspring. 12.4.2d

**Biological evolution:**

- Understand that the concept of biological evolution is a theory which explains the consequence of the interactions of: (1) the potential for a species to increase its numbers; (2) the genetic variability of offspring due to mutation and recombination of genes; (3) a finite supply of the resources of life; and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring. 12.4.3a
- Investigate and use the theory of biological evolution to explain diversity of life. 12.4.3b
- Investigate whether natural selection provides a scientific explanation of the fossil record and the molecular similarities among the diverse species of living organisms. 12.4.3c
- Investigate and use biological classifications based on similarities. 12.4.3d

**Interdependence of organisms:**

- Investigate and understand that atoms and molecules cycle among living and nonliving components of the biosphere. 12.4.4a
- Investigate and describe the flow of energy through ecosystems, in one direction, from producers to herbivores to carnivores and decomposers. 12.4.4b
- Investigate and cite examples of organisms cooperating and competing in ecosystems. 12.4.4c
- Investigate and understand that interactions among organisms are affected by the conflict between an organism's capacity to produce infinite populations and the finite amount of resources. 12.4.4d
- Investigate and describe how humans modify the ecosystem as a result of population growth, technology, and consumption. 12.4.4e

**Matter, energy, and organization in living systems:**

- Investigate and understand that living systems require a constant input of energy to maintain their chemical and physical organization. 12.4.5a
- Investigate and understand that producers use solar energy to combine molecules of carbon dioxide and water into organic compounds. 12.4.5b
- Distribution and abundance of organisms in ecosystems are limited by the availability of matter and energy and the ability of the ecosystem to recycle materials. 12.4.5c
- Understand the cyclic fluctuations of ecosystems to maintain equilibrium. 12.4.5

**Behavior of organisms:**

- Investigate and describe how nervous systems function in multicellular animals. 12.4.6a
- Investigate and describe how organisms respond to internal changes and external stimuli. 12.4.6b
- Investigate and explain how the behavioral patterns of organisms have evolved through natural selection. 12.4.6c
- Investigate and understand that behavioral biology relates to humans since it provides links to psychology, sociology, and anthropology. 12.4.6d

**Earth and Space Science****Energy in the earth's system:**

CONCEPT IS TAUGHT IN NINTH GRADE.

**Geochemical cycles:**

- Investigate and diagram how elements and compounds on earth move among reservoirs in the solid earth, oceans, atmosphere, and organisms as part of geochemical cycles. 12.5.2a

**Origin and evolution of the earth system:**

- Contrast the early earth with the planet we live on today. 12.5.3a
- Investigate and estimate geologic time by observing rock sequences and using fossils to correlate the sequences at various location. 12.5.3b
- Investigate and relate how the interactions among the solid earth, oceans, atmosphere, and organisms affect the ongoing evolution of the earth. 12.5.3d

**Origin and evolution of the universe:**

CONCEPT IS TAUGHT IN NINTH GRADE.

**Science and Technology****Understanding of science and technology:**

- Propose design and choose between alternative solutions of a problem. 12.6.1a
- Implement the selected solution. 12.6.1b
- Evaluate the solution and its consequences. 12.6.1c
- Communicate the problem, process, and solution. 12.6.1d

**Science in Personal and Social Perspectives****Personal and community health:**

- Investigate and explain how diseases are prevented, controlled, and cured. 12.7.1b
- Investigate and explain how genetic traits affect a person's health. 12.7.1c

**Natural resources:**

- Investigate and explain how human population use environmental resources to maintain and improve their existence. 12.7.3a
- Investigate and understand that the earth has renewable and finite resources. 12.7.3b
- Investigate and understand the limitations of natural systems to renew and recycle resources. 12.7.3c

**Environmental quality:**

- Investigate and describe how human activities impact natural ecosystems. 12.7.5
- Investigate and explain factors which may influence environmental quality. 12. 7.5b

**Population growth:**

- Investigate and explain how various factors influence birth rates and fertility rates. 12.7.2b
- Investigate and predict how population change may impacts resource use and environments. 12.7.2c
- Investigate and identify causes of population growth or decline. 12.7.2a

**Science and technology in local, national, and global challenges:**

- Understand that knowledge of basic concepts about scientific and technological challenges should precede active debate. 12.7.6a
- Investigate and understand that social issues and challenges may affect advancements in science and technology. 12.7.6b

**Natural and human-induced hazards:**

- Investigate and describe how human activities increase or reduce the potential for hazards. 12.7.5a
- Investigate and distinguish between slowly and rapidly occurring natural hazards and their impact on the environment. 12.7.5b
- Assess the potential danger and risks to all hazards to humans. 12.7.5

**History and Nature of Science****Science as a human endeavor:**

- Demonstrate ethical scientific practices (e.g., informing research subjects about risks and benefits, humane treatment of animals, truthful reporting, public disclosure of work, and peer review). 12.8.1a
- Examine and understand the societal, cultural, and personal beliefs that influence scientists. 12.8.1b
- Recognize science as one way of answering questions and explaining the natural world. 12.8.1c

**Nature of scientific knowledge:**

- Demonstrate the use of empirical standards, logical arguments, and skepticism in science. 12.8.2a
- Create scientific explanations consistent with experimental and observational evidence; make accurate predictions; strive to be logical; respect the rules of evidence; accepts criticism; report methods and procedures; and make knowledge public. 12.8.2b
- Understand that all scientific knowledge is, in principle, subject to change as new evidence becomes available. 12.8.2c

**Historical perspectives:**

- Investigate and describe the contributions of diverse cultures to scientific knowledge and technological inventions. 12.8.3a
- Understand that changes in scientific knowledge evolve over time and almost always build on earlier knowledge. 12.8.3b
- Understand that some advancements in science and technology have long-lasting effects on society. 12.8.3c

**Article I.      THEME APPENDIX****SYSTEMS, ORDER, AND ORGANIZATION**

***Systems***—A system is an organized group of related objects or components that form a whole. Systems can consist, for example, of organisms, machines, fundamental particles, galaxies, ideas, numbers, transportation, and education. The goal of this standard is to think and analyze in terms of systems, so that students keep track of mass, energy, objects, organisms, and event.

***Order***—Order is the behavior of units of matter, objects, organisms or events which can be described statistically. The goal of this standard is to think in terms of probability, certainty or uncertainty.

***Organization***—Organization provides useful ways of thinking about the world. The goal of this standard is to describe physical and living systems at different levels of organization.

**EVIDENCE, MODELS, AND EXPLANATIONS**

***Evidence***—Evidence consists of observations and data on which to base scientific explanations. The goal of this standard is to be able to use evidence to understand interactions and predict changes.

***Models***—Models are tentative schemes or structures that correspond to real objects, events, or classes of events, and that have explanatory power. The goal of this standard is to be able to make and use many models, including physical objects, plans, mental constructs, mathematical equations, and computer simulations.

***Explanations***—Explanations incorporate existing scientific knowledge and new evidence from observations, experiments, or models into internally consistent, logical statements such as hypotheses, laws, principles, and theories. The goal of this standard is create explanations which incorporate a scientific knowledge base, logic, and higher levels of analysis.

**CONSTANCY, CHANGE, AND MEASUREMENT**

***Constancy***—Constancy characterizes some objects and properties in nature. The goal of this standard is to recognize those conditions, states, or positions that cannot change or be changed.

***Change***—Changes in systems vary in rate, scale, and pattern, including trends and cycles. The goal of this standard is to identify and measure changes in properties of materials, positions of object, motion, and form and function of systems.

***Measurement***—Measurement makes quantitative distinctions between objects, events, or systems. The goal of this standard is to achieve competency in using tools of measurement and measurement systems and to achieve understandings of scales, and rates.

**EVOLUTION AND EQUILIBRIUM**

***Evolution***—Evolution is a series of changes, some gradual and some sporadic, that account for the present form and function of objects, organisms, and natural and designed systems. The goal of this standard is to recognize that the present arises from materials and forms of the past.

***Equilibrium***—Equilibrium is the physical state in which forces and changes occur in opposite and off-setting directions. The goal of this standard is to recognize systems that are in equilibrium.

**FORM AND FUNCTION**

***Form***—Form or shape of an object is frequently related to its use. The goal of this standard is to be able to describe and compare things in terms of number, shape, texture, size, weight, color, motion, and other characteristics.

***Function***—An object's use frequently relies on its characteristics. The goal of this standard is to be able to describe and explain how objects are used.

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