

## Grade 8 Science and Technology

**A. Unifying Themes: Students apply the principles of *systems*, *models*, constancy and change, and scale in science and technology**

### A1 Systems

**Students describe and apply principles of *systems* in man-made things, natural things, and processes.**

- a. Explain how individual parts working together in a *system* (including organisms, Earth systems, solar systems, or man-made structures) can do more than each part individually.
- b. Explain how the output of one part of a *system*, including waste products from manufacturing or organisms, can become the input of another part of a *system*.
- c. Describe how *systems* are nested and that *systems* may be thought of as containing subsystems (as well as being a subsystem of a larger *system*) and apply the understanding to analyze *systems*.

### A2 Models

**Students use *models* to examine a variety of real-world phenomena from the physical setting, the living environment, and the technological world and compare advantages and disadvantages of various *models*.**

- a. Compare different types of *models* that can be used to represent the same thing (including *models* of chemical reactions, motion, or cells) in order to match the purpose and complexity of a model to its use.
- b. Propose changes to *models* and explain how those changes may better reflect the real thing.

### A3 Constancy and Change

**Students describe how patterns of change vary in physical, biological, and technological *systems*.**

- a. Describe *systems* that are changing including ecosystems, Earth *systems*, and technologies.
- b. Give examples of *systems* including ecosystems, Earth systems, and technologies that appear to be unchanging (even though things may be changing within the *system*) and identify any feedback mechanisms that may be modifying the changes.
- c. Describe rates of change and cyclic patterns using appropriate grade-level mathematics.

#### A4 Scale

Students use scale to describe objects, phenomena, or processes related to Earth, space, matter, and mechanical and living *systems*.

- a. Describe how some things change or work differently at different scales.
- b. Use proportions, averages, and ranges to describe small and large extremes of scale.

**B. The Skills and Traits of Scientific Inquiry and *Technological Design*: Students plan, conduct, analyze data from and communicate results of in-depth scientific investigations; and they use a systematic process, tools, equipment, and a variety of materials to create a *technological design* and produce a solution or product to meet a specified need.**

#### B1 Skills and Traits of Scientific Inquiry

Students plan, conduct, analyze data from, and communicate results of investigations, including simple experiments.

- a. Identify questions that can be answered through scientific investigations.
- b. Design and safely conduct scientific investigations including experiments with controlled variables.
- c. Use appropriate tools, metric units, and techniques to gather, analyze, and interpret data.
- d. Use mathematics to gather, organize, and present data and structure convincing explanations.
- e. Use logic, critical reasoning and evidence to develop descriptions, explanations, predictions, and *models*.
- f. Communicate, critique, and analyze their own scientific work and the work of other students.

#### B2 Skills and Traits of *Technological Design*

Students use a systematic process, tools, equipment, and a variety of materials to design and produce a solution or product to meet a specified need, using established criteria.

- a. Identify appropriate problems for *technological design*.
- b. Design a solution or product.
- c. Communicate a proposed design using drawings and simple *models*.
- d. Implement a proposed design.
- e. Evaluate a completed design or product.
- f. Suggest improvements for their own and others' designs and try out proposed modifications.

- g. Explain the design process including the stages of problem identification, solution design, implementation, and evaluation.
- h. Present the design problem, process, and design or solution using oral, written, and/or pictorial means of communication.

**C. The Scientific and Technological Enterprise: Students understand the history and nature of scientific knowledge and technology, the processes of inquiry and *technological design*, and the impacts science and technology have on society and the environment.**

### **C1 Understandings of Inquiry**

**Students describe how scientists use varied and systematic approaches to investigations that may lead to further investigations.**

- a. Explain how the type of question informs the type of investigation.
- b. Explain why it is important to identify and control variables and replicate trials in experiments.
- c. Describe how scientists' analyses of findings can lead to new investigations.

### **C2 Understandings About Science and Technology**

**Students understand and compare the similarities and differences between scientific inquiry and *technological design*.**

- a. Compare the process of scientific inquiry to the process of *technological design*.
- b. Explain how constraints and consequences impact scientific inquiry and *technological design*.

### **C3 Science, Technology, and Society**

**Students identify and describe the role of science and technology in addressing personal and societal challenges.**

- a. Describe how science and technology can help address societal challenges including population, natural hazards, sustainability, personal health and safety, and environmental quality.
- b. Identify personal choices that can either positively or negatively impact society including population, ecosystem sustainability, personal health, and environmental quality.
- c. Identify factors that influence the development and use of science and technology.

## **C4 History and Nature of Science**

**Students describe historical examples that illustrate how science advances knowledge through the scientists involved and through the ways scientists think about their work and the work of others.**

- a. Describe how women and men of various backgrounds, working in teams or alone and communicating about their ideas extensively with others, engage in science, engineering, and related fields.
- b. Describe a breakthrough from the history of science that contributes to our current understanding of science.
- c. Describe and provide examples that illustrate that science is a human endeavor that generates explanations based on verifiable evidence that are subject to change when new evidence does not match existing explanations.

**D. The Physical Setting: Students understand the universal nature of matter, energy, force, and motion and identify how these relationships are exhibited in Earth Systems, in the solar system, and throughout the universe.**

## **D1 Universe and Solar System**

**Students explain the movements and describe the location, composition, and characteristics of our solar system and universe, including planets, the sun, and galaxies.**

- a. Describe the different kinds of objects in the solar system including planets, sun, moons, asteroids, and comets.
- b. Explain the motions that cause days, years, phases of the moon, and eclipses.
- c. Describe the location of our solar system in its galaxy and explain that other galaxies exist and that they include stars and planets.

## **D2 Earth**

**Students describe the various cycles, physical and biological forces and processes, position in space, energy transformations, and human actions that affect the short-term and long-term changes to the Earth.**

- a. Explain how the tilt of Earth's rotational axis relative to the plane of its yearly orbit around the sun affects the day length and sunlight intensity to cause seasons.
- b. Describe Earth Systems - biosphere, atmosphere, hydrosphere and lithosphere - and cycles and interactions within them (including water moving among and between them, rocks forming and transforming, and weather formation).
- c. Give several reasons why the climate is different in different regions of the Earth.
- d. Describe significant Earth resources and how their limited supply affects how they are used.
- e. Describe the effect of gravity on objects on Earth.

- f. Give examples of abrupt changes and slow changes in Earth Systems.

### **D3 Matter and Energy**

**Students describe physical and chemical properties of matter, interactions and changes in matter, and transfer of energy through matter.**

- a. Describe that all matter is made up of atoms and distinguish between/among elements, atoms, and molecules.
- b. Describe how physical characteristics of elements and types of reactions they undergo have been used to create the Periodic Table.
- c. Describe the difference between physical and chemical change.
- d. Explain the relationship of the motion of atoms and molecules to the states of matter for gases, liquids, and solids.
- e. Explain how atoms are packed together in arrangements that compose all substances including elements, compounds, mixtures, and solutions.
- f. Explain and apply the understanding that substances have characteristic properties, including density, boiling point, and solubility and these properties are not dependent on the amount of matter present.
- g. Use the idea of atoms to explain the conservation of matter.
- h. Describe several different types of energy forms including heat energy, chemical energy, and mechanical energy.
- i. Use examples of energy transformations from one form to another to explain that energy cannot be created or destroyed.
- j. Describe how *heat* is transferred from one object to another by conduction, convection, and/or radiation.
- k. Describe the properties of solar radiation and its interaction with objects on Earth.

### **D4 Force and Motion**

**Students describe the force of gravity, the motion of objects, the properties of waves, and the wavelike property of energy in light waves.**

- a. Describe the similarities and differences in the motion of sound vibrations, earthquakes, and light waves.
- b. Explain the relationship among visible light, the electromagnetic spectrum, and sight.
- c. Describe and apply an understanding of how the gravitational force between any two objects would change if their mass or the distance between them changed.
- d. Describe and apply an understanding of how electric currents and magnets can exert force on each other.
- e. Describe and apply an understanding of the effects of multiple forces on an object, and how unbalanced forces will cause changes in the speed or direction.

**E. The Living Environment: Students understand that cells are the basic unit of life, that all life as we know it has evolved through genetic transfer and natural selection to create a great diversity of organisms, and that these organisms**

**create interdependent webs through which matter and energy flow. Students understand similarities and differences between humans and other organisms and the interconnections of these interdependent webs.**

### **E1 Biodiversity**

**Students differentiate among organisms based on biological characteristics and identify patterns of similarity.**

- a. Compare physical characteristics that differentiate organisms into groups (including plants that use sunlight to make their own food, animals that consume energy-rich food, and organisms that cannot easily be classified as either).
- b. Explain how biologists use internal and external anatomical features to determine relatedness among organisms and to form the basis for classification *systems*.
- c. Explain ways to determine whether organisms are the same species.
- d. Describe how external and internal structures of animals and plants contribute to the variety of ways organisms are able to find food and reproduce.

### **E2 Ecosystems**

**Students differentiate among organisms based on biological characteristics and identify patterns of similarity.**

- e. Compare physical characteristics that differentiate organisms into groups (including plants that use sunlight to make their own food, animals that consume energy-rich food, and organisms that cannot easily be classified as either).
- f. Explain how biologists use internal and external anatomical features to determine relatedness among organisms and to form the basis for classification *systems*.
- g. Explain ways to determine whether organisms are the same species.
- h. Describe how external and internal structures of animals and plants contribute to the variety of ways organisms are able to find food and reproduce.
- i.

### **E3 Cells**

**Students describe the hierarchy of organization and function in organisms, and the similarities and differences in structure, function, and needs among and within organisms.**

- a. Describe the basic functions of organisms carried out within cells including the extracting of energy from food and the elimination of wastes.
- b. Explain the relationship among cells, tissues, organs, and organ *systems*, including how tissues and organs serve the needs of cells and organisms.
- c. Compare the structures, *systems*, and interactions that allow single-celled organisms and multi-celled plants and animals, including humans, to defend themselves, acquire and use energy, self-regulate, reproduce, and coordinate movement.

- d. Explain that all living things are composed of cells numbering from just one to millions.

#### **E4 Heredity and Reproduction**

**Students describe the general characteristics and mechanisms of reproduction and heredity in organisms, including humans, and ways in which organisms are affected by their genetic traits.**

- a. Explain that sexual reproduction includes fertilization that results in the inclusion of genetic information from each parent and determines the inherited traits that are a part of every cell.
- b. Identify some of the risks to the healthy development of an embryo including mother's diet, lifestyle, and hygiene.
- c. Describe asexual reproduction as a process by which all genetic information comes from one parent and determines the inherited traits that are a part of every cell.

#### **E5 Evolution**

**Students describe the evidence that evolution occurs over many generations, allowing species to acquire many of their unique characteristics or adaptations.**

- a. Explain how the layers of sedimentary rock and their contained fossils provide evidence for the long history of Earth and for the long history of changing life.
- b. Describe how small differences between parents and offspring can lead to descendants who are very different from their ancestors.
- c. Describe how variations in the behavior and traits of an offspring may permit some of them to survive a changing environment.
- d. Explain that new varieties of cultivated plants and domestic animals can be developed through genetic modification and describe the impacts of the new varieties of plants and animals.