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# Grade 6

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## Structure and Function

The integration of Earth and space, life, and physical sciences with technology/engineering gives grade 6 students relevant and engaging opportunities with natural phenomena and design problems that highlight the relationship of structure and function in the world around them. Students relate structure and function through analyzing the macro- and microscopic world, such as Earth features and processes, the role of cells and anatomy in supporting living organisms, and properties of materials and waves. Students use models and provide evidence to make claims and explanations about structure-function relationships in different STE domains.

## Grade 6: Earth and Space Sciences

### ESS1. Earth's Place in the Universe

6.MS-ESS1-1a. Develop and use a model of the Earth-Sun-Moon system to explain the causes of lunar phases and eclipses of the Sun and Moon.

Clarification Statement:

- Examples of models can be physical, graphical, or conceptual and should emphasize relative positions and distances.

6.MS-ESS1-4. Analyze and interpret rock layers and index fossils to determine the relative ages of rock formations that result from processes occurring over long periods of time.

Clarification Statements:

- Analysis includes laws of superposition and crosscutting relationships limited to minor displacement faults that offset layers.
- Processes that occur over long periods of time include changes in rock types through weathering, erosion, heat, and pressure.

State Assessment Boundary:

- Strata sequences that have been reordered or overturned, names of specific periods or epochs and events within them, or the identification and naming of minerals or rock types are not expected in state assessment.

6.MS-ESS1-5(MA). Use graphical displays to illustrate that Earth and its solar system are one of many in the Milky Way galaxy, which is one of billions of galaxies in the universe.

Clarification Statement:

- Graphical displays can include maps, charts, graphs, and data tables.

[MS-ESS1-1b and MS-ESS1-2 are found in grade 8. MS-ESS1-3 from NGSS is not included.]

### ESS2. Earth's Systems

6.MS-ESS2-3. Analyze and interpret maps showing the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence that Earth's plates have moved great distances, collided, and spread apart.

Clarification Statement:

- Maps may show similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches), similar to Wegener's visuals.

State Assessment Boundary:

- Mechanisms for plate motion or paleomagnetic anomalies in oceanic and continental crust are not expected in state assessment.

[MS-ESS2-2 and MS-ESS2-4 are found in grade 7. MS-ESS2-1, MS-ESS2-5, and MS-ESS2-6 are found in grade 8.]

## Grade 6: Life Science

### LS1. From Molecules to Organisms: Structures and Processes

6.MS-LS1-1. Provide evidence that all organisms (unicellular and multicellular) are made of cells.

Clarification Statement:

- Evidence can be drawn from multiple types of organisms, such as plants, animals, and bacteria.

6.MS-LS1-2. Develop and use a model to describe how parts of cells contribute to the cellular functions of obtaining food, water, and other nutrients from its environment, disposing of wastes, and providing energy for cellular processes.

Clarification Statement:

- Parts of plant and animal cells include (a) the nucleus, which contains a cell's genetic material and regulates its activities; (b) chloroplasts, which produce necessary food (sugar) and oxygen through photosynthesis (in plants); (c) mitochondria, which release energy from food through cellular respiration; (d) vacuoles, which store materials, including water, nutrients, and waste; (e) the cell membrane, which is a selective barrier that enables nutrients to enter the cell and wastes to be expelled; and (f) the cell wall, which provides structural support (in plants).

State Assessment Boundary:

- Specific biochemical steps or chemical processes, the role of ATP, active transport processes involving the cell membrane, or identifying or comparing different types of cells are not expected in state assessment.

6.MS-LS1-3. Construct an argument supported by evidence that the body systems interact to carry out essential functions of life.

Clarification Statements:

- Emphasis is on the functions and interactions of the body systems, not specific body parts or organs.
- An argument should convey that different types of cells can join together to form specialized tissues, which in turn may form organs that work together as body systems.
- Body systems to be included are the circulatory, digestive, respiratory, excretory, muscular/skeletal, and nervous systems.
- Essential functions of life include obtaining food and other nutrients (water, oxygen, minerals), releasing energy from food, removing wastes, responding to stimuli, maintaining internal conditions, and growing/developing.
- An example of interacting systems could include the respiratory system taking in oxygen from the environment which the circulatory system delivers to cells for cellular respiration, or the digestive system taking in nutrients which the circulatory system transports to cells around the body.

State Assessment Boundaries:

- The mechanism of one body system independent of others or the biochemical processes involved in body systems are not expected in state assessment.
- Describing the function or comparing different types of cells, tissues, or organs are not expected in state assessment.

[MS-LS1-4 is found in grade 7. MS-LS1-5 and MS-LS1-7 are found in grade 8. MS-LS1-6 and MS-LS1-8 from NGSS are not included.]

#### **LS4. Biological Evolution: Unity and Diversity**

6.MS-LS4-1. Analyze and interpret evidence from the fossil record to describe organisms and their environment, extinctions, and changes to life forms throughout the history of Earth.

Clarification Statement:

- Examples of evidence include sets of fossils that indicate a specific type of environment, anatomical structures that indicate the function of an organism in the environment, and fossilized tracks that indicate behavior of organisms.

State Assessment Boundary:

- Names of individual species, geological eras in the fossil record, or mechanisms for extinction or speciation are not expected in state assessment.

6.MS-LS4-2. Construct an argument using anatomical structures to support evolutionary relationships among and between fossil organisms and modern organisms.

Clarification Statement:

- Evolutionary relationships include (a) some organisms have similar traits with similar functions because they were inherited from a common ancestor, (b) some organisms have similar traits that serve similar functions because they live in similar environments, and (c) some organisms have traits inherited from common ancestors that no longer serve their original function because their environments are different than their ancestors' environments.

[MS-LS4-4 and MS-LS4-5 are found in grade 8. MS-LS4-3 and MS-LS4-6 from NGSS are not included.]

### **Grade 6: Physical Science**

#### **PS1. Matter and Its Interactions**

6.MS-PS1-6. Plan and conduct an experiment involving exothermic and endothermic chemical reactions to measure and describe the release or absorption of thermal energy.

Clarification Statements:

- Emphasis is on describing transfer of energy to and from the environment.
- Examples of chemical reactions could include dissolving ammonium chloride or calcium chloride.

6.MS-PS1-7(MA). Use a particulate model of matter to explain that density is the amount of matter (mass) in a given volume. Apply proportional reasoning to describe, calculate, and compare relative densities of different materials.

6.MS-PS1-8(MA). Conduct an experiment to show that many materials are mixtures of pure substances that can be separated by physical means into their component pure substances.

Clarification Statement:

- Examples of common mixtures include salt water, oil and vinegar, milk, and air.

[MS-PS1-1, MS-PS1-2, MS-PS1-4, and MS-PS1-5 are found in grade 8. MS-PS1-3 from NGSS is not included.]

## **PS2. Motion and Stability: Forces and Interactions**

6.MS-PS2-4. Use evidence to support the claim that gravitational forces between objects are attractive and are only noticeable when one or both of the objects have a very large mass.

Clarification Statement:

- Examples of objects with very large masses include the Sun, Earth, and other planets.

State Assessment Boundary:

- Newton's law of gravitation or Kepler's laws are not expected in state assessment.

[MS-PS2-3 and MS-PS2-5 are found in grade 7. MS-PS2-1 and MS-PS2-2 are found in grade 8.]

## **PS4. Waves and Their Applications in Technologies for Information Transfer**

6.MS-PS4-1. Use diagrams of a simple wave to explain that (a) a wave has a repeating pattern with a specific amplitude, frequency, and wavelength, and (b) the amplitude of a wave is related to the energy of the wave.

State Assessment Boundaries:

- Electromagnetic waves are not expected in state assessment.
- State assessment will be limited to standard repeating waves.

6.MS-PS4-2. Use diagrams and other models to show that both light rays and mechanical waves are reflected, absorbed, or transmitted through various materials.

Clarification Statements:

- Materials may include solids, liquids, and gases.
- Mechanical waves (including sound) need a material (medium) through which they are transmitted.
- Examples of models could include drawings, simulations, and written descriptions.

State Assessment Boundary:

- State assessment will be limited to qualitative applications.

6.MS-PS4-3. Present qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses representing 0s and 1s) can be used to encode and transmit information.

State Assessment Boundary:

- Binary counting or the specific mechanism of any given device are not expected in state assessment.

## **Grade 6: Technology/Engineering**

### **ETS1. Engineering Design**

6.MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.\*

6.MS-ETS1-5(MA). Create visual representations of solutions to a design problem. Accurately interpret and apply scale and proportion to visual representations.\*

Clarification Statements:

- Examples of visual representations can include sketches, scaled drawings, and orthographic projections.
- Examples of scale can include  $\frac{1}{4}'' = 1'0''$  and  $1 \text{ cm} = 1 \text{ m}$ .

6.MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution.

Clarification Statement:

- Examples of intended users can include students, parents, teachers, manufacturing personnel, engineers, and customers.

[MS-ETS1-2, MS-ETS1-4, and MS-ETS1-7(MA) are found in grade 7. MS-ETS1-3 from NGSS is not included.]

## **ETS2. Materials, Tools, and Manufacturing**

6.MS-ETS2-1(MA). Analyze and compare properties of metals, plastics, wood, and ceramics, including flexibility, ductility, hardness, thermal conductivity, electrical conductivity, and melting point.

6.MS-ETS2-2(MA). Given a design task, select appropriate materials based on specific properties needed in the construction of a solution.\*

Clarification Statement:

- Examples of materials can include metals, plastics, wood, and ceramics.

6.MS-ETS2-3(MA). Choose and safely use appropriate measuring tools, hand tools, fasteners, and common hand-held power tools used to construct a prototype.\*

Clarification Statements:

- Examples of measuring tools include a tape measure, a meter stick, and a ruler.
- Examples of hand tools include a hammer, a screwdriver, a wrench, and pliers.
- Examples of fasteners include nails, screws, nuts and bolts, staples, glue, and tape.
- Examples of common power tools include jigsaw, drill, and sander.

[MS-ETS2-4(MA), and MS-ETS2-5(MA) are found in grade 8.]