



# Grade Eight

## Focus on Physical Sciences

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### Motion

1. The velocity of an object is the rate of change of its position. As a basis for understanding this concept:
  - a. *Students know* position is defined in relation to some choice of a standard reference point and a set of reference directions.
  - b. *Students know* that average speed is the total distance traveled divided by the total time elapsed and that the speed of an object along the path traveled can vary.
  - c. *Students know* how to solve problems involving distance, time, and average speed.
  - d. *Students know* the velocity of an object must be described by specifying both the direction and the speed of the object.
  - e. *Students know* changes in velocity may be due to changes in speed, direction, or both.
  - f. *Students know* how to interpret graphs of position versus time and graphs of speed versus time for motion in a single direction.

### Forces

2. Unbalanced forces cause changes in velocity. As a basis for understanding this concept:
  - a. *Students know* a force has both direction and magnitude.
  - b. *Students know* when an object is subject to two or more forces at once, the result is the cumulative effect of all the forces.
  - c. *Students know* when the forces on an object are balanced, the motion of the object does not change.

- d. *Students know* how to identify separately the two or more forces that are acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.
- e. *Students know* that when the forces on an object are unbalanced, the object will change its velocity (that is, it will speed up, slow down, or change direction).
- f. *Students know* the greater the mass of an object, the more force is needed to achieve the same rate of change in motion.
- g. *Students know* the role of gravity in forming and maintaining the shapes of planets, stars, and the solar system.

### Structure of Matter

- 3. Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept:
  - a. *Students know* the structure of the atom and know it is composed of protons, neutrons, and electrons.
  - b. *Students know* that compounds are formed by combining two or more different elements and that compounds have properties that are different from their constituent elements.
  - c. *Students know* atoms and molecules form solids by building up repeating patterns, such as the crystal structure of NaCl or long-chain polymers.
  - d. *Students know* the states of matter (solid, liquid, gas) depend on molecular motion.
  - e. *Students know* that in solids the atoms are closely locked in position and can only vibrate; in liquids the atoms and molecules are more loosely connected and can collide with and move past one another; and in gases the atoms and molecules are free to move independently, colliding frequently.
  - f. *Students know* how to use the periodic table to identify elements in simple compounds.

### Earth in the Solar System (Earth Sciences)

- 4. The structure and composition of the universe can be learned from studying stars and galaxies and their evolution. As a basis for understanding this concept:
  - a. *Students know* galaxies are clusters of billions of stars and may have different shapes.

- b. *Students know* that the Sun is one of many stars in the Milky Way galaxy and that stars may differ in size, temperature, and color.
- c. *Students know* how to use astronomical units and light years as measures of distances between the Sun, stars, and Earth.
- d. *Students know* that stars are the source of light for all bright objects in outer space and that the Moon and planets shine by reflected sunlight, not by their own light.
- e. *Students know* the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

### Reactions

- 5. Chemical reactions are processes in which atoms are rearranged into different combinations of molecules. As a basis for understanding this concept:
  - a. *Students know* reactant atoms and molecules interact to form products with different chemical properties.
  - b. *Students know* the idea of atoms explains the conservation of matter: In chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.
  - c. *Students know* chemical reactions usually liberate heat or absorb heat.
  - d. *Students know* physical processes include freezing and boiling, in which a material changes form with no chemical reaction.
  - e. *Students know* how to determine whether a solution is acidic, basic, or neutral.

### Chemistry of Living Systems (Life Sciences)

- 6. Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept:
  - a. *Students know* that carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.
  - b. *Students know* that living organisms are made of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.
  - c. *Students know* that living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA.

## Periodic Table

7. The organization of the periodic table is based on the properties of the elements and reflects the structure of atoms. As a basis for understanding this concept:
  - a. *Students know* how to identify regions corresponding to metals, nonmetals, and inert gases.
  - b. *Students know* each element has a specific number of protons in the nucleus (the atomic number) and each isotope of the element has a different but specific number of neutrons in the nucleus.
  - c. *Students know* substances can be classified by their properties, including their melting temperature, density, hardness, and thermal and electrical conductivity.

## Density and Buoyancy

8. All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept:
  - a. *Students know* density is mass per unit volume.
  - b. *Students know* how to calculate the density of substances (regular and irregular solids and liquids) from measurements of mass and volume.
  - c. *Students know* the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid the object has displaced.
  - d. *Students know* how to predict whether an object will float or sink.

## Investigation and Experimentation

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9. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:
  - a. Plan and conduct a scientific investigation to test a hypothesis.
  - b. Evaluate the accuracy and reproducibility of data.
  - c. Distinguish between variable and controlled parameters in a test.
  - d. Recognize the slope of the linear graph as the constant in the relationship  $y = kx$  and apply this principle in interpreting graphs constructed from data.

- e. Construct appropriate graphs from data and develop quantitative statements about the relationships between variables.
- f. Apply simple mathematic relationships to determine a missing quantity in a mathematic expression, given the two remaining terms (including speed = distance/time, density = mass/volume, force = pressure  $\times$  area, volume = area  $\times$  height).
- g. Distinguish between linear and nonlinear relationships on a graph of data.