



Test Framework

Middle Grades General Science (205)

December 2021

Content Domain	Range of Competencies	Approximate Percentage of Test Score
I. Physical Science	0001–0004	40%
II. Life Science	0005–0006	30%
III. Earth and Space Science	0007–0008	30%

PHYSICAL SCIENCE

0001: Understand the properties and characteristics of matter.

- Identify historical and contemporary theories of atomic structure.
- Demonstrate knowledge of the physical and chemical properties of matter (e.g., reactivity, polarization, electronegativity).
- Recognize the characteristics of different types of chemical bonds and their effects on the properties of matter.
- Demonstrate knowledge of the organization of the periodic table and its relationship to the structure and behavior of elements.
- Apply knowledge of the characteristics of elements, compounds, and mixtures, including solutions, suspensions, and colloids.
- Demonstrate knowledge of the nature of radioactive materials (e.g., real-world examples, various forms of atoms, isotopes, radioactive vs. nonradioactive atoms).
- Apply knowledge of the principles and procedures of designing and carrying out scientific investigations, including appropriate safety procedures; apply mathematical and computational skills to scientific investigations; and analyze scientific data related to understanding the properties and characteristics of matter.
- Apply knowledge of engineering design practices related to understanding the properties and characteristics of matter, including identifying criteria and constraints for a given problem, using iterative design, and evaluating an engineering/technical solution.

0002: Understand physical and chemical changes in matter.

- Demonstrate knowledge of the conservation of matter in chemical reactions and in balancing chemical equations.
- Analyze physical and chemical changes.
- Apply knowledge of chemical formulas, the mole concept, and chemical equations to solve problems.
- Analyze phase changes and the characteristics of the different states of matter.
- Recognize the characteristics of different types of chemical reactions and factors that affect rates of reaction and chemical equilibrium.
- Apply knowledge of the ideal gas law and kinetic molecular theory.
- Apply knowledge of the principles and procedures of designing and carrying out scientific investigations, including appropriate safety procedures; apply mathematical and computational skills to scientific investigations; and analyze scientific data related to understanding the physical and chemical changes in matter.
- Apply knowledge of engineering design practices related to understanding the physical and chemical changes in matter, including identifying criteria and constraints for a given problem, using iterative design, and evaluating an engineering/technical solution.

0003: Understand the characteristics of different forms of energy and of mechanical and electromagnetic waves.

- Demonstrate knowledge of the law of conservation of energy, the laws of thermodynamics, and the concepts of entropy and enthalpy.
- Demonstrate knowledge of the characteristics of different forms of energy and their transformations.
- Demonstrate knowledge of the transfer of energy through conduction, convection, and radiation, including using models.
- Analyze characteristics of electrical charge and static electricity, problems involving Ohm's law, and series and parallel circuits.
- Demonstrate knowledge of the relationship between magnetism and electricity as well as the properties of permanent magnets and electromagnets.
- Recognize the characteristics of the electromagnetic spectrum.
- Analyze the effects of mirrors, lenses, and prisms on the behavior of light.
- Apply knowledge of the characteristics of waves (e.g., sound, mechanical, electromagnetic) and their behavior as they pass through different media, including the relationship between wave characteristics and their properties.
- Apply knowledge of the principles and procedures of designing and carrying out scientific investigations, including appropriate safety procedures; apply mathematical and computational skills to scientific investigations; and analyze scientific data related to understanding the characteristics of different forms of energy and of mechanical and electromagnetic waves.
- Apply knowledge of engineering design practices related to understanding the characteristics of different forms of energy and of mechanical and electromagnetic waves, including identifying criteria and constraints for a given problem, using iterative design, and evaluating an engineering/technical solution.

0004: Understand relationships between force, mass, and motion.

- Apply knowledge of Newton's three laws of motion in a variety of situations.
- Apply knowledge of scalar and vector quantities and solve related problems.
- Apply knowledge of separate forces that act on a system (e.g., gravity, friction, pressure, buoyancy) in a variety of situations, including determining the stability or net force on a system.
- Analyze the motion of an object, including through graphs and diagrams.
- Demonstrate knowledge of the principles of work and power, including as applied to simple machines.
- Apply knowledge of the principles and procedures of designing and carrying out scientific investigations, including appropriate safety procedures; apply mathematical and computational skills to scientific investigations; and analyze scientific data related to understanding the relationships between force, mass, and motion.
- Apply knowledge of engineering design practices related to understanding the relationships between force, mass, and motion, including identifying criteria and constraints for a given problem, using iterative design, and evaluating an engineering/technical solution.

LIFE SCIENCE

0005: Understand the characteristics and processes of cells and living organisms.

- Recognize how the structure of specialized cells relates to their various functions.
- Demonstrate knowledge of the structure and function of eukaryotic and prokaryotic cells, including cell organelles.
- Demonstrate knowledge of mitosis and meiosis.
- Analyze the reproduction, development, and life cycles of representative organisms.
- Demonstrate knowledge of the structures and functions of plant and animal systems, including the different levels of biological organization.
- Analyze how organisms obtain, use, and store matter and energy.
- Analyze the processes of respiration and photosynthesis at the cellular level.
- Analyze how organisms maintain homeostasis, fight diseases, and repair injuries.
- Apply knowledge of the principles and procedures of designing and carrying out scientific investigations, including appropriate safety procedures; apply mathematical and computational skills to scientific investigations; and analyze scientific data related to understanding the characteristics and processes of cells and living organisms.
- Apply knowledge of engineering design practices related to understanding the characteristics and processes of cells and living organisms, including identifying criteria and constraints for a given problem, using iterative design, and evaluating an engineering/technical solution.

0006: Understand the concepts and principles related to heredity, evolution, and ecosystems.

- Recognize the basic principles of heredity, the nature of the genetic code, the basic processes of DNA replication and protein synthesis, and the methods and uses of genetic engineering.
- Apply knowledge of the source and importance of variation of traits in a given species.
- Apply knowledge of the principles of and evidence for biological evolution.
- Demonstrate knowledge of the major events in the history of life on Earth, including mass extinctions and the evolution of organisms that characterize specific periods in Earth's history.
- Demonstrate knowledge of the characteristics of terrestrial and aquatic biomes, including representative species of plants and animals that inhabit them.
- Analyze the relationships between organisms in a variety of ecosystems and strategies used by different organisms to obtain the basic needs for life, including group behavior.
- Demonstrate knowledge of biotic and abiotic factors that affect population dynamics in ecosystems, including competition, resource availability, and niche and habitat requirements.
- Recognize the principles of biological classification.
- Analyze the cycling of matter and the flow of energy through different types of ecosystems.
- Apply knowledge of the principles and procedures of designing and carrying out scientific investigations, including appropriate safety procedures; apply mathematical and computational skills to scientific investigations; and analyze scientific data related to understanding the concepts and principles related to heredity, evolution, and ecosystems.
- Apply knowledge of engineering design practices related to understanding the concepts and principles related to heredity, evolution, and ecosystems, including identifying criteria and constraints for a given problem, using iterative design, and evaluating an engineering/technical solution.

EARTH AND SPACE SCIENCE

0007: Understand the characteristics of the formation and processes of Earth and its surface, the solar system, and the universe.

- Recognize the characteristics and evolution of stars and galaxies, including theories about the origin and nature of the universe and supporting evidence.
- Analyze the interactions of the sun, the moon, and Earth and the effects of these interactions on Earth.
- Demonstrate knowledge of the role of gravity in the solar system and the universe.
- Demonstrate knowledge of the characteristics of objects in the solar system (e.g., formation, history, structure, distance, size).
- Apply knowledge of geologic evidence (e.g., rock strata, fossils, plate tectonics) to support the timeline of Earth's geologic history.
- Analyze tectonic processes, the mechanisms driving plate movements, and the landforms and geologic phenomena produced by movement at plate boundaries.
- Demonstrate knowledge of the processes involved in the rock cycle and of the characteristics of igneous, metamorphic, and sedimentary rocks, including the characteristics and origins of common rocks, minerals, and fossils.
- Analyze the constructive and destructive processes that shape Earth's surface, including weathering, erosion, transportation, and deposition.
- Recognize the characteristics and origins of mineral, geothermal, and fossil fuel resources.
- Apply knowledge of the principles and procedures of designing and carrying out scientific investigations, including appropriate safety procedures; apply mathematical and computational skills to scientific investigations; and analyze scientific data related to understanding the characteristics of Earth, the solar system, and the universe.
- Apply knowledge of engineering design practices related to understanding the characteristics of Earth, the solar system, and the universe, including identifying criteria and constraints for a given problem, using iterative design, and evaluating an engineering/technical solution.

0008: Understand Earth's systems and human interrelationships with them.

- Analyze the physical processes and interactions of the hydrologic cycle with Earth's atmosphere, geosphere, and biosphere.
- Identify the processes and characteristics of marine and freshwater systems, including oceans, rivers, lakes, groundwater systems, and glaciers.
- Demonstrate knowledge of the structure, functions, and characteristics of the different layers of Earth's atmosphere.
- Analyze atmospheric conditions and geographic factors that produce weather and natural hazards in different parts of the world, and use weather maps and data to predict and explain weather events.
- Recognize factors controlling regional and global climate conditions and the role of humans in causing changes in climate, including the greenhouse effect and the roles of Earth systems in regulating change.
- Recognize how current changes in global climate are affecting Earth systems (e.g., ecosystems, the hydrosphere, coastal processes, agriculture).
- Analyze the positive and negative impacts on the environment that result from the extraction, development, use, and/or disposal of natural and synthetic materials (e.g., antibiotics, pesticides, plastics, nitrates, fossil fuels).
- Demonstrate knowledge of the ways in which science, engineering practices, and technology can be used to reduce humans' impact on the environment.
- Apply knowledge of the principles and procedures of designing and carrying out scientific investigations, including appropriate safety procedures; apply mathematical and computational skills to scientific investigations; and analyze scientific data related to understanding Earth's hydrosphere, atmosphere, weather, and climate.
- Apply knowledge of engineering design practices related to understanding Earth's hydrosphere, atmosphere, weather, and climate, including identifying criteria and constraints for a given problem, using iterative design, and evaluating an engineering/technical solution.