

Missouri Educator Gateway Assessments

FIELD 013: MIDDLE SCHOOL EDUCATION: SCIENCE TEST FRAMEWORK

January 2014

DRAFT

Content Domain	Range of Competencies	Approximate Percentage of Test Score
I. Science and Engineering Practices	0001–0003	22%
II. Physical Science	0004–0008	36%
III. Biology	0009–0011	21%
IV. Earth and Space Science	0012–0014	21%

Missouri Educator Gateway Assessments
TEST FRAMEWORK
FIELD 013: MIDDLE SCHOOL EDUCATION: SCIENCE

*A scientific calculator will be available to examinees taking
the Middle School Education: Science test.*

SCIENCE AND ENGINEERING PRACTICES

0001 Understand the practices of scientific inquiry and engineering design.

For example:

- 1.1 Apply knowledge of the principles and procedures for designing and carrying out scientific investigations.
- 1.2 Recognize methods and criteria for collecting, organizing, analyzing, and presenting scientific data.
- 1.3 Demonstrate knowledge of the evidential basis of scientific claims and engineering solutions (e.g., evaluating the reasonableness of a conclusion on the basis of its supporting data, analyzing how errors in calculation or measurement affect conclusions).
- 1.4 Demonstrate knowledge of the materials, equipment, and technology used in the sciences (e.g., microscopes, thermometers, spring scales, stopwatches, metric rulers).
- 1.5 Apply basic mathematical procedures and modeling to the reporting and interpretation of data and to solve problems in the sciences.
- 1.6 Apply knowledge of safety procedures and hazards associated with scientific investigations.
- 1.7 Apply knowledge of engineering design practices to solve a problem or address a need (e.g., defining problems, designing and evaluating solutions, optimizing solutions).

0002 Understand crosscutting concepts in the sciences and engineering.

For example:

- 2.1 Demonstrate knowledge of the crosscutting concepts that unite core ideas across the sciences and engineering (e.g., patterns, cause and effect, stability and change).
- 2.2 Apply knowledge of the nature of science as a system of inquiry based on a set of shared characteristics (e.g., empirical evidence, peer review).
- 2.3 Demonstrate knowledge of the historical development of major scientific discoveries and technological innovations, including contributions by people of diverse backgrounds.

**FIELD 013: MIDDLE SCHOOL EDUCATION: SCIENCE
TEST FRAMEWORK**

- 2.4 Apply literacy skills to the interpretation, synthesis, and analysis of information from scientific and technical sources (e.g., explaining central ideas, interpreting domain-specific terminology, recognizing how texts structure information into categories and hierarchies).

0003 Understand the relationships between science, technology, and human activity in a global context.

For example:

- 3.1 Demonstrate knowledge of the ways in which science and technology can be used to solve societal problems or achieve societal goals (e.g., curing diseases, slowing global climate change, exploring space).
- 3.2 Recognize ways in which society affects scientific progress.
- 3.3 Analyze social and economic impacts of technological and scientific developments.
- 3.4 Recognize the effects technological advances have had on the sciences, including the scientific discoveries they made possible.
- 3.5 Analyze benefits and drawbacks associated with scientific and technological advances.

PHYSICAL SCIENCE

0004 Understand the properties of matter.

For example:

- 4.1 Analyze various historical and contemporary models of atomic structure.
- 4.2 Analyze the characteristics and properties of elements, compounds, and mixtures, including solutions and the factors affecting solubility.
- 4.3 Apply knowledge of the physical and chemical properties of matter.
- 4.4 Recognize the characteristics of different types of chemical bonds and their effects on the properties of matter.
- 4.5 Demonstrate knowledge of the organization of the periodic table and its usefulness in predicting the physical and chemical properties and relative reactivity of given elements.
- 4.6 Apply knowledge of the characteristics of radioactive materials.

**FIELD 013: MIDDLE SCHOOL EDUCATION: SCIENCE
TEST FRAMEWORK**

0005 Understand physical and chemical changes of matter.

For example:

- 5.1 Apply the principles of the kinetic molecular theory to the analysis of phase changes and to describe the distinguishing characteristics of different states of matter.
- 5.2 Apply knowledge of the conservation of mass to the analysis of physical changes, chemical changes, and to the balancing of chemical equations.
- 5.3 Apply knowledge of chemical formulas, the mole concept, and chemical equations to solve problems.
- 5.4 Demonstrate knowledge of basic chemical reactions, including the factors that affect reaction rate and chemical equilibrium.

0006 Understand the characteristics of energy and energy transformations.

For example:

- 6.1 Demonstrate knowledge of the characteristics of different types of energy, energy sources, and the transfer of energy between objects or systems.
- 6.2 Apply knowledge of the conservation of energy to the analysis of physical and chemical changes.
- 6.3 Demonstrate knowledge of thermal energy and the transfer of energy through conduction, convection, and radiation.
- 6.4 Analyze characteristics of electric charge, static electricity, Ohm's law, and series and parallel circuits.
- 6.5 Demonstrate knowledge of the relationship between magnetism and electricity as well as the properties of permanent magnets.

0007 Understand the properties and principles of force and motion.

For example:

- 7.1 Apply knowledge of Newton's three laws of motion in a variety of situations.
- 7.2 Solve problems involving force, mass, and motion, including the interpretation of force diagrams.
- 7.3 Apply knowledge of gravity, friction, and buoyancy in a variety of situations.
- 7.4 Demonstrate knowledge of the principles of work and power, including as applied to simple machines.

**FIELD 013: MIDDLE SCHOOL EDUCATION: SCIENCE
TEST FRAMEWORK**

0008 Understand the characteristics and properties of mechanical and electromagnetic waves.

For example:

- 8.1 Apply knowledge of the characteristics of mechanical waves and their behavior as they pass through different media.
- 8.2 Analyze the properties and propagation of sound in a variety of situations.
- 8.3 Analyze the characteristics of the electromagnetic spectrum.
- 8.4 Analyze the effects of mirrors, lenses, and prisms on the behavior of light.
- 8.5 Demonstrate knowledge of refraction and reflection in natural phenomena.

BIOLOGY

0009 Understand the characteristics of living organisms.

For example:

- 9.1 Demonstrate knowledge of cell theory, prokaryotic cells, and the structure and function of organelles in eukaryotic cells.
- 9.2 Analyze the processes of respiration and photosynthesis at the cellular levels and the relationship between them.
- 9.3 Analyze how organisms obtain, use, and store matter and energy, and maintain homeostasis.
- 9.4 Demonstrate knowledge of the structures and functions of plant and animal systems, including the different levels of biological organization.
- 9.5 Analyze how systems in complex multicellular organisms, including humans, interact to carry out life processes.
- 9.6 Demonstrate knowledge of the causes, effects, and treatments of common human diseases.

**FIELD 013: MIDDLE SCHOOL EDUCATION: SCIENCE
TEST FRAMEWORK**

0010 Understand reproduction, heredity, and biological classification.

For example:

- 10.1 Demonstrate knowledge of asexual and sexual reproductive strategies (e.g., binary fission of single-celled organisms, external fertilization in frogs, sexual reproduction in flowering plants) and life cycles of representative organisms.
- 10.2 Analyze the processes of mitosis and meiosis.
- 10.3 Apply knowledge of the basic principles of heredity, the nature of the genetic code, and the basic processes of DNA replication.
- 10.4 Demonstrate knowledge of the principles of biological evolution (e.g., natural selection, gene flow, genetic drift, mutation) and the evidence used to explain how species change over time (e.g., fossil records, adaptations, homologous structures).
- 10.5 Demonstrate knowledge of the diversity of life and the principles of biological classification.

0011 Understand the interactions of organisms with their environments.

For example:

- 11.1 Demonstrate knowledge of the characteristics of terrestrial and aquatic biomes, including representative species of plants and animals that inhabit them.
- 11.2 Analyze the relationships between producers, consumers, and decomposers in a variety of ecosystems.
- 11.3 Analyze the biotic and abiotic factors that affect population dynamics in ecosystems, including competition, resource availability, and habitat requirements.
- 11.4 Analyze the cycling of matter (e.g., carbon, nitrogen) and the flow of energy through different types of ecosystems.
- 11.5 Recognize the ways in which human activities and environmental changes (e.g., deforestation, flooding) affect ecosystems and species diversity.

**FIELD 013: MIDDLE SCHOOL EDUCATION: SCIENCE
TEST FRAMEWORK**

EARTH AND SPACE SCIENCE

0012 Understand Earth's history and the processes that shape and change its geosphere.

For example:

- 12.1 Demonstrate knowledge of current scientific theories of Earth's formation, history, and structure, as well as the supporting geologic evidence.
- 12.2 Analyze tectonic processes, the mechanisms driving plate movements, and the landforms and geologic phenomena produced by movement at plate boundaries.
- 12.3 Apply knowledge of the processes involved in the rock cycle and the characteristics of igneous, metamorphic, and sedimentary rocks.
- 12.4 Analyze the constructive and destructive processes that shape Earth's surface, including weathering, erosion, transportation, and deposition.
- 12.5 Recognize the characteristics and origins of common rocks, minerals, and fossils, as well as mineral, geothermal, and fossil fuel resources.
- 12.6 Demonstrate knowledge of the sources, limits, and uses of natural resources and how human activity affects their quality and availability.

0013 Understand Earth's hydrosphere, atmosphere, weather, and climate.

For example:

- 13.1 Analyze the physical processes driving the hydrologic cycle (e.g., solar heating, evaporation, condensation).
- 13.2 Recognize the characteristics of marine and freshwater systems, including oceans, rivers, lakes, glaciers, and groundwater systems.
- 13.3 Demonstrate knowledge of the structure and characteristics of the different layers of the atmosphere.
- 13.4 Demonstrate knowledge of atmospheric and geographic factors that produce different types of weather, including hazardous weather events, and factors that control regional climate conditions.
- 13.5 Analyze weather maps and data to predict and explain weather events.

**FIELD 013: MIDDLE SCHOOL EDUCATION: SCIENCE
TEST FRAMEWORK**

0014 Understand the composition and structure of the universe.

For example:

- 14.1 Demonstrate knowledge of the characteristics of objects in the solar system (e.g., sun, planets, asteroids, comets, planetary satellites).
- 14.2 Analyze the interactions of the sun, the moon, and Earth and the effects of these interactions on Earth systems.
- 14.3 Recognize the characteristics and evolution of stars and galaxies, including theories on the origin and nature of the universe.
- 14.4 Demonstrate knowledge of evidence supporting the current understanding of the solar system and universe and the technology and methods used to gather that evidence.
- 14.5 Demonstrate knowledge of the role of gravity in the solar system and the universe.