



GENERAL SCIENCE

Test Framework

| | Content Domain | Range of Competencies | Approximate Percentage of Test Score |
|-------------|-------------------------|------------------------------|---|
| I. | Nature of Science | 0001–0003 | 19% |
| II. | Physical Science | 0004–0009 | 37% |
| III. | Life Science | 0010–0013 | 25% |
| IV. | Earth and Space Science | 0014–0016 | 19% |

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I. NATURE OF SCIENCE

0001 Understand principles and procedures of scientific inquiry.

- ▶ Demonstrate knowledge of the principles and procedures for designing and carrying out scientific investigations.
- ▶ Recognize methods and criteria for collecting, organizing, analyzing, and presenting scientific data.
- ▶ Recognize the evidential basis of scientific claims.
- ▶ Demonstrate knowledge of safety procedures and hazards associated with scientific investigations.
- ▶ Demonstrate knowledge of the materials, equipment, and technology used in the sciences.
- ▶ Apply basic mathematical procedures in analyzing and representing data and solving problems in the sciences.

0002 Understand the history and nature of science.

- ▶ Demonstrate knowledge of the historical development of major scientific ideas, including contributions by men and women of diverse backgrounds.
- ▶ Demonstrate knowledge of current major theories, models, and concepts in physical science, life science, and Earth and space science.
- ▶ Identify unifying themes, principles, and relationships that connect the different branches of the sciences.
- ▶ Demonstrate knowledge of the nature of science as a system of inquiry.

0003 Understand the relationships between science, technology, engineering, mathematics, and society.

- ▶ Analyze the interrelationships between science, technology, engineering, mathematics, and society.
- ▶ Demonstrate scientific literacy in evaluating scientific research and the coverage of science in the media.
- ▶ Analyze social, economic, and ethical issues associated with technological and scientific developments.

II. PHYSICAL SCIENCE

0004 Understand the properties and characteristics of matter.

- ▶ Analyze various historical and contemporary models of atomic structure and the supporting evidence for these models.
- ▶ Demonstrate knowledge of the quantum theory of matter and energy (e.g., atomic structure, chemical bonding).
- ▶ Analyze the characteristics of elements, compounds, and mixtures, including colloids, suspensions, and solutions.
- ▶ Analyze the colligative properties of solutions (e.g., freezing point, boiling point, osmotic pressure, vapor pressure).
- ▶ 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.
- ▶ Apply methods used to determine the chemical and physical properties of unknown substances.
- ▶ Demonstrate knowledge of the basic principles of the kinetic molecular theory and the distinguishing characteristics of the four states of matter.
- ▶ Demonstrate knowledge of the behavior of ideal gases, including the relationships between pressure, temperature, and volume.
- ▶ Demonstrate knowledge of the characteristics of radioactive materials.

0005 Understand chemical bonding, different types of chemical reactions, and stoichiometry.

- ▶ Demonstrate knowledge of chemical formulas and the International Union of Pure and Applied Chemistry (IUPAC) rules of nomenclature.
- ▶ Analyze different types of chemical bonds and intermolecular forces and their effect on the properties of matter.
- ▶ Apply knowledge of stoichiometry and the mole concept in balancing chemical equations and solving problems involving the mass relationships of reactants and products.
- ▶ Analyze chemical reactions, including acid-base reactions and oxidation-reduction reactions, in terms of the properties of reactants and products.
- ▶ Demonstrate knowledge of factors that affect reaction rates, including the introduction of catalysts and changes in concentration or temperature.
- ▶ Demonstrate knowledge of the concept of chemical equilibrium, the factors that influence chemical equilibrium, and Le Châtelier's principle.

0006 Understand the characteristics of energy transformations in physical and chemical systems.

- ▶ Analyze phase changes, phase diagrams, and heating and cooling curves.
- ▶ Analyze factors that affect the solubility of a substance and the rate at which substances dissolve.
- ▶ Demonstrate knowledge of the laws of thermodynamics and the principles of calorimetry, including solving basic calorimetry problems.
- ▶ Analyze energy changes involved in phase transitions, dissolving solutes in solvents, and diluting solutions.

0007 Understand force, motion, and energy.

- ▶ Demonstrate knowledge of Newton's three laws of motion in a variety of situations and the limitations of Newton's laws at high speeds.
- ▶ Analyze motion in terms of concepts of displacement, velocity, and acceleration.
- ▶ Analyze free body diagrams and vector properties to solve problems involving multiple forces in one and two dimensions.
- ▶ Demonstrate knowledge of Newton's law of gravitation and its applications.
- ▶ Analyze the types and uses of simple machines and their principles of operation.
- ▶ Demonstrate knowledge of work, the conservation of energy, and different forms of energy (e.g., potential, kinetic, thermal).
- ▶ Analyze the transfer of energy through convection, conduction, and radiation.

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

- ▶ Analyze the properties of waves (e.g., speed, frequency, wavelength).
- ▶ Analyze the properties and propagation of sound waves.
- ▶ Analyze the wave characteristics of the electromagnetic spectrum.
- ▶ Analyze the effects of mirrors, lenses, and prisms on the behavior of light.
- ▶ Demonstrate knowledge of refraction, reflection, and polarization of electromagnetic waves.
- ▶ Demonstrate knowledge of the Doppler effect.
- ▶ Demonstrate knowledge of the dual nature of light and matter.

0009 Understand electricity and magnetism.

- ▶ Analyze characteristics of electric charge, electric force, static electricity, electric current, and potential difference.
- ▶ Analyze the operation of series and parallel circuits and the relationship between electric current, voltage, and resistance described by Ohm's law.
- ▶ Demonstrate knowledge of the characteristics of permanent magnets and magnetic fields.
- ▶ Demonstrate knowledge of electromagnets and principles and applications of electromagnetism (e.g., transformers, inductors, motors, generators).

III. LIFE SCIENCE

0010 Understand the characteristics, organization, and processes of cells.

- ▶ Demonstrate knowledge of cell theory and its implications.
- ▶ Analyze the structure and function of organelles in eukaryotic and prokaryotic cells.
- ▶ Demonstrate knowledge of the processes of respiration and photosynthesis at the cellular and molecular levels and the relationship between them.
- ▶ Recognize how the structure of specialized cells relates to their different functions.
- ▶ Demonstrate knowledge of mitosis, meiosis, and the cell cycle.
- ▶ Demonstrate knowledge of active and passive transport across cell membranes.
- ▶ Recognize the structure and function of different biomolecules (e.g., lipids, proteins, carbohydrates, nucleic acids).
- ▶ Demonstrate knowledge of the role of enzymes as catalysts in cellular reactions and factors that affect enzyme function.

0011 Understand the classification and characteristics of organisms.

- ▶ Demonstrate knowledge of the diversity of life and the taxonomic relationships among living organisms.
- ▶ Recognize characteristics of the reproduction, development, and life cycles of representative organisms.
- ▶ Demonstrate knowledge of the functions of specialized structures and systems in protists, plants, animals, and fungi.
- ▶ Demonstrate knowledge of the structures and functions of human body systems.
- ▶ Analyze how organisms obtain, use, and store matter and energy.
- ▶ Analyze how organisms maintain homeostasis and fight diseases.
- ▶ Demonstrate knowledge of viruses and prions.

0012 Understand concepts and principles related to genetics and evolution.

- ▶ Apply the basic principles of heredity, Mendelian genetics, and the use of Punnett squares and the laws of probability.
- ▶ Demonstrate knowledge of the nature of the genetic code and the basic processes of DNA replication and protein synthesis.
- ▶ Recognize the methods and applications of genetic engineering.
- ▶ Analyze the principles and evidence of biological evolution to explain how species change over time.
- ▶ Demonstrate knowledge of major events in the history of life, mass extinctions and the evolution of organisms, including humans.

0013 Understand characteristics of different biomes, relationships among organisms, and the flow of matter and energy through ecosystems.

- ▶ Demonstrate knowledge of the characteristics of terrestrial and aquatic biomes, including representative species of plants and animals that inhabit them.
- ▶ Recognize strategies used by different organisms to obtain the basic needs for life.
- ▶ Analyze the relationships between producers, consumers, and decomposers in a variety of ecosystems.
- ▶ Analyze the biotic and abiotic factors that affect population dynamics in ecosystems, including competition, resource availability, and habitat requirements.
- ▶ Analyze the cycling of matter and the flow of energy through different types of ecosystems.
- ▶ Recognize the ways both human activities and climate change affect ecosystems.

IV. EARTH AND SPACE SCIENCE

0014 Understand physical geology and the history of Earth.

- ▶ Demonstrate knowledge of Earth's formation, history, and structure, as well as the supporting geologic evidence.
- ▶ 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.
- ▶ Analyze the constructive and destructive processes that shape Earth's surface, including weathering, erosion, transportation, and deposition.
- ▶ Recognize the characteristics and origins of common rocks, minerals, and fossils, as well as mineral, geothermal, and fossil fuel resources.
- ▶ Demonstrate knowledge of the effects of continental glaciations during the Pleistocene epoch and the characteristics of glacial deposits.

0015 Understand characteristics of the hydrosphere, weather, and climate.

- ▶ Analyze the physical processes driving the hydrologic cycle (e.g., solar heating, evaporation, condensation).
- ▶ Identify the processes and characteristics of marine and freshwater systems, including oceans, rivers, lakes, glaciers, and groundwater systems.
- ▶ Analyze coastal processes, the formation of barrier islands, and the characteristics of deltas and estuaries.
- ▶ Demonstrate knowledge of the structure and characteristics of the different layers of the atmosphere and the atmospheric and geographic factors that produce different types of weather, including hazardous weather events.
- ▶ Analyze weather conditions, maps, and data to predict and explain weather events.
- ▶ Demonstrate knowledge of the geographic factors that control regional climate conditions.
- ▶ Analyze the causes and effects of current and past changes in global climates on ecosystems, the hydrosphere, coastal processes, and agriculture.
- ▶ Recognize the significance of interactions of the ocean and the atmosphere.

0016 Understand characteristics of the solar system and universe.

- ▶ Demonstrate knowledge of the formation of the solar system and the characteristics of planets, asteroids, comets, and planetary satellites.
- ▶ Demonstrate knowledge of the apparent motion of objects in the sky and the celestial sphere model.
- ▶ Analyze the interactions of the sun, the moon, and Earth and the effects of these interactions on Earth systems.
- ▶ Recognize the characteristics and evolution of stars and galaxies, including theories on the origin and nature of the universe.
- ▶ Demonstrate knowledge of evidence supporting the current understanding of the solar system and universe and of the technology and methods used to gather that evidence.
- ▶ Demonstrate knowledge of the role of gravity in the solar system and the universe.