National Evaluation Series

Test Framework

General Science (318)

May 2023

Content Domain	Range of Competencies	Approximate Percentage of Test Score
I. Physical Science	0001–0004	40%
II. Life Science	0005–0007	30%
III. Earth and Space Science	0008–0010	30%

PHYSICAL SCIENCE

0001: Apply knowledge of the characteristics, properties, and structures within matter.

- Demonstrate knowledge of the various historical and contemporary models of atomic structure and their supporting evidence.
- Demonstrate knowledge of the electron and nuclear characteristics, properties, and structure of an atom and the energy associated with an atom and its parts.
- Apply knowledge of physical and chemical properties of matter and how to classify mixtures (e.g., homogeneous, heterogeneous, suspensions) and pure substances (e.g., atoms, elements, compounds) based on their composition and other properties.
- Apply knowledge of the organization of the periodic table and trends of physical and chemical properties therein, including the relative reactivity of given elements.
- Apply knowledge of the basic principles (e.g., temperature, heat, energy) of the kinetic molecular theory, including the distinguishing characteristics and changes in the states of matter.
- Demonstrate knowledge of the behavior of ideal gases, including the relationships between pressure, temperature, and volume.
- Apply knowledge of stoichiometry and the mole concept, including balancing chemical equations and solving problems involving the mass relationships of reactants and products and the conservation of mass in chemical reactions.
- Apply knowledge of different types of chemical bonds (e.g., ionic, covalent, hydrogen) and their effect on the properties and characteristics of matter, including design requirements on materials (e.g., metal joints in bridges, elastic properties of molecular chains).
- Apply knowledge of nuclear processes (e.g., radioactive decay, fission, fusion), isotopes, typical nuclear reactions (i.e., alpha, beta, and gamma), and the scale of energy involved.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data; using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to the characteristics, properties, and structures within matter, including science ethics, safety procedures, and the proper use of equipment.

0002: Apply knowledge of chemical reactions and their relationship to energy within systems.

- Analyze the properties and the energy of reactants and products in chemical reactions, including acid-base reactions and oxidation-reduction reactions.
- Demonstrate knowledge of factors that affect reaction rates (e.g., catalysts, concentration, temperature).
- Demonstrate knowledge of the concept of chemical equilibrium and the factors that influence chemical equilibrium, including Le Châtelier's principle.
- Analyze phase changes, phase diagrams, and heating and cooling curves.
- Apply knowledge of the laws of thermodynamics and the principles of calorimetry, including solving basic calorimetry problems.
- Apply knowledge of factors that affect the solubility of a substance and the rate at which substances dissolve.
- Analyze energy changes involved in phase transitions, dissolving solutes in solvents, and diluting solutions.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to chemical reactions and their relationship to energy within systems, including safety procedures and the proper use of equipment.

0003: Apply knowledge of force, motion, work, and energy and their relationships to one another.

- Apply knowledge of the laws of motion and their relationships to force and mass, including determining quantities within static and dynamic scenarios.
- Analyze motion in terms of vector and scalar concepts (e.g., displacement, velocity, acceleration).
- Analyze free body diagrams to solve problems involving multiple forces in one and two dimensions.
- Analyze and evaluate systems to meet or refine criteria involving net force on a system.
- Demonstrate knowledge of the universal law of gravitation and its applications.
- Apply knowledge of the types and uses of simple machines and their principles of operation, including understanding work and power and their relationship to force.
- Demonstrate knowledge of the conservation of energy and momentum, including collisions.
- Apply knowledge of different types of energy (e.g., potential, kinetic, thermal) and types of energy transfer (i.e., convection, conduction, and radiation).
- Apply knowledge of the work-energy theorem, including using models and determining changes and rates of changes in the amounts of different types of energy in systems.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to force, motion, work, and energy, including safety procedures and the proper use of equipment.

0004: Apply knowledge of waves, electricity, magnetism, and electromagnetism.

- Apply knowledge of the properties of different types of waves (e.g., speed, frequency, wavelength), including the differences in these properties when waves are moving in various types of media.
- Apply knowledge of the properties and propagation of sound waves, including the Doppler effect.
- Analyze the effects of mirrors, lenses, and prisms on the behavior of light.
- Demonstrate knowledge of refraction, reflection, and polarization of electromagnetic waves.
- Apply knowledge of waves carrying energy.
- Demonstrate knowledge that information can be embedded in waves in analog or digital format, including the advantages and disadvantages of each format.
- Demonstrate knowledge of the particle and wave behavior of electromagnetic radiation, including supporting experimental evidence.
- Apply knowledge of the particle and wave models of electromagnetic radiation (e.g., photoelectric effect, ionizing radiation, photoelectric cells).
- Apply knowledge of Coulomb's law and the characteristics of electric charge, electric force, electric fields, static electricity, electric current, and potential difference.
- Analyze the operation of series and parallel circuits and the relationships between electric current, voltage, and resistance described by Ohm's law, including the underlying atomic and molecular properties that give rise to conductors.
- Demonstrate knowledge of the characteristics of permanent magnets and magnetic fields, including the underlying atomic and molecular properties that contribute to a macroscopic-scale magnetic effect.
- Demonstrate knowledge of electromagnets and the principles and applications of electromagnetism (e.g., transformers, inductors, motors, generators).
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to waves, electricity, magnetism, and electromagnetism, including safety procedures and the proper use of equipment.

LIFE SCIENCE

0005: Apply knowledge of the characteristics of organisms and life processes.

- Demonstrate knowledge of the structure and function of different macromolecules (i.e., lipids, proteins, carbohydrates, and nucleic acids), cell theory, and the characteristics of living organisms.
- Apply knowledge of the structure and function of organelles in various types of cells (e.g., eukaryotic, prokaryotic, plant, animal).
- Analyze how organisms obtain, use, and store matter and energy, including through processes of photosynthesis and cellular respiration.
- Demonstrate knowledge of cell division processes (i.e., mitosis, meiosis, and binary fission) and their role in reproduction, growth development, and the life cycles of living organisms.
- Apply knowledge of the structures and functions of plants and their role in the processes and feedback systems used to maintain life (e.g., homeostasis, metabolism), including the levels of biological organization.
- Apply knowledge of the structures and functions of animals, excluding humans, and their role in the processes and feedback systems used to maintain life (e.g., homeostasis, metabolism), including the levels of biological organization.
- Apply knowledge of the structures and functions of humans and their role in the processes and feedback systems used to maintain life (e.g., homeostasis, metabolism), including the levels of biological organization.
- Apply knowledge of the functions of specialized structures in plant systems and animal behavior used as strategies to increase the probability of successful reproduction.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to the characteristics of organisms and life processes, including safety procedures and the proper use of equipment.

0006: Apply knowledge of concepts and principles related to genetics and evolution.

- Demonstrate knowledge of the historical evidence of the evolution of species over time (e.g., fossil records, homologies, DNA evidence, embryology).
- Apply knowledge of the principles of biological evolution (e.g., natural selection, gene flow, genetic drift), including how natural selection can lead to adaptation.
- Demonstrate knowledge of major events in the history of life, including mass extinctions and the evolution of organisms.
- Demonstrate knowledge of the diversity of life and the taxonomic relationships among living organisms.
- Apply the basic principles of heredity and genetics, including through 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.
- Demonstrate knowledge of the causes and types of genetic and environmental mutations that occur in living organisms.
- Demonstrate knowledge of the methods and applications of genetic engineering.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to concepts and principles related to genetics and evolution, including safety procedures and the proper use of equipment.

0007: Apply knowledge of organisms, matter, and energy within ecosystems.

- Demonstrate knowledge of the characteristics of terrestrial and aquatic biomes, including representative species of plants and animals that inhabit them.
- Apply knowledge of the interrelationships between producers, consumers, and decomposers in a variety of ecosystems and strategies used by different organisms to obtain the basic needs for life.
- Apply knowledge of the cycling of matter and the flow of energy through different types of ecosystems, including through food webs.
- Analyze the biotic and abiotic factors that affect population dynamics in ecosystems (e.g., competition, resource availability, habitat requirements).
- Demonstrate knowledge of factors that affect carrying capacities and biodiversity of ecosystems.
- Apply knowledge of the process of ecological succession and its relationship to stability and change.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to organisms, matter, and energy within ecosystems, including safety procedures and the proper use of equipment.

EARTH AND SPACE SCIENCE

0008: Apply knowledge of the universe, space, and geological systems.

- Demonstrate knowledge of theories on the origin, evolution, and evidence supporting the current understanding of the universe, including the technologies and methods used to gather that evidence.
- Demonstrate knowledge of the characteristics and evolution of stars, galaxies, and other objects in the universe.
- Demonstrate knowledge of the characteristics of objects in the solar system (e.g., planets, asteroids, comets, planetary satellites), including the formation of and the function of gravity within the solar system.
- Apply knowledge of the effects that occur from the interactions of the sun, the moon, and Earth systems (e.g., seasons, daylight, tides).
- Demonstrate knowledge of Earth's geological timescale and formation and the supporting geologic evidence (e.g., radioactive dating, relative dating, fossil record).
- Apply knowledge of relative dating and principles of stratigraphy, including models and diagrams of rock outcrops.
- Apply knowledge of Earth's structure and composition, including evidence used to support current models of the interior and exterior of Earth.
- Apply knowledge of tectonic processes, the mechanisms driving plate movements, and the landforms and geologic phenomena produced by movement at plate boundaries.
- Apply knowledge of the processes involved in the rock cycle and the characteristics and origins of various types of rocks and minerals.
- Apply knowledge of the constructive and destructive processes that shape the topographical features on Earth's surface (e.g., canyons, sinkholes, deltas, dunes), including weathering, erosion, transportation, and deposition processes.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to the universe, space, and geological systems, including safety procedures and the proper use of equipment.

0009: Apply knowledge of the characteristics of the Earth's spheres, weather, and climate.

- Demonstrate knowledge of positive and negative feedback loops and factors that affect the relationships between the hydrosphere, biosphere, atmosphere, and lithosphere.
- Demonstrate knowledge of the properties of water, including their effects on the hydrosphere, biosphere, atmosphere, and lithosphere.
- Apply knowledge of the processes, sinks, and sources within elemental cycles (e.g., carbon, nitrogen, phosphorous), including their effect on other Earth spheres.
- Analyze the physical processes driving the hydrologic cycle (e.g., solar heating, evaporation, condensation).
- Demonstrate knowledge of the processes and characteristics of marine and freshwater systems, including oceans, rivers, lakes, glaciers, and groundwater systems.
- Demonstrate knowledge of the structure and characteristics of the different layers of the atmosphere, including the processes of precipitation, cloud formation, and atmospheric convection.
- Demonstrate knowledge of the atmospheric and geographic factors that produce different types of weather and climate conditions, including hazardous weather events.
- Analyze weather conditions, maps, and data to predict and explain weather events.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to characteristics of the Earth's spheres, weather, and climate, including safety procedures and the proper use of equipment.

0010: Apply knowledge of resources and human interaction with the environment.

- Demonstrate knowledge of the sources and uses of renewable and nonrenewable resources, including energy and geological resources.
- Apply knowledge of the effect of using different renewable or nonrenewable energies on the climate and environment.
- Apply knowledge of how human activities affect the hydrosphere, biosphere, atmosphere, and lithosphere.
- Apply knowledge of how changes in one Earth sphere due to human activity can cause changes in other Earth spheres, including through feedback loops.
- Analyze the causes and effects of changes in global climate on ecosystems, the hydrosphere, the atmosphere, the lithosphere, and coastal processes.
- Apply knowledge of factors that influence human activity (e.g., natural resources, natural hazards, climate).
- Apply knowledge of methods and strategies used to mitigate climate change and human activity.
- Demonstrate knowledge of scientific practices (e.g., asking questions; developing and using models; planning and carrying out investigations; analyzing and interpreting data, using mathematics and computational thinking; constructing explanations; engaging in argument from evidence; obtaining, evaluating, and communicating information) and the engineering design process (e.g., defining problems, iterative design, designing solutions) related to resources and human interaction with the environment, including safety procedures and the proper use of equipment.