INDIANA CORE ASSESSMENTS FOR EDUCATOR LICENSURE

FIELD 071: MIDDLE SCHOOL SCIENCE

TEST FRAMEWORK

September 2020

Domain		Range of Objectives	Approximate Percentage of Test Score
I.	Scientific Processes, Scientific Connections, and Engineering Design	0001–0003	15%
II.	Physical Sciences	0004–0006	25%
III.	Earth and Space Science	0007–0010	25%
IV.	Life Science	0011–0013	25%
V.	Instruction and Assessment	0014	10%

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Scientific Processes, Scientific Connections, and Engineering Design
Physical Sciences
Earth and Space Science
Life Science
Instruction and Assessment

SCIENTIFIC PROCESSES, SCIENTIFIC CONNECTIONS, AND ENGINEERING DESIGN

0001 Apply knowledge of scientific processes.

For example:

- Apply knowledge of the characteristics, assumptions, and goals of science and scientific reasoning, including the process of theory development.
- Apply knowledge of the processes and procedures of developing and carrying out a scientific investigation (e.g., formulating testable hypotheses, developing methods, using control and experimental groups, communicating results).
- Demonstrate knowledge of common tools, materials, measurements, and technology used in scientific investigations.
- Analyze and interpret scientific data, graphs, charts, tables, or models, including experimental data, limiting variables, and the application of the mathematical concepts of statistics and probability.
- Evaluate and synthesize scientific and technical texts (e.g., central ideas, content-specific language, key symbols, organization of text) and scientific information, claims, and arguments, including understanding the application of reliable scientific resources and the research process (e.g., compilation of prior knowledge, empirical evidence, critical evaluation of results, role of peer review, annotation of sources).

0002 Demonstrate knowledge of scientific, technological, engineering, and mathematical concepts and their interrelationships and applications.

For example:

- Apply knowledge of the unifying concepts and core ideas that exist across multiple scientific and engineering fields (i.e., life science, physical sciences, Earth and space science, engineering).
- Demonstrate knowledge of the interrelationships between scientific concepts, technological applications, engineering, and mathematics.
- Demonstrate knowledge of the historical development of major scientific discoveries.
- Demonstrate knowledge of how science and technology can affect societal and economic development (e.g., communication, disease, standards of living, energy availability) and how science and technology are influenced by society, culture, and ethics.

0003 Apply knowledge of the nature and process of engineering design.

For example:

- Demonstrate knowledge of the basic characteristics, principles, and goals of the engineering design process (e.g., meet a need or want, construct a prototype).
- Identify criteria and constraints of an engineering problem (e.g., scientific principles, cost, materials, time) and evaluate competing design solutions using these criteria and constraints.
- Apply knowledge of the roles and processes of modeling and iterative testing in engineering design.
- Evaluate an engineering design or solution, including identification of failure points of a prototype and modifications needed to optimize a proposed object, tool, or process based upon using the best characteristics among competing design solutions.

PHYSICAL SCIENCES

0004 Demonstrate knowledge of the structure and properties of matter.

For example:

- Analyze historical and contemporary models, characteristics, and major subatomic components of atoms.
- Interpret the organization and physical and chemical trends of elements in the periodic table, including how these elements combine to form all known substances.
- Demonstrate knowledge of the characteristics and composition of elements, molecules, compounds, solutions, and mixtures.
- Demonstrate knowledge of the differences between, and the measurements of, mass, weight, volume, and density of substances and how to identify physical and chemical changes.
- Demonstrate knowledge of the types of chemical bonds, principles behind the formation of chemical bonds, and the effects of chemical bonds on the properties of matter.
- Apply knowledge of the types and characteristics of chemical reactions and factors that affect reaction rates and equilibrium.
- Demonstrate knowledge of the law of conservation of mass to physical and chemical interactions, such as the principles of stoichiometry and the mole concept, including balancing equations.
- Demonstrate basic knowledge of acids and bases, including their characteristics and reactions.

0005 Apply knowledge of forces, motion, and energy.

For example:

- Apply knowledge of Newton's laws of motion.
- Apply knowledge of the vector and scalar forms of change in position and rate of change in position (e.g., distance, velocity, acceleration), including examining scenarios, graphs, and the net force of a system.
- Demonstrate knowledge of the principles of work and power, including the characteristics and uses of simple machines.
- Apply knowledge of the law of the conservation of energy to physical and chemical interactions.
- Demonstrate knowledge of the different states of matter and their behavior (e.g., kinetic molecular theory, gas laws) and the effect of temperature changes on particle motion and states of a pure substance.
- Calculate and evaluate changes in potential and kinetic energy in a variety of contexts (e.g., phases, components, practical applications), including in the transference of kinetic energy between objects.
- Apply knowledge of different forms of energy (e.g., mechanical, chemical, solar, thermal) and the transformation of energy from one form to another.
- Apply knowledge of the concepts of heat and temperature, including energy changes associated with chemical and physical processes, and the principles and applications of the first and second laws of thermodynamics.

0006 Apply knowledge of waves and electromagnetism.

For example:

- Apply knowledge of the characteristics of mechanical waves (e.g., amplitude, wavelength, frequency, period), including their role in energy transfer in a variety of contexts (e.g., phases, digital signals, radio, cooking).
- Apply knowledge of the properties of sound waves and their propagation in different media.
- Demonstrate knowledge of the nature of light waves and the use and characteristics of different types of lenses and mirrors.
- Apply knowledge of the electromagnetic spectrum, including the transfer of electromagnetic energy within and between different materials and through space (i.e., refraction, absorption, reflection, transmission, and diffraction).
- Apply knowledge of electric current and the properties of static charge, including the conservation of charge, electric fields, and factors that affect the strength of electric forces.
- Analyze characteristics (e.g., power, voltage) and components (e.g., resistor, battery) of series and parallel circuits.
- Apply knowledge of the characteristics of magnets and magnetic fields, including factors that affect the strength of magnetic forces, the properties of permanent magnets, and the principles of electromagnetic induction.

EARTH AND SPACE SCIENCE

0007 Demonstrate knowledge of space.

For example:

- Demonstrate knowledge of the origin, nature, and structure of the universe.
- Demonstrate knowledge of the characteristics and relative scale of objects in the solar system (e.g., the Sun, planetary bodies, asteroids), including comparison of Earth and the Moon with other celestial bodies.
- Apply knowledge of the role of gravity and inertia in the formation and motion of different objects in the universe and the correlation between mass, distance, and the gravitational interactions of objects.
- Apply knowledge of the regular and predictable pattern of real and apparent movements of the stars, planets, and the Moon, including models of the interactions of the Sun, Moon, and Earth and the effect of these interactions on Earth systems (e.g., tides, seasons, time changes).

0008 Demonstrate knowledge of Earth's origin and geologic processes.

For example:

- Demonstrate knowledge of the origin, evolution, structure, and composition of Earth, including major evidence for these conclusions (e.g., seismic waves, meteorite composition).
- Demonstrate knowledge of the geologic timescale and evidence for major events in Earth's history, including the use and interpretation of radiometric and stratigraphic data.
- Demonstrate knowledge of the rock cycle; the processes of rock formation (e.g., igneous, metamorphic, sedimentary); and the characteristics, identification, and composition of rocks and minerals.
- Apply knowledge of physical processes (e.g., weathering, erosion, transportation, deposition) and their contribution to the formation of major landforms (e.g., plateau, valley, mountain, delta, alluvial fan), including evidence of these processes found in and around Indiana.
- Identify and analyze supporting evidence for the theory of plate tectonics (e.g., mechanisms driving plate movement, continental shapes, landforms at plate boundaries, volcanoes, earthquakes).

0009 Apply knowledge of Earth's systems, weather, and climate.

For example:

- Analyze the interactions of the hydrosphere, atmosphere, biosphere, and geosphere.
- Apply knowledge of the physical and chemical properties of water and the characteristics and processes of water movement within and between reservoirs (e.g., subsurface, oceans, glaciers).
- Demonstrate knowledge of the structures and characteristics of different layers of the atmosphere.
- Apply knowledge of the causes, characteristics, and interactions of air masses, including forecasting different types of weather using meteorological maps.
- Apply knowledge of the physical and biological characteristics of Earth's different climate regions, including their geographic location and factors that determine regional climates (e.g., oceanic and wind circulation, topography).
- Apply knowledge of the flow of energy through conduction, convection, and radiation in Earth systems (e.g., oceanic and wind circulation, geothermal events).

0010 Apply knowledge of natural resources and their uses, natural events, and human impacts on the environment.

For example:

- Apply knowledge of the global climate system, changes in climate that have occurred over time, and the mechanisms and the significance of the greenhouse effect.
- Apply knowledge of the limits, use, and management of Earth's resources (e.g., water, mineral, biological, wind), including the development and impact of common synthetic materials.
- Apply knowledge of the origin, availability, effectiveness, and potential risks and benefits of nonrenewable and renewable energy resources.
- Analyze the impact of humans on the environment (e.g., pollution, deforestation, invasive species), including strategies for reducing those impacts while maintaining Earth systems (e.g., heat distribution, climate, biodiversity, ecosystem functioning).
- Demonstrate knowledge of the impact of natural hazards (e.g., weather, earthquakes) on humans and the natural environment, including factors that contribute to the extent of damage of an event and the development of technologies to mitigate their effects.

LIFE SCIENCE

0011 Apply knowledge of the structure and function of viruses and living organisms.

For example:

- Demonstrate knowledge of the basic characteristics of living things (e.g., the cellular basis of life, response to stimuli), the diversity of life, and the principles of taxonomy.
- Apply knowledge of the processes of photosynthesis and cellular respiration (e.g., aerobic and anaerobic).
- Analyze the use, storage, and transfer of matter and energy in organisms, including the maintenance of homeostasis.
- Apply knowledge of the similarities and differences between viruses and bacteria and their effects on humans.
- Identify the characteristics, structures, and functions of prokaryotes and single-celled eukaryotic organisms.
- Apply knowledge of the characteristics, structures, and functions of basic biomolecules, cells, cell organelles, and specialized cells (e.g., neuron, plant leaf cell).
- Demonstrate knowledge of the structures and functions of the primary components of organ systems in fungi, plants, and animals, including humans.

0012 Apply knowledge of reproduction and inheritance.

For example:

- Demonstrate knowledge of the structure and function of DNA, RNA, and proteins as well as the basic processes of DNA replication and protein synthesis.
- Apply knowledge of the principles of genetics and the patterns of inheritance, including their application to genetic problems and genetic engineering.
- Apply knowledge of the molecular basis of heredity, including environmental and genetic factors that affect growth and development.
- Demonstrate knowledge of the effects of natural and engineered mutations and how these mutations affect the genetic code and protein synthesis, including the role of mutations (e.g., new alleles, cancer).
- Apply knowledge of cell division and the basic processes and results of asexual and sexual reproduction in prokaryotes and eukaryotes.

0013 Apply knowledge of biological evolution and ecosystem function.

For example:

- Apply knowledge of the scientific theory of evolution and its supporting evidence (e.g., fossil record, embryology).
- Analyze the processes of biological evolution (e.g., natural selection, genetic drift), including differences among individuals that lead to survival and speciation.
- Demonstrate knowledge of biomes, including characteristics and adaptations of their living inhabitants and how these inhabitants sense, process, and respond to their environment.
- Apply knowledge of the relationships between organisms across trophic levels (e.g., food webs, predation, symbiosis) that are native to Indiana and other ecosystems.
- Demonstrate knowledge of the generation and impact of biodiversity in an environment, including factors that affect biodiversity (e.g., resource availability, disease, invasive species).
- Demonstrate knowledge of the transfer of energy and nutrients between and within biotic and abiotic components in ecosystems and the cycling of matter through biogeochemical cycles.

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TEST FRAMEWORK

INSTRUCTION AND ASSESSMENT

0014 Apply knowledge of standards and instructional strategies.

For example:

- Apply knowledge of state and national standards to inform science instruction and help students achieve learning objectives in science.
- Apply knowledge of planning and designing science instruction that addresses the needs of all students.
- Apply knowledge of instructional strategies and resources that promote active inquiry and encourage students' intellectual and social growth and development (e.g., conceptual understanding, collaboration), including those that require the application of scientific and engineering concepts to real-world scenarios.
- Apply knowledge of the strategies and resources for the incorporation of general life skills (e.g., reading, writing, mathematics, active inquiry, creative thinking, logical reasoning) into scientific contexts.
- Demonstrate knowledge of the strategies and skills associated with the use of technological and other resources in a classroom or laboratory setting.
- Demonstrate knowledge of methods for assessing students' understanding and mastery of basic scientific concepts, including the use of formal and informal assessment.
- Evaluate misconceptions or errors in student understanding or work.
- Demonstrate knowledge of safe laboratory practices and the safe handling of chemicals, materials, and organisms (e.g., source of materials, storage, potential hazards, dealing with injuries, ethical treatment of organisms).
- Demonstrate knowledge of age-related classroom management and procedures.