ILLINOIS LICENSURE TESTING SYSTEM

FIELD 203: MIDDLE GRADES (5–8) SCIENCE

TEST FRAMEWORK

June 2016

Effective beginning February 20, 2017

ILLINOIS LICENSURE TESTING SYSTEM

FIELD 203: MIDDLE GRADES (5–8) SCIENCE

TEST FRAMEWORK

June 2016

	Subarea	Range of Objectives
I.	Scientific and Engineering Practices and Crosscutting Concepts	0001–0003
II.	Physical Science	0004–0007
III.	Life Science	0008–0011
IV.	Earth and Space Science	0012–0014
V.	Disciplinary Literacy in Science	0015–0018

Effective beginning February 20, 2017

ILLINOIS LICENSURE TESTING SYSTEM

FIELD 203: MIDDLE GRADES (5–8) SCIENCE

TEST FRAMEWORK

Scientific and Engineering Practices and Crosscutting Concepts
Physical Science
Life Science
Earth and Space Science
Disciplinary Literacy in Science

SUBAREA I—SCIENTIFIC AND ENGINEERING PRACTICES AND CROSSCUTTING CONCEPTS

0001 Understand scientific practices.

For example:

- Evaluate questions that are empirically answerable.
- Apply knowledge of the use of models (e.g., diagrams, physical replicas, mathematical representations) to explain natural phenomena and the evidence on which the models are based.
- Demonstrate knowledge of planning and conducting scientific investigations, including the use of appropriate tools and technology.
- Demonstrate knowledge of safety rules and practices in the science classroom and laboratory.
- Apply mathematics and computational thinking to analyze and interpret data, represent physical variables and their relationships, make and test predictions, and assess the significance of patterns or correlations.
- Analyze explanations for natural phenomena by identifying strengths and weaknesses in lines of reasoning and evaluating multiple sources of evidence used to make a claim.
- Analyze how scientific knowledge and understanding have impacted peoples' lives and societal values throughout history.

0002 Understand engineering practices and design.

For example:

- Apply knowledge of engineering practices to define problems, determine criteria for a successful solution, and identify constraints.
- Demonstrate knowledge of past, current, and potential technological designs and innovations, and their impacts on society.
- Analyze designs in terms of their flaws, possible solutions, and strengths and limitations.
- Identify ways to obtain data essential to improving the effectiveness, efficiency, and durability of designs under a range of conditions.
- Analyze data, compare various potential solutions to a problem, and determine which design best solves a problem within given constraints.
- Apply knowledge of the engineering design process that is used to optimize design solutions.

0003 Understand crosscutting concepts.

For example:

- Identify patterns of forms and events that guide the organization and allow the classification of natural phenomena.
- Explain causal relationships and their mechanisms, and how they can be tested and used to predict and explain events in new contexts.
- Apply knowledge of how changes in scale, proportion, and quantity with respect to size, time, and energy affect a system's structure or performance.
- Apply knowledge of systems and system models that are applicable throughout science and engineering.
- Analyze how the flow, cycle, and conservation of energy and matter can be tracked within systems.
- Apply knowledge of how the shape and substructure of an object or living thing determine its properties and functions.
- Analyze how the conditions of stability and the determinants of the rates of change or evolution of a system determine the characteristics of the system.

SUBAREA II—PHYSICAL SCIENCE

0004 Understand the structure and properties of matter and chemical reactions.

For example:

- Demonstrate knowledge of the nuclear and atomic structure of matter (e.g., the three basic parts of the atom, the formation of molecules).
- Apply knowledge of the properties of materials in relation to their chemical or physical structures and evaluate uses of materials based on their properties.
- Analyze the characteristics of gases, liquids, and solids and the changes of state that occur with variations in temperature or pressure.
- Analyze the characteristics of chemical reactions, including their causes and effects, in the context of the conservation of mass, charge, and energy.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

0005 Understand forces and interactions.

For example:

- Apply knowledge of position, time, velocity, and acceleration and their interrelationships with respect to the motion of objects described in a given reference frame with appropriate units.
- Apply knowledge of forces (e.g., gravity, friction), inertia, energy, and momentum to predict motions and interactions involving forces within the context of conservation of energy and/or momentum.
- Apply knowledge of the characteristics of electric and magnetic forces and fields, and factors that effect their size and strength.
- Demonstrate knowledge of the effects and applications of electromagnetic forces in real-world situations.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

0006 Understand energy.

For example:

- Apply knowledge of kinetic energy and potential energy and their characteristics.
- Apply knowledge of temperature and the relationship between temperature and the total energy of a system.
- Apply knowledge of the conservation of energy, energy transfer, and the relationship between energy and forces in a variety of situations.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

0007 Understand waves and electromagnetic radiation and their applications.

For example:

- Apply characteristics of mechanical waves (e.g., sound, seismic, water) and electromagnetic waves.
- Apply knowledge of factors that determine whether light is reflected, absorbed, or transmitted through an object.
- Apply knowledge of the wave model of light and how it explains brightness, color, and the path of light at surfaces between different transparent materials.
- Demonstrate knowledge of the role of waves in information technologies and instrumentation.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

SUBAREA III—LIFE SCIENCE

0008 Understand structures and functions of organisms.

For example:

- Demonstrate knowledge of the structures and functions of cells.
- Apply knowledge of how cells are organized into subsystems and systems that work together for specialized body functions.
- Analyze how photosynthesis and respiration control the cycling of matter and the flow of energy into and out of organisms.
- Analyze characteristics and behaviors of organisms that increase the probability of successful reproduction.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

0009 Understand ecosystems.

For example:

- Demonstrate knowledge of the concepts of population, community, and ecosystem and how they are related.
- Apply knowledge of how organisms and populations of organisms are dependent on the interactions of abiotic factors and biotic factors in their environments.
- Apply knowledge of the patterns of interactions of organisms with both abiotic and biotic components of their environments that are shared across ecosystems.
- Analyze how matter and energy move through ecosystems.
- Apply knowledge of how ecosystems are dynamic, with characteristics that can change over time, and factors that can disrupt ecosystems.
- Analyze biodiversity as a measure of the health of ecosystems and how changes in biodiversity can affect the availability of resources for humans.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

0010 Understand heredity.

For example:

- Demonstrate knowledge of the molecular basis of heredity, including the structures, functions, and relationships of chromosomes, genes, and proteins.
- Apply knowledge of how genetic information is transmitted (e.g., Punnett squares, sex-linked traits, pedigree analysis).
- Apply knowledge of the mechanisms and effects of mutations.
- Compare and contrast asexual and sexual forms of reproduction.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

0011 Understand biological evolution.

For example:

- Apply knowledge of the various types of evidence that support the theory of evolution.
- Demonstrate knowledge of biological diversity, with emphasis on the evolutionary relationships between various groups of organisms.
- Analyze the processes of natural and artificial selection and how organisms become adapted to their environments.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

SUBAREA IV—EARTH AND SPACE SCIENCE

0012 Understand Earth's place in the universe.

For example:

- Apply knowledge of the cyclic patterns of motion of the sun, moon, planets, and stars in the sky.
- Demonstrate knowledge of the origin of the solar system, the objects in the solar system (e.g., planets, comets, asteroids), and the force that controls their interactions.
- Demonstrate knowledge of the types, properties, and dynamics of objects external to the solar system (e.g., black holes, supernovas, galaxies).
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to develop understanding of significant concepts and skills in science through hands-on experience with real materials.

0013 Understand Earth's systems.

For example:

- Demonstrate knowledge of planet Earth's geologic history and the types of evidence on which it is based.
- Demonstrate knowledge of the basic principles of plate tectonic theory, evidence supporting the theory, and the mechanisms of plate dynamics.
- Apply knowledge of the cycling of various materials through Earth's land, water, and atmospheric systems.
- Apply knowledge of the role of water in shaping Earth's landforms, both on the surface and underground.
- Demonstrate knowledge of how the characteristics of water drive ocean currents and transfer energy and how patterns of water movement in the atmosphere determine local weather patterns.
- Demonstrate knowledge of variables that determine climate.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

0014 Understand Earth and human activity.

For example:

- Demonstrate knowledge of the types, characteristics, and distributions of Earth's renewable and nonrenewable resources.
- Analyze the impacts of increasing human consumption of natural resources and methods used to preserve and protect them.
- Demonstrate knowledge of the impacts of human activities on the biosphere, ecosystems, species, populations, and the Earth as a whole, including global climate change.
- Demonstrate knowledge of the history and distribution of natural hazards and the underlying geologic forces and circumstances that are responsible (e.g., flooding, earthquakes, volcanic eruptions) and how this knowledge can help forecast future events.
- Select or analyze research-based instructional and assessment activities, methods, or strategies that use appropriate instructional materials, technology, and equipment and that allow students to explain phenomena and design solutions to problems by integrating scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

SUBAREA V—DISCIPLINARY LITERACY IN SCIENCE

0015 Apply knowledge of foundations of research-based disciplinary literacy instruction and assessment.

For example:

- Apply the scientific basis of teaching to plan, evaluate, and modify instruction in disciplinary literacy, and apply knowledge of appropriate research to identify and implement instructional practices and strategies to support the disciplinary literacy development of all students (e.g., English language learners, diverse learners).
- Demonstrate knowledge of the Illinois Learning Standards for English Language Arts and Literacy in History/Social Studies, Science and Technical Subjects (23 Ill. Adm. Code 1.Appendix D, State Goals for Learning) and recognize the influence of students' literacy skills on their performance on discipline-specific assessments.
- Apply knowledge of the use of a wide range of high-quality informational texts to support the development of disciplinary literacy, including selecting texts that address students' interests, backgrounds, and learning needs; estimating the difficulty level of text using readability measures and qualitative factors related to text complexity; choosing culturally responsive texts to promote students' understanding of their lives and society; using a variety of technologies to support disciplinary literacy instruction.
- Apply knowledge of the use of assessment to support students' development of disciplinary literacy (e.g., assessing students' interest and engagement) by using assessment data and student work samples to plan and evaluate disciplinary literacy instruction; providing feedback to students to help them understand how to improve performance; engaging students in self-assessment; and recognizing how to maintain and use accurate records of students' performance and progress.
- Analyze the needs of diverse learners with respect to the development of disciplinary literacy, including understanding the impact of cultural, linguistic, cognitive, academic, physical, social, and emotional differences on students' language and literacy development; and applying knowledge of strategies for supporting struggling readers and writers in the content-area classroom.
- Analyze strategies and routines that contribute to the development of a supportive language and literacy environment in the science classroom.

0016 Apply knowledge of academic-language and vocabulary development to support students' disciplinary literacy development in the science classroom.

For example:

- Analyze the role of academic language (i.e., the vocabulary and language structures used in oral and written academic discourse) in supporting students' understanding of academic concepts, content, skills, and processes and their comprehension of academic texts.
- Apply knowledge of criteria for selecting vocabulary for explicit word study in the science classroom (e.g., words central to a unit of study and/or the meaning of a text and likely to be unfamiliar to students).
- Apply knowledge of strategies that support students' ability to determine and/or verify the meaning of unfamiliar words in oral and written academic discourse, including the use of structural analysis, contextual analysis, and reference materials.
- Apply knowledge of a wide variety of strategies for reinforcing and expanding students' depth of understanding and retention of new discipline-specific vocabulary (e.g., using oral and written activities that support students' use of newly acquired vocabulary, utilizing authentic texts to help students develop word consciousness).
- Apply knowledge of strategies for promoting students' understanding of and ability to use various forms (e.g., sentence structures, text structures) and functions (e.g., interpreting, explaining, summarizing, classifying, comparing, justifying) of academic language to develop and express content understandings in the science classroom.
- Apply knowledge of strategies for promoting students' ability to analyze, interpret, and use conventions of Standard English grammar and usage (e.g., irregular plural nouns, past tense of irregular verbs, subject-verb agreement, pronoun-antecedent agreement, conjunctions, prepositions, interjections, perfect verb tenses) to support their listening comprehension, speaking, reading comprehension, and writing in the science classroom.
- Apply knowledge of differentiated instruction and appropriate assessment strategies in academic-language and vocabulary development that are responsive to the strengths and needs of all students, including employing various strategies, materials, pacing, and levels of text and language complexity to meet the diverse needs of learners in the science classroom.

0017 Apply knowledge of reading comprehension to support students' disciplinary literacy development in the science classroom.

For example:

- Apply knowledge of the organizational structures, rhetorical features, text features, and graphics commonly used in texts in the science classroom, including the characteristics of various genres and forms of informational texts and the role, perspective, and purpose of various texts.
- Analyze disciplinary text features that may impede students' reading comprehension (e.g., author's assumption of prior knowledge, use of unusual key vocabulary, complexity of sentences, unclear cohesive links, subtlety of relationships between ideas, sophistication of tone, complexity of text structure, use of data).
- Apply fundamental principles for instruction in reading comprehension in the content areas, including using scaffolding and close reading to enable students to understand and learn from challenging text, using active reading strategies to improve comprehension (e.g., visualizing, monitoring, questioning, summarizing, synthesizing, making inferences, evaluating), introducing texts efficiently while providing a clear purpose for reading, providing explicit instruction in note-taking and text annotation, using text-dependent questions, and guiding text-based discussions.
- Apply knowledge of strategies for promoting students' ability to trace and evaluate the argument and specific claims in texts and to distinguish claims that are supported by reasons and evidence from claims that are not supported.
- Apply knowledge of strategies for promoting students' ability to interpret graphic features of texts (e.g., tables, charts, illustrations, table of contents, captions, headings, indexes) and determine their relationship to the text (e.g., how well information in a graphic feature aligns with informational text).
- Apply knowledge of strategies for promoting students' ability to analyze the organizational structure of texts (e.g., chronological, sequential, cause/effect, compare/contrast); identify and analyze content in texts that indicates point of view, perspective, purpose, fact, opinion, speculation, and audience; recognize features of text common to the discipline; and consider how specific sentences, paragraphs, and larger portions of the text relate to each other and the text as a whole.
- Apply knowledge of strategies for promoting students' ability to read multiple texts to comparatively analyze and evaluate information in the texts and to synthesize information from the texts into a coherent understanding of a topic.
- Apply knowledge of differentiated instruction and appropriate assessment strategies in reading comprehension that are responsive to the strengths and needs of all students, including employing various strategies, materials, pacing, and levels of text and language complexity to meet the diverse needs of learners in the science classroom.

0018 Apply knowledge of the development of writing, listening, and speaking skills to support students' disciplinary literacy development in the science classroom.

For example:

- Apply fundamental principles for instruction in writing, listening, and speaking in the science classroom, including providing instructional support and opportunities for students to write, listen, and speak routinely for authentic purposes; providing feedback on written work and oral presentations to guide students' revisions; engaging students in writing and oral language activities to develop their understanding of scientific concepts and skills (e.g., participating in collaborative writing and discussions about science, asking science-based and text-based questions, reporting on a topic, recounting experiences related to scientific learning); and engaging students in using technology to produce and publish science-based writing and to interact and collaborate with others about science.
- Apply knowledge of strategies for promoting students' ability to present ideas and information effectively in the science classroom and to produce coherent and clear writing and oral presentations that reflect organization, development, substance (e.g., relevant facts and details), transitional devices, style, and use of technology (e.g., presentation software, media and visual displays) appropriate to the task, purpose, and audience.
- Apply knowledge of strategies for promoting students' ability to develop different types of content-based texts, including arguments, claims, and opinion pieces that are supported by valid reasoning and sufficient, relevant evidence; narrative texts that use description and pacing to develop and organize a sequence of events; and informative and explanatory texts that examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
- Apply knowledge of strategies for promoting students' ability to conduct scientific research projects, including how to select and develop topics; gather information from a variety of sources; assess the credibility and accuracy of sources; synthesize information; and avoid plagiarism through the use of appropriate paraphrasing and summarizing, and by quoting or citing sources following a standard format for citations.
- Apply knowledge of differentiated instruction and appropriate assessment strategies in writing, listening, and speaking that are responsive to the strengths and needs of all students, including employing various strategies, materials, pacing, and levels of text and language complexity to meet the diverse needs of learners in the science classroom.