Mississippi Science Test, Second Edition (MST2)

Grades 5 & 8

Blueprint-Interpretive Guide

October 2015

Carey M. Wright, Ed.D.

State Superintendent of Education

Mississippi Science Test, Second Edition
Grades 5 & 8 Blueprint Interpretive Guide

A Joint Publication

Division of Research and Development, Office of Student Assessment

- Dr. J. P. Beaudoin, Chief Research and Development Officer
- Walton Drane, Director of Operations and Test Security
- Marion Jones, Director of Support Services
- Richard Baliko, NAEP State Coordinator and ACT Program Coordinator
- Kimberly Jones, Division Director and Coordinator for SATP2, MST2, MWAP3
- Brooks Little, Test Security Investigator
- Michael Martin, Test Security Investigator
- Sharon Prestridge, Special Populations Coordinator
- Bobby Richardson, Educator in Residence
- Vincent Segalini, MAP Program Coordinator
- Patrice Williams, MKAS^2 State Coordinator
- Trishon Wilson, Administrative Assistant

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1.0 Purpose Statement

The Grades 5 and 8 Science assessments blueprints contain information about the make-up of the individual assessment, including the assessment strands, competencies, and objectives. number of core items, and number of field-test items. In addition, the blueprint identifies the number objectives per strand/competency, the number of scored items per strand/competency, and number of raw score points per competency. The blueprint serves as a roadmap for creating and selecting items and constructing the test form. The blueprint is used throughout the framework cycle of the assessment and is used in constructing the test forms for each administration.

1.1 Blueprint Design Overview

The Grades 5 & 8 Science Test Blueprints (Appendixes A & B) are developed to align with the grade 5 and grade 8 competencies and objectives in the *2010 Mississippi Science Framework* (Appendixes C and D: Grade 5 and 8 extracted). The grades 5 and 8 science assessments are aligned to the competencies. The Test Blueprint guiding the development of the science assessments delineates how the forty-five (45) grade 5 and fifty (50) grade 8 scored items on the assessments are dispersed throughout the competencies. The *2010 Mississippi Science Framework* is comprised of three content strands and five process strands; however, the grades 5 and 8 Science assessments are developed to the three content strands and one of the process strands:

- Inquiry,
- Physical Science,
- Life Science, and
- Earth and Space Science.

The remaining process strands are not listed separately throughout the frameworks; however, should be incorporated into the content. Under each of the tested strands, the blueprint delineates the competencies that will be measured. The Blueprint details how many objectives are associated with each competency and the number of items assessed per competency. Not all objectives are assessed on each form. More detailed information about the grades 5 and 8 science assessments can be found in the MST2 Technical Manuals and the 2014 MST2 Interpretive Guide.

Table 1.2 Interpreting the Blueprints

	Column A	**Column B**	**Column C**	**Column D**
Row # 1	**Strand Competency Objective**	**Objectives**	**Total Open ended (MC) Items**	**Total RS Points**
Row # 2	***Inquiry***	***8***	***7***	***7***
Row # 3	**1. Inquiry- Develop and demonstrate an understanding of scientific inquiry using process skills.**	**8**	**7**	**7**
Row # 4	a. Form a hypothesis, predict outcomes, and conduct a fair investigation that includes manipulating variables and using experimental controls. (DOK 3)			

- Row # 1 includes
    - headings that indicate the strand,
    - competencies,
    - objectives,
    - number of objectives per strand/competency,
    - total number of scored multiple choice items, and

  - total raw score points per strand/competency.

- Row # 2 identifies
  - the assessment or content strand
    - delineated by bold and italicized print.
- Row # 3 identifies
  - the competency number,
  - the competency,
  - the number of objectives assessed per competency,
  - the number of scored multiple-choice items per competency, and
  - the total raw score points per competency.
- Row # 4 identifies
  - the objective alphabet,
  - the objective, and
  - the DOK at which the objective is assessed.
- Column A identifies
  - the strand,
  - competency number,
  - a description of the competency, and
  - the objective alphabet,
  - the objective, and
  - the DOK at which the objective is assessed.
- Columns B identifies
  - the number of objectives per strand, and

- the number of objectives per competency.

- Column C identifies
  - the number of scored items per strand, and
  - the number of scored items per competency.

- Column D identifies
  - the number of raw score points per strand, and
  - the number of raw score points per competency.

1.3 Calculating Scores

Two types of scores are used for reporting student results: Raw Scores and Scale Scores. The raw score is the number of points earned per competency, which equates to the questions a student answers correctly. Item scores within each strand are summed to produce raw scores for each of the strands. This raw score alone has no meaning about a student's level of performance; therefore, is converted to a scale score. Scale scores are statistical conversions of raw scores that adjust for variations in the difficulty of items in different test forms and permit valid comparison across all test administrations. The scale score is the number the student receives that determines the student's level of performance as either advanced, proficient, basic, or minimal.

1.4 Item Type

1.4.1 Multiple-choice

All items on the grades 5 and 8 science assessment are multiple-choice items. Multiple-choice items are an efficient way to assess knowledge and skills, and they can be developed to measure each of the cognitive targets. A well-designed multiple-choice item contains a stem that clearly presents the question to the student. Item stems are written in the form of a question. An introductory statement that provides additional context may precede the stem. The stem is

followed by four answer choices or options with only one plausible correct option. The other three options are clear distractors but are not options designed to trick the student. Answer options do not include such choices as "none of the above," "both A and B," and "all of the above." In addition, each item on the assessment is assigned a performance level descriptor (PLD) of either advanced, proficient, basic or minimal. A certain percentage of the core items on an assessment must be at the advanced, proficient, and basic levels in order to assess the full range of the performance levels. The distribution make-up of items across PLD levels (Appendix E) also guides the development of the assessment.

2.0 Strands and Competencies

The blueprints for the grades 5 and 8 assessment indicate the number of items that will be written to each strand and competency. Both the grades 5 and 8 assessments are comprised of four competencies and each test item correlates to one of the competencies. The total number of items assessed per strand and competency varies. Whenever possible, all objectives within a competency should be covered on the assessment when the total number of points for a competency allows it. Advisory committees comprised of Mississippi science educators participated in the development of the blueprints. These educators utilized their expertise to assist with determining the number of items assessed per competency.

2.1 Inquiry

2.1a Items written to measure the Inquiry competency are written to measure a student's ability to 1) develop and demonstrate an understanding of scientific inquiry using process skills.

2.1b Items written to measure the Inquiry competency are written to measure a student's ability to 1) draw conclusions from scientific investigations including controlled experiments.

2.2 Physical Science

2.2a Items written to measure the Biochemical Basis of Life competency are written to measure a student's ability to 1) understand relationships of the properties of objects and materials, position and motion of objects, and transfer of energy to explain the physical world.

2.2b Items written to measure the Biochemical Basis of Life competency are written to measure a student's ability to 1) apply concepts relating to an understanding of chemical and physical changes, interactions involving energy, and forces that affect motion of objects.

2.3 Life Science

2.3a Items written to measure the Living Organisms and Their Environment competency are written to measure a student's ability to 1) predict characteristics, structures, life cycles, environments, evolution, and diversity of organisms.

2.3b Items written to measure the Living Organisms and Their Environment competency are written to measure a student's ability to 1) compare and contrast the structure and functions of the cell, levels of organization of living things, basis of heredity, and adaptations that explain variations in populations.

2.4 – Earth and Space Science

2.4a Items written to measure the Diversity and Biological Change competency are written to measure a student's ability to 1) develop an understanding of the properties of Earth materials, objects in the sky, and changes in Earth and sky.

2.4b Items written to measure the Diversity and Biological Change competency are written to measure a student's ability to 1) describe the Earth's System in terms of its position to objects in the universe, structure, and composition, climate, and renewable and nonrenewable resources.

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Appendix A

Mississippi Science Test, Second Edition

Fifth Grade Science Blueprint

Mississippi Science Test, Second Edition
Fifth Grade Science Blueprint

Strand Competency Objective	Objectives	Total Open-ended (MC) Items	Total RS Points
Inquiry	***8***	***7***	***7***
1. Develop and demonstrate an understanding of scientific inquiry using process skills.	***8***	***7***	***7***
a. Form a hypothesis, predict outcomes, and conduct a fair investigation that includes manipulating variables and using experimental controls. (DOK 3)			
b. Distinguish between observations and inferences. (DOK 2)			
c. Use precise measurement in conjunction with simple tools and technology to perform tests and collect data. (DOK 1) • Tools (English rulers [to the nearest one-sixteenth of an inch], metric rulers [to the nearest millimeter], thermometers, scales, hand lenses, microscopes, balances, clocks, calculators, anemometers, rain gauges, barometers, hygrometers) • Types of data (height, mass, volume, temperature, length, time, distance, volume, perimeter, area)			
d. Organize and interpret data in tables and graphs to construct explanations and draw conclusions. (DOK 2)			
e. Use drawings, tables, graphs, and written and oral language to describe objects and explain ideas and actions. (DOK 2)			
f. Make and compare different proposals when designing a solution or product. (DOK 2)			
g. Evaluate results of different data (whether trivial or significant). (DOK 2)			
h. Infer and describe alternate explanations and predictions. (DOK 3)			
Physical Science	***7***	***14***	***14***
2. Understand relationships of the properties of objects and materials, position and motion of objects, and transfer of energy to explain the physical world.	***7***	***14***	***14***
a. Determine how the properties of an object affect how it acts and interacts. (DOK 2)			

Strand Competency Objective	Objectives	Total Open-ended (MC) Items	Total RS Points
b. Differentiate between elements, compounds, and mixtures and between chemical and physical changes. (DOK 2)			
c. Investigate the motion of an object in terms of its position, direction of motion, and speed. (DOK 2) • The relative positions and movements of objects using points of reference • Force required to move an object using appropriate devices • Variables that affect speed • Effects of an unbalanced force on an object's motion in terms of speed and direction			
d. Categorize examples of potential energy as gravitational, elastic, or chemical. (DOK 2)			
e. Differentiate between the properties of light as reflection, refraction, and absorption. (DOK 1) • Image reflected by a plane mirror and a curved-surfaced mirror • Light passing through air or water • Optical tools such as prisms, lenses, mirrors, and eyeglasses			
f. Describe physical properties of matter including mixtures and solutions. (DOK 1) • Filtration, sifting, magnetism, evaporation, and flotation • Mass, density, boiling point, and freezing point of matter • Effects of temperature changes on the solubility of substances			
g. Categorize materials as conductors or insulators and discuss their real life applications. (DOK 2)			
Life Science	***5***	***10***	***10***
3. Predict characteristics, structures, life cycles, environments, evolution, and diversity of organisms.	**5**	**10**	**10**

Strand Competency Objective	Objectives	Total Open-ended (MC) Items	Total RS Points
a. Compare and contrast the diversity of organisms due to adaptations to show how organisms have evolved as a result of environmental changes. (DOK 2) • Diversity based on kingdoms, phyla, and classes • Adaptations that increase an organism's chances to survive and reproduce in a particular habitat • Evidence of fossils as indicators of how life and environmental conditions have changed			
b. Research and classify the organization of living things. (DOK 2) • Differences between plant and animal cells • Function of the major parts of body systems and the ways they support one another • Examples of organisms as single-celled or multi-celled			
c. Research and cite evidence of the work of scientists as it contributed to the discovery and prevention of disease. (DOK 3)			
d. Distinguish between asexual and sexual reproduction. (DOK 1) • Asexual reproduction processes in plants and fungi • Asexual cell division • Sexual reproduction			
e. Give examples of how consumers and producers are related in food chains and food webs. (DOK 1)			
Earth and Space Science	**7**	**14**	14
4. Develop an understanding of the properties of Earth materials, objects in the sky, and changes in Earth and sky.	7	14	14
a. Categorize Earth's materials. (DOK 1) • Rocks, minerals, soils, water, and atmospheric gases • Layers of the atmosphere, hydrosphere, and lithosphere			
b. Explain how surface features caused by constructive processes differ from destructive processes. (DOK 2)			

Strand Competency Objective	Objectives	Total Open-ended (MC) Items	Total RS Points
c. Summarize how weather changes. (DOK 2) • Weather changes from day to day and over the seasons • Tools by which weather is observed, recorded, and predicted			
d. Describe changes caused by humans on the environment and natural resources and cite evidence from research of ways to conserve natural resources in the United States, including (but not limited to) Mississippi. (DOK 2)			
e. Predict the movement patterns of the sun, moon, and Earth over a specified time period. (DOK 1)			
f. Compare and contrast the physical characteristics of the planets. (DOK 2)			
g. Conclude that the supply of many Earth resources is limited and critique a plan to extend the use of Earth's resources. (DOK 3)			

Note: MC = Multiple Choice; RS = Raw Score

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Appendix B

Grade 8 Blueprint

Mississippi Science Test, Second Edition
Eighth Grade Science Blueprint

Strand Competency Objective	Objectives	Total Open-ended (MC) Items	Total RS Points
Inquiry	***8***	***7***	***7***
1. Draw conclusions from scientific investigations including controlled experiments.	***8***	***7***	***7***
a. Design, conduct, and analyze conclusions from an investigation that includes using experimental controls. (DOK 3)			
b. Distinguish between qualitative and quantitative observations and make inferences based on observations. (DOK 3)			
c. Summarize data to show the cause and effect relationship between qualitative and quantitative observations (using standard, metric, and non-standard units of measurement). (DOK 3)			
d. Analyze evidence that is used to form explanations and draw conclusions. (DOK 3)			
e. Develop a logical argument defending conclusions of an experimental method. (DOK 3)			
f. Develop a logical argument to explain why perfectly designed solutions do not exist. (DOK 3)			
g. Justify a scientist's need to revise conclusions after encountering new experimental evidence that does not match existing explanations. (DOK 3)			
h. Analyze different ideas and recognize the skepticism of others as part of the scientific process in considering alternative conclusions. (DOK 3)			
Physical Science	***6***	***10***	***10***
2. Apply concepts relating to an understanding of chemical and physical changes, interactions involving energy, and forces that affect motion of objects.	***6***	***10***	***10***
a. Identify patterns found in chemical symbols, formulas, reactions, and equations that apply to the law of conservation of mass. (DOK 1)			
b. Predict the properties and interactions of given elements using the periodic table of the elements. (DOK 2)			
c. Distinguish the motion of an object by its position, direction of motion, speed, and acceleration and represent resulting data in graphic form in order to make a prediction. (DOK 2)			

Strand Competency Objective	Objectives	Total Open-ended (MC) Items	Total RS Points
d. Relate how electrical energy transfers through electric circuits, generators, and power grids, including the importance of contributions from Mississippi companies. (DOK 2)			
e. Contrast various components of the electromagnetic spectrum (e.g., infrared, visible light, ultraviolet) and predict their impacts on living things. (DOK 2)			
f. Recognize Newton's Three Laws of Motion and identify situations that illustrate each law. (DOK 2)			
Life Science	***8***	***18***	***18***
3. Compare and contrast the structure and functions of the cell, levels of organization of living things, basis of heredity, and adaptations that explain variations in populations.	**8**	**18**	**18**
a. Analyze how adaptations to a particular environment can increase an organism's survival and reproduction and relate organisms and their ecological niches to evolutionary change and extinction. (DOK 3)			
b. Compare and contrast the major components and functions of different types of cells. (DOK 2)			
c. Describe how viruses, bacteria, fungi, and parasites may infect the human body and interfere with normal body functions. (DOK 1)			
d. Describe heredity as the passage of instructions from one generation to another and recognize that hereditary information is contained in genes, located in the chromosomes of each cell. (DOK 2)			
e. Explain energy flow in a specified ecosystem. (DOK 2)			
f. Develop a logical argument for or against research conducted in selective breeding and genetic engineering, including (but not limited to) research conducted in Mississippi. (DOK 3)			
g. Research and draw conclusions about the use of single-celled organisms in industry, in the production of food, and impacts on life. (DOK 3)			
h. Describe how an organism gets energy from oxidizing its food and releasing some of its energy as heat. (DOK 1)			
Earth and Space Science	**8**	**15**	15

Strand Competency Objective	Objectives	Total Open-ended (MC) Items	Total RS Points
4. Describe the Earth's System in terms of its position to objects in the universe, structure, and composition, climate, and renewable and nonrenewable resources.	**8**	**15**	**15**
a. Compare and contrast the lithosphere and the asthenosphere. (DOK 1)			
b. Describe the cause and effect relationship between the composition of and movement within the Earth's lithosphere. (DOK 1)			
c. Examine weather forecasting and describe how meteorologists use atmospheric features and technology to predict the weather. (DOK 2)			
d. Research the importance of the conservation of renewable and nonrenewable resources, including (but not limited to) Mississippi, and justify methods that might be useful in decreasing the human impact on global warming. (DOK 3)			
e. Explain how the tilt of Earth's axis and the position of the Earth in relation to the sun determine climatic zones, seasons, and length of the days. (DOK 2)			
f. Describe the hierarchical structure (stars, clusters, galaxies, galactic clusters) of the universe and examine the expanding universe to include its age and history and the modern techniques used to measure objects and distances in the universe. (DOK 2)			
g. Justify the importance of continued research and use of new technology in the development and commercialization of potentially useful natural products, including, but not limited to research efforts in Mississippi. (DOK 3)			
h. Justify why an imaginary hurricane might or might not hit a particular area, using important technological resources including (but not limited to) the following: (DOK 2) • John C. Stennis Space Center Applied Research and Technology Project Office in Hancock County • National Oceanic and Atmospheric Administration (NOAA) • The National Weather Service			

Note: MC = Multiple Choice; RS = Raw Score

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Appendix C

Grade 5 Frameworks

FIFTH GRADE

The *Fifth Grade* competencies and objectives build on the *Kindergarten* through *Fourth* grade concepts. Students explore structure and function in living systems, reproduction and heredity, behavior, populations and ecosystems, diversity, and adaptations of organisms. Students also investigate properties and changes of properties in matter, motions, forces, transfer of energy, structure of the Earth system, Earth's history, and Earth in the solar system. Throughout the teaching process, inquiry, safety skills, the scientific method process, measuring, use of scientific equipment, current events, environmental factors, and hands-on activities should be emphasized.

The *Mississippi Science Framework* is comprised of three content strands: **Life Science, Earth and Space Science, and Physical Science.** The five process strands are **Science as Inquiry, Unifying Concepts and Processes, Science and Technology, Science in Personal and Social Perspectives, and the History and Nature of Science**. The three content strands, along with the five process strands, combine to provide continuity to the teaching of K-12 science. Even though the process strands are not listed throughout the framework, these strands should be incorporated when presenting the content of the curriculum. **Science as Inquiry** is listed as a separate strand in order to place emphasis on developing the ability to ask questions, to observe, to experiment, to measure, to problem solve, to gather data, and to communicate findings. **Inquiry is not an isolated unit of instruction and must be embedded throughout the content strands.**

The competencies, printed in bold face type, are the part of the framework that is required to be taught to all students. The Elementary/Middle School Science Tests and Biology I Subject Area Test are aligned to the competencies. Competencies do not have to be taught in the order presented in the framework. The competencies are presented in outline form for consistency and easy reference throughout the framework. Competencies are intentionally broad in order to allow school districts and teachers the flexibility to create a curriculum that meets the needs of their students. They may relate to one, many, or all of the science framework strands and may be combined and taught with other competencies throughout the school year. Competencies provide a guideline of on-going instruction, not isolated units, activities, or skills. The competencies are not intended to be a list of content skills that are taught and recorded as "mastered."

The objectives indicate how competencies can be fulfilled through a progression of content and concepts at each grade level and course. Many of the objectives are interrelated rather than sequential, which means that objectives are not intended to be taught in the specific order in which they are presented. Multiple objectives can and should be taught at the same time.

The Elementary/Middle School Science Test and Biology I Subject Area Test will be developed based on the objectives found in the framework. At least fifty percent (50%) of the test items on the Elementary/Middle School Science Test must match the Depth of Knowledge (DOK) level assigned to the objectives for each competency. The Depth of Knowledge (DOK) level is indicated at the end of each objective.

FIFTH GRADE

CONTENT STRANDS:

Inquiry **Life Science**
Physical Science **Earth and Space Science**

COMPETENCIES AND OBJECTIVES:

INQUIRY

1. Develop and demonstrate an understanding of scientific inquiry using process skills.

a. Form a hypothesis, predict outcomes, and conduct a fair investigation that includes manipulating variables and using experimental controls. (DOK 3)
b. Distinguish between observations and inferences. (DOK 2)
c. Use precise measurement in conjunction with simple tools and technology to perform tests and collect data. (DOK 1)
    - Tools (English rulers [to the nearest one-sixteenth of an inch], metric rulers [to the nearest millimeter], thermometers, scales, hand lenses, microscopes, balances, clocks, calculators, anemometers, rain gauges, barometers, hygrometers)
    - Types of data (height, mass, volume, temperature, length, time, distance, volume, perimeter, area)
d. Organize and interpret data in tables and graphs to construct explanations and draw conclusions. (DOK 2)
e. Use drawings, tables, graphs, and written and oral language to describe objects and explain ideas and actions. (DOK 2)
f. Make and compare different proposals when designing a solution or product. (DOK 2)
g. Evaluate results of different data (whether trivial or significant). (DOK 2)
h. Infer and describe alternate explanations and predictions. (DOK 3)

PHYSICAL SCIENCE

2. Understand relationships of the properties of objects and materials, position and motion of objects, and transfer of energy to explain the physical world.

a. Determine how the properties of an object affect how it acts and interacts. (DOK 2)
b. Differentiate between elements, compounds, and mixtures and between chemical and physical changes (e.g., gas evolves, color, and/or temperature changes). (DOK 2)

c. Investigate the motion of an object in terms of its position, direction of motion, and speed. (DOK 2)
   - The relative positions and movements of objects using points of reference (distance vs. time of moving objects)
   - Force required to move an object using appropriate devices (e.g., spring scale)
   - Variables that affect speed (e.g., ramp height/length/surface, mass of object)
   - Effects of an unbalanced force on an object's motion in terms of speed and direction

d. Categorize examples of potential energy as gravitational (e.g., boulder on a hill, child on a slide), elastic (e.g., compressed spring, slingshot, rubber band), or chemical (e.g., unlit match, food). (DOK 2)

e. Differentiate between the properties of light as reflection, refraction, and absorption. (DOK 1)
   - Image reflected by a plane mirror and a curved-surfaced mirror
   - Light passing through air or water
   - Optical tools such as prisms, lenses, mirrors, and eyeglasses

f. Describe physical properties of matter (e.g., mass, density, boiling point, freezing point) including mixtures and solutions. (DOK 1)
   - Filtration, sifting, magnetism, evaporation, and flotation
   - Mass, density, boiling point, and freezing point of matter
   - Effects of temperature changes on the solubility of substances

g. Categorize materials as conductors or insulators and discuss their real life applications (e.g., building construction, clothing, animal covering). (DOK 2)

LIFE SCIENCE

3. Predict characteristics, structures, life cycles, environments, evolution, and diversity of organisms.

a. Compare and contrast the diversity of organisms due to adaptations to show how organisms have evolved as a result of environmental changes. (DOK 2)
   - Diversity based on kingdoms, phyla, and classes (e.g., internal/external structure, body temperature, size, shape)
   - Adaptations that increase an organism's chances to survive and reproduce in a particular habitat (e.g., cacti needles/leaves, fur/scales)
   - Evidence of fossils as indicators of how life and environmental conditions have changed

b. Research and classify the organization of living things. (DOK 2)
   - Differences between plant and animal cells
   - Function of the major parts of body systems (nervous, circulatory, respiratory, digestive, skeletal, muscular) and the ways they support one another
   - Examples of organisms as single-celled or multi-celled

c. Research and cite evidence of the work of scientists (e.g., Pasteur, Fleming,

Salk) as it contributed to the discovery and prevention of disease. (DOK 3)

d. Distinguish between asexual and sexual reproduction. (DOK 1)
    - Asexual reproduction processes in plants and fungi (e.g., vegetative propagation in stems, roots, and leaves of plants, budding in yeasts, fruiting bodies in fungi)
    - Asexual cell division (mushroom spores produced/dispersed)
    - Sexual reproduction (e.g., eggs, seeds, fruit)
e. Give examples of how consumers and producers (carnivores, herbivores, omnivores, and decomposers) are related in food chains and food webs. (DOK 1)

EARTH AND SPACE SCIENCE

4. Develop an understanding of the properties of Earth materials, objects in the sky, and changes in Earth and sky.

a. Categorize Earth's materials. (DOK 1)
    - Rocks, minerals, soils, water, and atmospheric gases
    - Layers of the atmosphere, hydrosphere, and lithosphere
b. Explain how surface features caused by constructive processes (e.g., depositions, volcanic eruptions, earthquakes) differ from destructive processes (e.g., erosion, weathering, impact of organisms). (DOK 2)
c. Summarize how weather changes. (DOK 2)
    - Weather changes from day to day and over the seasons
    - Tools by which weather is observed, recorded, and predicted
d. Describe changes caused by humans on the environment and natural resources and cite evidence from research of ways to conserve natural resources in the United States, including (but not limited to) Mississippi. Examples of Mississippi efforts include the following: (DOK 2)
    - Associated Physics of America, a private company located in Greenwood Mississippi, develops ways to convert a variety of agricultural products into efficient, environment-friendly and cost-effective energy sources.
    - The Natural Resource Enterprises (NRE) Program of the Department of Wildlife and Fisheries and the Cooperative Extension Service at MSU educate landowners in the Southeast about sustainable natural resource enterprises and compatible habitat management practices.
    - The Engineer Research and Development Center of the Vicksburg District of the U.S. Army Corps of Engineers provides quality engineering and other professional products and services to develop and manage the Nation's water resources, reduce flood damage, and protect the environment.
e. Predict the movement patterns of the sun, moon, and Earth over a specified time period. (DOK 1)
f. Compare and contrast the physical characteristics of the planets (e.g., mass, surface gravity, distance from the sun, surface characteristics, moons). (DOK 2)

g. Conclude that the supply of many Earth resources (e.g., fuels, metals, fresh water, farmland) is limited and critique a plan to extend the use of Earth's resources (e.g., recycling, reuse, renewal). (DOK 3)

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Appendix D

Grade 8 Framework

EIGHTH GRADE

The *Eighth Grade* competencies and objectives build on the Kindergarten through Seventh grade concepts and explore the joint enterprises of science and technology and the interrelationships of these to each other in the context of society and the environment. Eighth grade science is designed to build connections that link technology and societal impacts to topics such as properties and changes of properties of matter, motions and forces, energy transfer, structure and function in living systems, and the structure of the Earth system. Throughout the teaching process, inquiry, safety skills, the scientific method process, measuring, use of scientific equipment, current events, environmental, and hands-on activities should be emphasized.

The *Mississippi Science Framework* is comprised of three content strands: **Life Science, Earth and Space Science, and Physical Science.** The five process strands are **Science as Inquiry, Unifying Concepts and Processes, Science and Technology, Science in Personal and Social Perspectives, and the History and Nature of Science**. The three content strands, along with the five process strands, combine to provide continuity to the teaching of K-12 science. Even though the process strands are not listed throughout the framework, these strands should be incorporated when presenting the content of the curriculum. **Science as Inquiry** is listed as a separate strand in order to place emphasis on developing the ability to ask questions, to observe, to experiment, to measure, to problem solve, to gather data, and to communicate findings. **Inquiry is not an isolated unit of instruction and must be embedded throughout the content strands.**

The competencies, printed in bold face type, are the part of the framework that is required to be taught to all students. The Elementary/Middle School Science Tests and Biology I Subject Area Test are aligned to the competencies. Competencies do not have to be taught in the order presented in the framework. The competencies are presented in outline form for consistency and easy reference throughout the framework. Competencies are intentionally broad in order to allow school districts and teachers the flexibility to create a curriculum that meets the needs of their students. They may relate to one, many, or all of the science framework strands and may be combined and taught with other competencies throughout the school year. Competencies provide a guideline of on-going instruction, not isolated units, activities, or skills. The competencies are not intended to be a list of content skills that are taught and recorded as “mastered.”

The objectives indicate how competencies can be fulfilled through a progression of content and concepts at each grade level and course. Many of the objectives are interrelated rather than sequential, which means that objectives are not intended to be taught in the specific order in which they are presented. Multiple objectives can and should be taught at the same time.

The Elementary/Middle School Science Test and Biology I Subject Area Test will be developed based on the objectives found in the framework. At least fifty percent (50%) of the test items on the Elementary/Middle School Science Test must match the Depth of Knowledge (DOK) level assigned to the objectives for each competency. The Depth of Knowledge (DOK) level is indicated at the end of each objective.

Eighth Grade

CONTENT STRANDS:

Inquiry **Life Science**
Physical Science **Earth and Space Science**

COMPETENCIES AND OBJECTIVES:

INQUIRY

1. Draw conclusions from scientific investigations including controlled experiments.

a. Design, conduct, and analyze conclusions from an investigation that includes using experimental controls. (DOK 3)
b. Distinguish between qualitative and quantitative observations and make inferences based on observations. (DOK 3)
c. Summarize data to show the cause and effect relationship between qualitative and quantitative observations (using standard, metric, and non-standard units of measurement). (DOK 3)
    - Tools (e.g., English rulers [to the nearest one-sixteenth of an inch], metric rulers [to the nearest millimeter], thermometers, scales, hand lenses, microscopes, balances, clocks, calculators, anemometers, rain gauges, barometers, hygrometers, telescopes, compasses, spring scales, pH indicators, stopwatches, graduated cylinders, medicine droppers)
    - Types of data (e.g., linear measures, mass, volume, temperature, area, perimeter)
    - Resources (e.g., Internet, electronic encyclopedias, journals, community resources, etc.)
d. Analyze evidence that is used to form explanations and draw conclusions. (DOK 3)
e. Develop a logical argument defending conclusions of an experimental method. (DOK 3)
f. Develop a logical argument to explain why perfectly designed solutions do not exist. (DOK 3)
g. Justify a scientist's need to revise conclusions after encountering new experimental evidence that does not match existing explanations. (DOK 3)
h. Analyze different ideas and recognize the skepticism of others as part of the scientific process in considering alternative conclusions. (DOK 3)

PHYSICAL SCIENCE

2. Apply concepts relating to an understanding of chemical and physical changes, interactions involving energy, and forces that affect motion of objects.

a. Identify patterns found in chemical symbols, formulas, reactions, and equations that apply to the law of conservation of mass. (DOK 1)
   - Chemical symbols and chemical formulas of common substances such as NaCl (table salt), H_20 (water), $C_6H_{12}O_6$ (sugar), O_2 (oxygen gas), CO_2 (carbon dioxide), and N_2 (nitrogen gas)
   - Mass of reactants before a change and products after a change
   - Balanced chemical equations such as photosynthesis and respiration

b. Predict the properties and interactions of given elements using the periodic table of the elements. (DOK 2)
   - Metals and nonmetals
   - Acids and bases
   - Chemical changes in matter (e.g., rusting [slow oxidation], combustion [fast oxidation], food spoilage)

c. Distinguish the motion of an object by its position, direction of motion, speed, and acceleration and represent resulting data in graphic form in order to make a prediction. (DOK 2)

d. Relate how electrical energy transfers through electric circuits, generators, and power grids, including the importance of contributions from Mississippi companies. (DOK 2)
   - The Electrical Power Products Division of Howard Industries, a leading manufacturer of electrical distribution equipment in such locations as Laurel and Ellisville, MS
   - Kuhlman Electric Corporation, located in Crystal Springs, MS

e. Contrast various components of the electromagnetic spectrum (e.g., infrared, visible light, ultraviolet) and predict their impacts on living things. (DOK 2)

f. Recognize Newton's Three Laws of Motion and identify situations that illustrate each law (e.g., inertia, acceleration, action, reaction forces). (DOK 2)

LIFE SCIENCE

3. Compare and contrast the structure and functions of the cell, levels of organization of living things, basis of heredity, and adaptations that explain variations in populations.

a. Analyze how adaptations to a particular environment (e.g., desert, aquatic, high altitude) can increase an organism's survival and reproduction and relate organisms and their ecological niches to evolutionary change and extinction. (DOK 3)

b. Compare and contrast the major components and functions of different types of cells. (DOK 2)
    - Differences in plant and animal cells
    - Structures (nucleus, cytoplasm, cell membrane, cell wall, mitochondrion, and nuclear membrane)
    - Different types of cells and tissues (e.g., epithelial, nerve, bone, blood, muscle)

c. Describe how viruses, bacteria, fungi, and parasites may infect the human body and interfere with normal body functions. (DOK 1)

d. Describe heredity as the passage of instructions from one generation to another and recognize that hereditary information is contained in genes, located in the chromosomes of each cell. (DOK 2)
    - How traits are passed from parents to offspring through pairs of genes
    - Phenotypes and genotypes
    - Hierarchy of DNA, genes, and chromosomes and their relationship to phenotype
    - Punnett square calculations

e. Explain energy flow in a specified ecosystem. (DOK 2)
    - Populations, communities, and habitats
    - Niches, ecosystems and biomes
    - Producers, consumers and decomposers in an ecosystem

f. Develop a logical argument for or against research conducted in selective breeding and genetic engineering, including (but not limited to) research conducted in Mississippi. Examples from Mississippi include the following: (DOK 3)
    - The Animal Functional Genomics Laboratory at Mississippi State University
    - The Stoneville Pedigreed Seed Company in Stoneville, MS
    - Catfish Genetics Research Unit at the Thad Cochran National Warm Water Aquaculture Center in Stoneville, MS

g. Research and draw conclusions about the use of single-celled organisms in industry, in the production of food, and impacts on life. (DOK 3)

h. Describe how an organism gets energy from oxidizing its food and releasing some of its energy as heat. (DOK 1)

EARTH AND SPACE SCIENCE

4. Describe the Earth's System in terms of its position to objects in the universe, structure and composition, climate, and renewable and nonrenewable resources.

a. Compare and contrast the lithosphere and the asthenosphere. (DOK 1)
- Composition, density, and location of continental crust and oceanic crust
- Physical nature of the lithosphere (brittle and rigid) with the asthenosphere (plastic and flowing)
- How the lithosphere responds to tectonic forces (faulting and folding)

b. Describe the cause and effect relationship between the composition of and movement within the Earth's lithosphere. (DOK 1)
- Seismic wave velocities of earthquakes and volcanoes to lithospheric plate boundaries using seismic data
- Volcanoes formed at mid-ocean ridges, within intra-plate regions, at island arcs, and along some continental edges
- Modern distribution of continents to the movement of lithospheric plates since the formation of Pangaea

c. Examine weather forecasting and describe how meteorologists use atmospheric features and technology to predict the weather. (DOK 2)
- Temperature, precipitation, wind (speed/direction), dew point, relative humidity, and barometric pressure
- How the thermal energy transferred to the air results in vertical and horizontal movement of air masses, Coriolis effect
- Global wind patterns (e.g., trade winds, westerlies, jet streams)
- Satellites and computer modeling

d. Research the importance of the conservation of renewable and nonrenewable resources, including (but not limited to) Mississippi, and justify methods that might be useful in decreasing the human impact on global warming. (DOK 3)
- Greenhouse gases
- The effects of the human population
- Relationships of the cycles of water, carbon, oxygen, and nitrogen

e. Explain how the tilt of Earth's axis and the position of the Earth in relation to the sun determine climatic zones, seasons, and length of the days. (DOK 2)

f. Describe the hierarchical structure (stars, clusters, galaxies, galactic clusters) of the universe and examine the expanding universe to include its age and history and the modern techniques (e.g., radio, infrared, ultraviolet and X-ray astronomy) used to measure objects and distances in the universe. (DOK 2)

g. Justify the importance of continued research and use of new technology in the development and commercialization of potentially useful natural products, including, but not limited to research efforts in Mississippi. (DOK 3)
    - The Thad Cochran National Center for Natural Products Research, housed at the University of Mississippi
    - The Jamie Whitten Delta States Research Center in Stoneville, MS,
    - The Mississippi Polymer Institute, housed at the University of Southern Mississippi

h. Justify why an imaginary hurricane might or might not hit a particular area, using important technological resources including (but not limited to) the following: (DOK 2)
    - John C. Stennis Space Center Applied Research and Technology Project Office in Hancock County
    - National Oceanic and Atmospheric Administration (NOAA)
    - The National Weather Service

Mississippi Science Test, Second Edition
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Appendix E

Distribution of Performance Level Descriptors

Table II-3 Test Blueprint of PLDs

	Grade 5			Grade 8		
Competency	**Basic**	**Proficient**	**Advanced**	**Basic**	**Proficient**	**Advanced**
1. Inquiry	0-2	4-5	0-2	0-2	4-5	0-2
2. Physical Science	0-3	9-10	0-2	1-4	5-8	0-2
3. Life Science	0-2	6-7	0-2	1-4	11-15	1-4
4. Earth and Space Science	0-3	9-10	0-3	0-3	9-11	2-4
Total	7-8	30	5-7	8-9	33-34	5-7
Percent	15-18%	67-73%	12-15%	15-18%	67-73%	12-15%

Source: MST2 2013-2014 Technical Manual