

# **Draft Mississippi Science Framework**

**2010**

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## MISSION STATEMENT

The Mississippi Department of Education is dedicated to student success including the improvement of student achievement in science in order to produce citizens who are capable of making complex decisions, solving complex problems, and communicating fluently in a technological society. Through the utilization of the *2010 Mississippi Science Framework*, teachers will challenge their students to think more deeply about the science content, thus improving student understanding of science. This document is based on premises that all children can learn, and that high expectations produce high achievement.

## PURPOSE

The primary purpose of the *2010 Mississippi Science Framework* is to provide a basis for curriculum development for K-12 teachers. The framework provides an outline of what students should learn through competencies and objectives. The *2010 Mississippi Science Framework* replaces the *2001 Mississippi Science Framework*. The content of the framework is centered on the strands of **inquiry, physical science, life science, and Earth and space science**. Instruction in these areas is designed to expose students to experiences which reflect how science should be valued, to enhance students' confidence in their ability to apply scientific processes, and to help students learn to communicate and reason scientifically. The *2010 Mississippi Science Framework* provides teachers with the systematic progression across grade levels and is written to ensure the development of essential science concepts that students will utilize as they pursue a career or continue their education.

## THE REVISION PROCESS FOR THE SCIENCE FRAMEWORK

From nominations by school district superintendents and others, the Mississippi Science Curriculum Writing Team was selected in July 2005. The purpose of the team was to draft a new science framework. The team was composed of teachers, administrators, and university professors throughout Mississippi.

In order to gain a sufficient understanding of the direction of science education, the writing team reviewed the *National Science Education Standards, Benchmarks for Science Literacy*, the *Science Framework for the 2010 National Assessment of Educational Progress (NAEP)*, current literature, and research. These resources served as a foundation for the development of the framework.

The Mississippi Department of Education solicited comment from the Norman Webb Group and other outside evaluators to assure a vertical flow of science with emphasis on rigorous science content and alignment with national standards.

## CYCLE

All Mississippi content area frameworks are revised on a six-year cycle. Approximately three years after a framework is implemented, a writing team is selected to review the current framework and make modifications based on best practices in the teaching of content areas as reflected in state and national trends. The revision process is approximately two years.

The pilot (optional) year for the *2010 Mississippi Science Framework* is school year 2009-2010. The implementation (required) year for the framework is school year 2010-2011.

# FOURTH GRADE

The *Fourth Grade* competencies and objectives are designed to build on concepts and processes learned in Kindergarten through Third grade. Students explore and investigate the diversity of organisms, environmental concerns, matter, forces, and energy. Students apply their understanding of appropriate science concepts, principles, laws and theories in interacting with society and the environment and use the processes of science in solving problems, making decisions, and furthering understanding.

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.

# FOURTH GRADE

## CONTENT STRANDS:

Inquiry  
Physical Science

Life Science  
Earth and Space Science

## COMPETENCIES AND OBJECTIVES:

### INQUIRY

#### 1. Explain and use skills necessary to conduct scientific inquiry.

- a. Form hypotheses and predict outcomes of problems to be investigated. (DOK 3)
- b. Use the senses and simple tools to gather qualitative information about objects or events (size, shape, color, texture, sound, position, change). (DOK 1)
- c. Demonstrate the accurate use of simple tools to gather and compare information (DOK 1)
  - Tools (English rulers [to the nearest eighth of an inch], metric rulers [to the nearest centimeter], thermometers, spring scales, hand lenses, balances, microscopes, calculators, clocks, anemometers, rain gauges)
  - Types of data (height, mass/weight, temperature, length, distance, volume, area, perimeter)
- d. Use simple sketches, diagrams, tables, charts, and writing to draw conclusions and communicate data results. (DOK 2)
- e. Interpret and describe patterns of data using drawings, diagrams, charts, tables, graphs, and maps. (DOK 2)
- f. Explain why scientists and engineers often work in teams with different individuals doing different things that contribute to the results. (DOK 2)
- g. Draw conclusions about important steps (e.g., making observations, asking questions, trying to solve a problem, etc.) that led to inventions and discoveries. (DOK 3)

### PHYSICAL SCIENCE

#### 2. Use the properties of objects and materials, position and motion of objects, and transfer of energy to develop an understanding of physical science concepts.

- a. Recognize that materials may be composed of parts that are too small to be seen without magnification. (DOK 1)

- b. Distinguish between physical and chemical changes and between objects composed of a single substance from those composed of more than one substance. (DOK 2)
- c. Determine the causes and effects of forces on motion. (DOK 2)
  - Force exerted over a distance causes work to be done and that the result (work) is the product of force and distance
  - Friction on moving objects and actions that increase or decrease friction
  - Momentum and inertia
- d. Explain how energy flowing through an electrical circuit can be converted from electrical energy to light, sound, or heat energy. (DOK1)
  - Parts of an electric circuit and resulting actions when circuits are opened or closed
  - Construction and uses of electromagnets
  - Energy transferred through an electrical circuit to a bulb or bell to its surroundings as light, sound, and heat (thermal) energy
- e. Describe how light behaves (travels in a straight line, is absorbed, reflected, refracted, or appears transparent or translucent). (DOK 1)
- f. Investigate and draw conclusions about the relationship between the rate of vibrating objects and the pitch of the sound. (DOK 3)
- g. Describe how heat flows from a warm object to a cold one and categorize examples of materials that may or may not be used as insulators. (DOK 2)

## **LIFE SCIENCE**

### **3. Analyze the characteristics, structures, life cycles, and environments of organisms.**

- a. Describe the cause and effect relationships that explain the diversity and evolution of organisms over time. (DOK 2)
  - Observable traits due to inherited or environmental adaptations
  - Variations in environment (over time and from place to place)
  - Variations in species as exemplified by fossils
  - Extinction of a species due to insufficient adaptive capability in the face of environmental changes
- b. Classify the organs and functions of the nervous, circulatory, and respiratory systems of the body. (DOK 1)
- c. Compare characteristics of organisms, including growth and development, reproduction, acquisition and use of energy, and response to the environment. (DOK 2)
  - Life cycles of various animals to include complete and incomplete metamorphosis
  - Plant or animal structures that serve different functions in growth, adaptation, and survival
  - Photosynthesis

- d. Distinguish the parts of plants as they relate to sexual reproduction and explain the effects of various actions on the pollination process (e.g., wind, water, insects, adaptations of flowering plants, negative impacts of pesticides). (DOK 2)
- e. Analyze food webs to interpret how energy flows from the sun. (DOK 2)
- f. Describe the structural and functional relationships among the cells of an organism. (DOK 2)
  - Benefit from cooperating
  - Vary greatly in appearance
  - Perform very different roles

## **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. Classify sedimentary, metamorphic, and igneous rocks. (DOK 2)
- b. Compare and contrast Earth's geological features and the changes caused by external forces. (DOK 2)
  - Bodies of water, beaches, ocean ridges, continental shelves, plateaus, faults, canyons, sand dunes, and ice caps
  - External forces including heat, wind, and water
  - Movement of continental plates
- c. Investigate, record, analyze and predict weather by observing, measuring with simple weather instruments, and recording weather data (e.g., temperature, precipitation, sky conditions, weather events), and using past patterns to predict future patterns. (DOK 2)
- d. Describe how human activities have decreased the capacity of the environment to support some life forms. (DOK 2)
  - Reducing the amount of forest cover
  - Increasing the amount of chemicals released into the atmosphere
  - Farming intensively
- e. Compare and contrast the seasons and explain why seasons vary at different locations on Earth. (DOK 2)
- f. Describe objects in the universe including their movement. (DOK 2)
  - Physical features of the moon (craters, plains, mountains)
  - Appearance and movement of Earth and its moon (e.g., waxing/waning of the moon and lunar/solar eclipses)
  - Why a planet can be seen in different constellations (locations) at different times
- g. Summarize the process that results in deposits of fossil fuels and conclude why fossil fuels are classified as nonrenewable resources. (DOK 2)

# 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.

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**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**  
**Physical Science**

**Life 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
  - 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)