

# Ohio's Learning Content Standards: Science

Adopted July 2011

## GUIDING PRINCIPLES

The Revised Science Education Standards have been informed by international and national studies, educational stakeholders and academic content experts. The guiding principles include:

- **Definition of Science:** Science is a systematic method of continuing investigation, based on observation, scientific hypothesis testing, measurement, experimentation and theory building, which leads to explanations of natural phenomena, processes or objects that are open to further testing and revision based on evidence. Scientific knowledge is logical, predictive and testable, and grows and advances as new evidence is discovered.
- **Scientific Inquiry:** There is no science without inquiry. Scientific inquiry is a way of knowing and a process of doing science. It is the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas as well as an understanding of how scientists study the natural world. Teachers need to model scientific inquiry by teaching with inquiry.
- **21<sup>st</sup> Century Skills:** 21<sup>st</sup> century skills are integral to the science standards and curriculum development revision documents. They are an essential part of the model curriculum component through the incorporation and integration of scientific inquiry, science skills and process and technological and engineering design. As enumerated by Am. Sub. H.B. 1, these skills include: creativity and innovation; critical thinking, problem solving and communication; information, media and technological literacy; personal management, productivity, accountability, leadership and responsibility; and interdisciplinary, project-based, real-world learning opportunities.
- **Technological Design:** Technological design is a problem or project- based way of applying creativity, science, engineering and mathematics to meet a human need or want. Modern science is an integrated endeavor. Technological design integrates learning by using science, technology, engineering and mathematics and fosters 21<sup>st</sup> Century Skills.
- **Technology and Engineering:** Technology modifies the natural world through innovative processes, systems, structures and devices to extend human abilities. Engineering is design under constraint that develops and applies technology to satisfy human needs and wants. Technology and engineering, coupled with the knowledge and methods derived from science and mathematics, profoundly influence the quality of life.

- **Depth of Content:** It is vital that the *Content Statements and Content Elaborations* within the standards document communicate the most essential concepts and the complexity of the discipline in a manner that is manageable and accessible for teachers. The focus is on what students must know to master the specific grade-level content. The *Expectations for Learning* cognitive demands provide the means by which students can demonstrate this grade-level mastery.

- **Internationally Benchmarked:** Ohio's Revised Science Education Standards and Model Curriculum incorporate research from investigations of the science standards of:

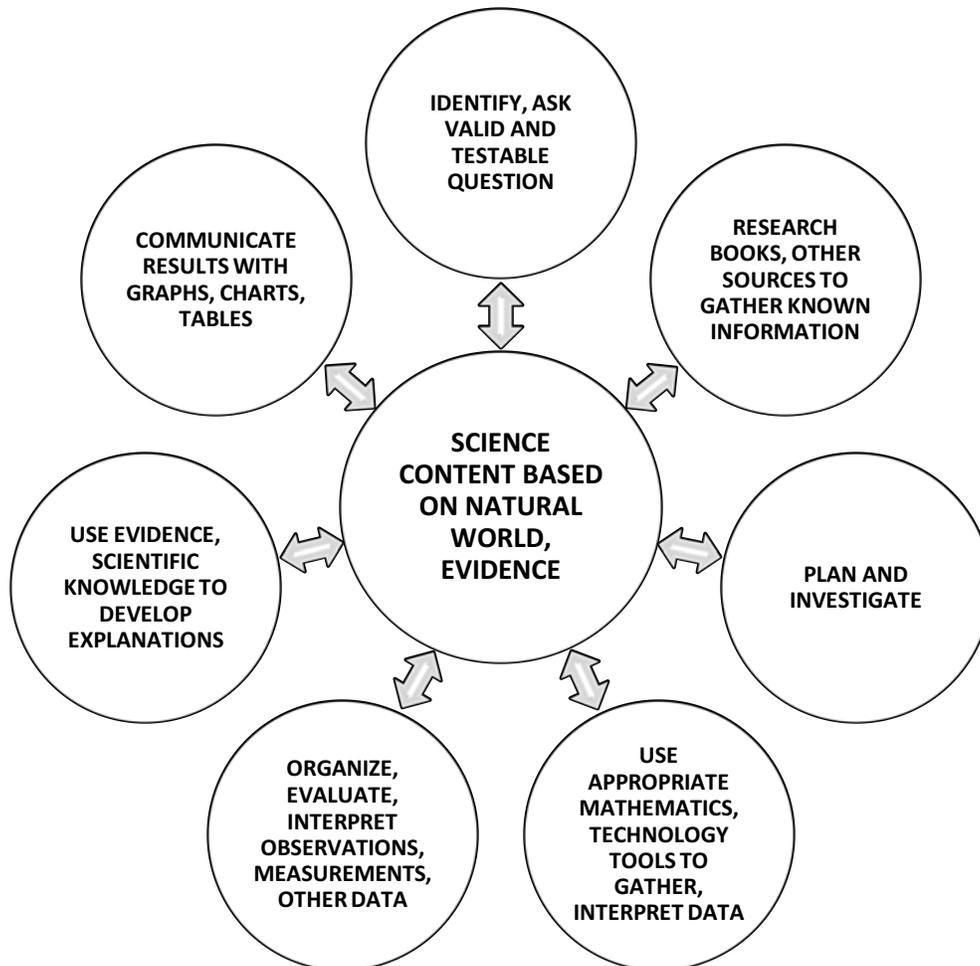
- Countries whose students demonstrate high-performance on both the Trends in International Mathematics and Science Studies (TIMSS) and Program in Student Assessment (PISA) tests; and
- States with students who perform well on the National Assessment of Education Progress (NAEP). As a result, there is a clear focus on rigor, relevance, coherence and organization, with an emphasis on horizontal and vertical articulation of content within and across disciplines.

- **Assessment:** Ohio's assessment system will be informed by and aligned with the *Content Statements, Content Elaborations and Expectations for Learning*.

- **Standards and Curriculum:** The Standards and Model Curriculum provide a framework from which local curricula can be developed. They themselves are not the curriculum. The curriculum will continue to be a local responsibility.

# SCIENTIFIC INQUIRY/LEARNING CYCLE

EVALUATE...ENGAGE...EXPLORE...



EXPLAIN...EXTEND...EVALUATE...

Teachers using the 5Es and grounded in the content of the revised science standards will be able to:

- Scaffold their students in framing questions, grappling with data, creating explanations, and critiquing explanations (including others in public forums) – all important components of inquiry.
- Select instructional materials from the Model Curriculum that promote the teaching and learning of science by inquiry.
- Assess students' abilities in multiple ways that are compatible with inquiry.

Students engaging with grade appropriate science content in depth through the Scientific Inquiry/Learning Cycle will be better prepared to meet the challenges they will be confronting as they enter higher education or pursue a career.

# Science Content Themes by Grade Band

## K-2 Observations of the Environment

This theme focuses on helping students develop the skills for systematic discovery to understand the science of the natural world around them in greater depth by using scientific inquiry.

## 3-5 Interconnections within Systems

This theme focuses on helping students explore the components of various systems and then investigate dynamic and sustainable relationships within systems using scientific inquiry.

# Science Content Topics by Grade Level

## Kindergarten

Living and nonliving things have specific physical properties that can be used to sort and classify. The physical properties of air and water are presented as they apply to weather.

### EARTH AND SPACE SCIENCE: **Daily and Seasonal Changes**

This topic focuses on observing, exploring, describing and comparing weather changes, patterns in the sky and changing seasons.

- Weather changes are long-term and short-term.
- The moon, sun and stars are visible at different times of the day or night.

### PHYSICAL SCIENCE: **Properties of Everyday Objects and Materials**

This topic focuses on the production of sound and on observing, exploring, describing and comparing the properties of objects and materials with which the student is familiar.

- Objects and materials can be sorted and described by their properties.
- Some objects and materials can be made to vibrate to produce sound.

### LIFE SCIENCE: **Physical and Behavioral Traits of Living Things**

This topic focuses on observing, exploring, describing and comparing living things in Ohio.

- Living things are different from nonliving things.
- Living things have physical traits and behaviors, which influence their survival.

**Grade 1** Energy is observed through movement, heating, cooling, and the needs of living organisms.

**EARTH AND SPACE SCIENCE: Sun, Energy and Weather**

This topic focuses on the sun as a source of energy and energy changes that occur to land, air and water.

- The sun is the principal source of energy for the Earth.
- The physical properties of water change.

**PHYSICAL SCIENCE: Motion and Materials**

This topic focuses on the changes in properties that occur in objects and materials.

Changes of position of an object are a result of pushing or pulling.

- Properties of objects and materials can change.
- Objects can be moved in a variety of ways, such as straight, zigzag, circular, and back and forth

**LIFE SCIENCE: Basic Needs of Living Things**

This topic focuses on the physical needs of living things in Ohio. Energy from the sun or food, nutrients, water, shelter, and air are some of the physical needs of living things.

- Living things have basic needs, which are met by obtaining materials from the physical environment.
- Living things survive only in environments that meet their needs.

**Grade 2** Living and nonliving things may move. A moving object has energy. Air moving is wind and wind can make a windmill turn. Changes in energy and movement can cause changes to organisms and the environment in which they live.

**EARTH AND SPACE SCIENCE: The Atmosphere**

This topic focuses on air and water as they relate to weather and weather changes that can be observed and measured.

- The atmosphere is made up of air.
- Water is present in the air.
- Long- and short-term weather changes occur due to changes in energy.

**PHYSICAL SCIENCE: Changes in Motion**

This topic focuses on observing the relationship between forces and motion.

- Forces change the motion of an object.

**LIFE SCIENCE: Interactions within Habitats**

This topic focuses on how ecosystems work by observations of simple interactions between the biotic/living and abiotic/nonliving parts of an ecosystem. Just as living things impact the environment in which they live, the environment impacts living things.

- Living things cause changes on Earth.
- Some kinds of individuals that once lived on Earth have completely disappeared, although they were something like others that are alive today.

**Grade 3** Matter is what makes up all substances on Earth. Matter has specific properties and exists in different states. Earth's resources are made of matter, can be used by living things and can be used for the energy they contain. There are many different forms of energy. Each living component of an ecosystem is composed of matter and uses energy.

**EARTH AND SPACE SCIENCE: Earth's Resources**

This topic focuses on Earth's resources. While resources can be living and nonliving, within this strand, the emphasis is on Earth's nonliving resources, such as water, air, rock, soil, and the energy resources they represent.

- Earth's nonliving resources have specific properties.
- Earth's resources can be used for energy.
- Earth's resources are limited.

**PHYSICAL SCIENCE: Matter and Forms of Energy**

This topic focuses on the relationship between matter and energy. Matter has specific properties and is found in all substances on Earth. Heat is a familiar form of energy that can change the states of matter.

- All objects and substances in the natural world are composed of matter.
- Matter exists in different states, each of which has different properties.
- Heat, electrical energy, light, sound, and magnetic energy are forms of energy.

**LIFE SCIENCE: Behavior, Growth and Changes**

This topic explores life cycles of organisms and the relationship between the natural environment and an organism's (physical and behavioral) traits, which affect its ability to survive and reproduce.

- Offspring resemble their parents and each other.
- Individuals of the same kind differ in their traits and sometimes the differences give individuals an advantage in surviving and reproducing.
- Plants and animals have life cycles that are part of their adaptations for survival in their natural environments.

**Grade 4** Heat and electrical energy are forms of energy that can be transferred from one location to another. Matter has properties that allow the transfer of heat and electrical energy. Heating and cooling affect the weathering of Earth's surface and Earth's past environments. The processes that shape Earth's surface and the fossil evidence found can help decode Earth's history.

**EARTH AND SPACE SCIENCE: Earth's Surface**

This topic focuses on the variety of processes that shape and reshape Earth's surface.

- Earth's surface has specific characteristics and landforms that can be identified.
- The surface of Earth changes due to weathering.
- The surface of Earth changes due to erosion and deposition.

**PHYSICAL SCIENCE: Electricity, Heat, and Matter**

This topic focuses on the conservation of matter and the processes of energy transfer and transformation, especially as they relate to heat and electrical energy

- The total amount of matter is conserved when it undergoes a change.
- Energy can be transformed from one form to another or can be transferred from one location to another.

**LIFE SCIENCE: Earth's Living History**

This topic focuses on using fossil evidence and living organisms to observe that suitable habitats depend upon a combination of biotic and abiotic factors.

- Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.
- Fossils can be compared to one another and to present day organisms according to their similarities and differences.

**Grade 5** Cycles on Earth, such as those occurring in ecosystems, in the solar system and in the movement of light and sound, result in describable patterns. Speed is a measurement of movement. Change in speed is related to force and mass. The transfer of energy drives changes in systems, including ecosystems and physical systems.

**EARTH AND SPACE SCIENCE: Cycles and Patterns in the Solar System**

This topic focuses on the characteristics, cycles, and patterns in the solar system and within the universe.

- The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.
- The sun is one of many stars that exist in the universe.
- Most of the cycles and patterns of motion between the Earth and sun are predictable.

**PHYSICAL SCIENCE: Light, Sound and Motion**

This topic focuses on the forces that affect motion. This includes the relationship between the change in speed of an object, the amount of force applied and the mass of the object. Light and sound are explored as forms of energy that move in predictable ways, depending on the matter through which they move.

- The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.
- Light and sound are forms of energy that behave in predictable ways.

**LIFE SCIENCE: Interactions within Ecosystems**

This topic focuses on foundational knowledge of the structures and functions of ecosystems.

- Organisms perform a variety of roles in an ecosystem.
- All of the processes that take place within organisms require energy.

## **SCIENCE INQUIRY AND APPLICATIONS TECHNOLOGICAL AND ENGINEERING DESIGN**

During the years of PreK to grade 4, all students must develop the ability to:

- Observe and ask questions about the natural environment;
- Plan and conduct simple investigations;
- Employ simple equipment and tools to gather data and extend the senses;
- Use appropriate mathematics with data to construct reasonable explanations;
- Communicate about observations, investigations and explanations;
- Review and ask questions about the observations and explanations of others;
- Identify problems and potential technological/engineering solutions;
- Understand the design process, role of troubleshooting;
- Understand goals of physical, informational and bio-related technologies; and
- Understand how physical technologies impact humans.