



# Indiana Content Standards for Educators

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## MIDDLE SCHOOL SCIENCE

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These standards can be used by educator preparation programs to design licensure programs for middle school science teachers. An educator preparation program can use these standards to develop science content preparation for elementary candidates to meet the REPA 3 requirement for a content area and for middle school science licensure. Any candidate recommended for licensure for middle school science needs to have mastery of all standards indicated in this document.

Middle school science teachers are expected to have a broad and comprehensive understanding of the knowledge and skills needed for this educator license, and to use that knowledge to help students prepare for the challenges and opportunities of the twenty-first century. This requires the ability to identify, comprehend, analyze, synthesize, and evaluate the basic principles, fundamental concepts, and essential content defined in these standards, and to apply that knowledge to the tasks of planning and delivering effective instruction and assessment.

# Middle School Science Educator Standards

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## **Standard 1: The Nature and Processes of Science**

Middle school science teachers have a broad and comprehensive understanding of the nature of science and the processes of scientific inquiry.

## **Standard 2: Central Concepts and Connections in Science**

Middle school science teachers have a comprehensive understanding of the core ideas and principles that connect different scientific disciplines and of the relationships between science, engineering, technology, and society.

## **Standard 3: The Nature and Processes of Engineering and Engineering Design**

Middle school science teachers have a broad and comprehensive understanding of the core ideas and principles behind engineering practices and design.

## **Standard 4: Physical Science**

Middle school science teachers have a broad and comprehensive understanding of physical science.

## **Standard 5: Earth and Space Science**

Middle school science teachers have a broad and comprehensive understanding of Earth and space science, the use and management of geologic resources, and the effects of human activities on the environment.

## **Standard 6: Life Science**

Middle school science teachers have a broad and comprehensive understanding of the life sciences.

## **Standard 7: Middle School Science Instruction and Assessment**

Middle school science teachers have a broad and comprehensive understanding of content-specific instruction and assessment in science.

## Middle School Science Educator Standards

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### Standard 1: The Nature and Processes of Science

**Middle school science teachers have a broad and comprehensive understanding of the nature of science and the processes of scientific inquiry, including:**

- 1.1** characteristics, assumptions, and goals of science
- 1.2** tentative nature of scientific knowledge, which is subject to change as new evidence, new tools, or new ways of thinking become available
- 1.3** principles and procedures for designing and conducting controlled scientific investigations and the formulation of testable hypotheses
- 1.4** common tools and materials used in scientific investigations
- 1.5** scientific data collection, limiting variables, organization, analysis, interpretation, and communication, including the use of technology
- 1.6** role and applications of mathematics in science
- 1.7** characteristics and uses of various sources of scientific information and the evaluation of scientific information, claims, and arguments
- 1.8** role of peer review and critical evaluation of the results of scientific investigations, models, and explanations

### Standard 2: Central Concepts and Connections in Science

**Middle school science teachers have a comprehensive understanding of the core ideas and principles that connect different scientific disciplines and of the relationships between science, technology, engineering, math, and society, including:**

- 2.1** concepts and processes that unify the scientific, technological, engineering and math fields
- 2.2** core ideas and principles that connect the various disciplines of science
- 2.3** interrelationships between science, technology, engineering, and math
- 2.4** social, cultural, and ethical aspects of science, technology, engineering, and math
- 2.5** historical development of important ideas in science from different periods and cultures

### Standard 3: The Nature and Processes of Engineering and Engineering Design

**Middle school science teachers have a broad and comprehensive understanding of the core ideas and principles behind engineering practices and design, including:**

- 3.1** basic characteristics, principles, and goals of the engineering design process
- 3.2** basic engineering process and its application to real-world situations
- 3.3** use of basic criteria and constraints within the engineering design process
- 3.4** development of a prototype
- 3.5** principles and processes of iterative testing and model usage
- 3.6** design solution evaluation, including modifications needed to the design

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### Standard 4: Physical Science

**Middle school science teachers have a broad and comprehensive understanding of physical science, including:**

- 4.1** characteristics and arrangement of subatomic particles and historical and contemporary models of the atom
- 4.2** periodic trends and organization of the periodic table and effect of these trends on the chemical and physical properties of matter
- 4.3** properties of the different states of matter, kinetic molecular theory, the gas laws, and the concepts of heat and temperature, including heat transfer
- 4.4** characteristics and comparisons of elements, molecules, compounds, solutions, and mixtures
- 4.5** principles of chemical bonding and types and characteristics of chemical bonds
- 4.6** types and characteristics of chemical reactions, factors that affect reaction rates and equilibrium, and distinguishing between physical and chemical changes
- 4.7** basic understanding of the law of conservation of mass, the principles of stoichiometry, the mole concept, and their application in balancing chemical equations
- 4.8** basic understanding of acids and bases and their characteristic properties
- 4.9** Newton's laws of motion and universal gravitation and their application, including using the vector nature of force and motion
- 4.10** basic principles of work, energy, and power and the characteristics and uses of simple machines
- 4.11** forms of energy, the transformation of energy from one form to another, and the relationship of potential and kinetic energy
- 4.12** amplitude, wavelength, frequency, and period of mechanical waves and the characteristics and applications of energy transfer by mechanical waves
- 4.13** basic understanding of the properties of sound waves and their propagation in different media
- 4.14** basic understanding of the electromagnetic spectrum, nature of light, patterns of electromagnetic wave movement through different media, and the properties and uses of lenses and mirrors
- 4.15** basic understanding of static and flowing electricity, conservation of charge, electric current, potential difference, resistance, and parallel and series circuits
- 4.16** basic understanding of the properties of permanent magnets and the principles and applications of electromagnetic induction

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### Standard 5: Earth and Space Science

**Middle school science teachers have a broad and comprehensive understanding of Earth and space science, the use and management of geologic resources, and the effects of human activities on the environment, including:**

- 5.1** origin, structure, and components of the universe
- 5.2** characteristics and models of the solar system and planets, movement of celestial bodies, and the effects of the sun and moon on Earth systems
- 5.3** origin, evolution, structure, and composition of Earth
- 5.4** geologic time scale, evidence for the major events in the history and origin of Earth, and the principles and applications of radiometric dating and stratigraphy
- 5.5** processes of weathering, erosion, and deposition and the origin of major landforms, including those specific to Indiana
- 5.6** processes involved in the rock cycle and the characteristics, identification, and composition of rocks and minerals
- 5.7** theory of and supporting evidence for plate tectonics
- 5.8** hydrosphere, atmosphere, biosphere, and geosphere interactions
- 5.9** physical and chemical properties of water, the hydrological cycle, and the characteristics and processes of freshwater systems, oceans, and glaciers
- 5.10** structure and processes of the atmosphere and the causes and characteristics of different types of weather, including meteorological technology and maps
- 5.11** basic characteristics of Earth's different climate regions, the global climate system, and changes in climate that have occurred over the course of geologic time and human history
- 5.12** causes and consequences of natural hazards
- 5.13** impact of human activities on Earth systems and ecosystems and strategies for reducing these human impacts, including the development and impact of common synthetic materials
- 5.14** benefits and risks associated with the extraction and management of geologic resources and renewable and nonrenewable energy resources, including those specific to Indiana
- 5.15** basic concepts and usage of geologic and energy resources and the basic process of production and transmission of electric power

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### Standard 6: Life Science

**Middle school science teachers have a broad and comprehensive understanding of the life sciences, including:**

- 6.1** characteristics of all life and the basic principles of taxonomy
- 6.2** characteristics of single-celled organisms and the similarities and differences between prokaryotes and eukaryotes
- 6.3** similarities and differences of viruses and bacteria, including the effects on humans
- 6.4** processes of photosynthesis, cellular respiration, energy use and transfer in organisms, and maintenance of homeostasis
- 6.5** basic structure and function of cell organelles and plant and animal cells
- 6.6** characteristics and functions of common specialized cells in plants and animals
- 6.7** structure and function of primary components of the organ systems in humans, plants, animals, and fungi
- 6.8** processes of cell division, heredity, and reproduction
- 6.9** structure of DNA and RNA and the processes of replication, transcription, translation, and protein synthesis
- 6.10** basic principles of genetics, patterns of inheritance, and their application to genetics problems, including the basic principles and applications of genetic engineering
- 6.11** the scientific theory of evolutionary, its supporting evidence, and the process of natural selection
- 6.12** relationships between organisms at the species level and among trophic levels, including the impact of changes in biodiversity on these relationships
- 6.13** interactions between living and nonliving components of ecosystems and the basic interactions between organisms and ecosystems

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### Standard 7: Middle School Science Instruction and Assessment

**Middle school science teachers have a broad and comprehensive understanding of content-specific instruction and assessment in science, including:**

- 7.1** state and national learning standards for middle school science and in preparing students for high school science
- 7.2** instructional strategies and resources for promoting students' development of conceptual understanding, inquiry skills, and scientific habits of mind
- 7.3** strategies and skills for planning and designing science instruction that meet the needs of diverse and exceptional learners
- 7.4** instructional strategies and communication methods that encourage active inquiry, supportive interaction, literacy, mathematics, creative thinking, and collaboration in the science classroom
- 7.5** strategies and resources for promoting students' reading, writing, literacy, mathematics, and communication skills in a scientific context
- 7.6** instructional strategies that encourage the application of scientific and engineering concepts to real-world scenarios
- 7.7** strategies and skills for selecting, adapting, and using technological and other resources to enhance teaching and learning in science
- 7.8** strategies, skills, and methods for effectively assessing student understanding and mastery of essential science concepts and skills
- 7.9** safe execution of laboratory exercises, including following procedures, resources, and guidelines for maintaining a safe science learning environment and proper storage and disposal of chemicals and materials
- 7.10** implementation of content and grade level appropriate classroom management and procedures