



Indiana Content Standards for Educators

MIDDLE SCHOOL SCIENCE

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.

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Table of Contents

Middle School Science Educator Standards.....	1
Selected Bibliography of Standards and Sources Related to Middle School Science	7
Alignment of Educator Standards with State and National Standards	10

Middle School Science Educator Standards

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: Chemistry

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

Standard 4: Physics

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

Standard 5: Earth and Space Science

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

Standard 6: Life Science

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

Standard 7: Energy and Society

Middle school science teachers have a broad and comprehensive understanding of the production and use of energy and the effects of energy use on society and the environment.

Standard 8: 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

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** the characteristics, assumptions, and goals of science
- 1.2** the tentative nature of scientific knowledge, which is subject to change as new evidence, new tools, or new ways of thinking become available
- 1.3** the formulation of testable hypotheses and the principles and procedures for designing and conducting scientific investigations
- 1.4** common tools, materials, and technology used in scientific investigations
- 1.5** the collection, organization, analysis, interpretation, and communication of scientific data, including the use of technology
- 1.6** the safe execution of laboratory exercises and safe storage and disposal of chemicals and materials
- 1.7** the role and applications of mathematics in science
- 1.8** the characteristics and uses of various sources of scientific information and the evaluation of scientific information, claims, and arguments
- 1.9** the 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, engineering, technology, and society, including:

- 2.1** the unifying concepts and processes that cut across the sciences and engineering
- 2.2** the core ideas and principles that connect the various disciplines of science
- 2.3** the basic characteristics, principles, and goals of the engineering, or technological, design process
- 2.4** the interrelationships between science and technology
- 2.5** the social, cultural, and ethical aspects of science and technology
- 2.6** the historical development of important ideas in science from different periods and cultures

Middle School Science Educator Standards

Standard 3: Chemistry

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

- 3.1** the characteristics and arrangement of subatomic particles and historical and contemporary models of the atom
- 3.2** the organization of the periodic table and periodic trends in the chemical and physical properties of matter
- 3.3** the properties of the different states of matter, kinetic molecular theory, the gas laws, and the concepts of heat and temperature
- 3.4** distinguishing characteristics of elements, compounds, and mixtures
- 3.5** principles of chemical bonding and types and characteristics of chemical bonds and their effects on the properties of matter
- 3.6** types and characteristics of chemical reactions and factors that affect reaction rates and equilibrium
- 3.7** the law of conservation of mass and the principles of stoichiometry and their application in balancing chemical equations
- 3.8** the mole concept and its application in chemical calculations
- 3.9** acids and bases and their characteristic properties
- 3.10** forms of energy and the transformation of energy from one form to another
- 3.11** energy transfers through conduction, convection, and radiation
- 3.12** energy changes associated with physical processes and chemical reactions and principles and applications of the first and second laws of thermodynamics

Standard 4: Physics

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

- 4.1** Newton's laws of motion and universal gravitation and their application
- 4.2** the vector nature of force and motion and the concepts of displacement, velocity, and acceleration
- 4.3** the principles of work, energy, and power and the characteristics and uses of simple machines
- 4.4** characteristics of energy transfer by mechanical waves in air, water, and Earth materials
- 4.5** the amplitude, wavelength, frequency, and period of mechanical waves
- 4.6** properties of sound waves and their propagation in different media
- 4.7** the electromagnetic spectrum and the propagation of electromagnetic energy
- 4.8** the refraction, absorption, and reflection of electromagnetic waves
- 4.9** the nature of light and the properties and operation of lenses and mirrors
- 4.10** electrostatics, conservation of charge, and Coulomb's law
- 4.11** electricity, electric current, potential difference, resistance, and parallel and series circuits
- 4.12** the properties of permanent magnets and the principles and applications of electromagnetic induction

Standard 5: Earth and Space Science

Middle school science teachers have a broad and comprehensive understanding of Earth and space science, including:

- 5.1** the origin, structure, and components of the universe
- 5.2** the characteristics of the solar system and planets and the effects of the sun and moon on Earth systems
- 5.3** the origin, evolution, structure, and composition of Earth
- 5.4** the 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 involved in the formation of igneous, metamorphic, and sedimentary rocks
- 5.6** the processes of weathering, erosion, and deposition and the origin of major landforms
- 5.7** the characteristics, identification, and composition of rocks and minerals
- 5.8** the causes and consequences of volcanic activity and earthquakes
- 5.9** the theory of and supporting evidence for plate tectonics
- 5.10** the characteristics and processes of freshwater systems, oceans, and glaciers and the physical and chemical properties of water
- 5.11** the structure and processes of the atmosphere and the causes and characteristics of different types of weather
- 5.12** physical and biological characteristics of Earth's different climate regions, the global climate system, and changes in climate that have occurred over the course of human history and geologic time
- 5.13** the cycling of matter through biogeochemical cycles, 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, including:

- 6.1** the structure and function of plant and animal cells and cell organelles
- 6.2** the characteristics of bacteria and protists
- 6.3** the processes of photosynthesis and cellular respiration
- 6.4** the characteristics and function of specialized cells in plants and animals
- 6.5** the structure of DNA and RNA and the processes of replication, transcription, translation, and protein synthesis
- 6.6** the processes of cell division and the molecular basis of heredity
- 6.7** the principles of genetics, patterns of inheritance, and their application to genetics problems
- 6.8** the basic principles, methods, and applications of genetic engineering
- 6.9** the structure and function of organ systems in plants, animals, and fungi
- 6.10** basic anatomy and physiology of the primary components of human body systems
- 6.11** modern evolutionary theory and its supporting evidence and the process of natural selection
- 6.12** the interactions between living and nonliving components of ecosystems and the relationships between organisms in ecosystems
- 6.13** the impact of human activities and natural phenomena on ecosystems and the effects of such changes on biodiversity

Standard 7: Energy and Society

Middle school science teachers have a broad and comprehensive understanding of the production and use of energy and the effects of energy use on society and the environment, including:

- 7.1** the benefits and risks associated with the extraction, use, and management of nonrenewable energy resources, such as coal, oil, natural gas, and uranium
- 7.2** the benefits and risks associated with the development of renewable forms of energy, such as wind energy, solar energy, geothermal energy, water power, and biofuels
- 7.3** the production and transmission of electric power from different types of power plants to homes and businesses
- 7.4** the use of energy in homes, different types of industries, and transportation and strategies for reducing energy use through technological innovation and conservation
- 7.5** the use of energy and natural resources in industrialized, developing, and underdeveloped nations and the role of energy resources in the development of an economically viable society

Middle School Science Educator Standards

Standard 8: 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:

- 8.1** the Indiana Revised Academic Standards for Science
- 8.2** the National Science Education Standards, the NCATE/NSTA Standards for Science Teacher Preparation, the Common Core State Standards for Literacy: Science and Technical Subjects, and the ISTE National Educational Technology Standards
- 8.3** instructional strategies and resources for promoting students' development of conceptual understanding, inquiry skills, and scientific habits of mind
- 8.4** strategies and skills for planning and designing science instruction, including the use of techniques and approaches that meet the needs of diverse learners
- 8.5** instructional strategies and communication methods that encourage active inquiry, supportive interaction, and collaboration in the science classroom
- 8.6** strategies and resources for promoting students' reading, writing, and mathematics skills in science
- 8.7** strategies and skills for selecting, adapting, and using technological resources to enhance teaching and learning in science
- 8.8** procedures, resources, and guidelines for maintaining a safe science learning environment
- 8.9** strategies and skills for effectively assessing student understanding and mastery of essential science concepts and skills

Selected Bibliography of Standards and Sources Related to Middle School Science

State and National Standards and Curriculum Frameworks

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19. Everett, C., & Spear, R. (2008). Investigating the earth and its environment. *Science Teacher*, 75(1), 58–61.

Sources on Science—Life Science Content

20. American Association for the Advancement of Science and the National Science Teachers Association. *Atlas of science literacy*, Volume 1 (2001) and Volume 2 (2007). Washington, DC: American Association for the Advancement of Science.
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