



## **Field 046: Science—Physical Science Assessment Blueprint**

### **Domain I—Foundations of Science**

- 0001 The Nature and Processes of Science (Standard 1)
- 0002 Central Concepts and Connections in Science (Standard 2)

### **Domain II—Chemistry**

- 0003 Atomic Structure, the Properties of Matter, and Nuclear Processes (Standard 3)
- 0004 Chemical Bonding, Chemical Reactions, and Stoichiometry (Standard 4)
- 0005 Energy Transformations, Energy Transfers, and Thermochemistry (Standard 5)

### **Domain III—Physics**

- 0006 Motion and Forces (Standard 6)
- 0007 Mechanical Waves (Standard 7)
- 0008 Electromagnetic Energy, Electricity, and Magnetism (Standard 8)
- 0009 Energy and Society (Standard 9)

### **Domain IV—Science Instruction and Assessment**

- 0010 Science Instruction and Assessment (Standard 10)

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<b>Domain</b>	<b>Objectives</b>	<b>Standards</b>	<b>Approximate Test Weight</b>
I. Foundations of Science	0001–0002	1–2	10%
II. Chemistry	0003–0005	3–5	40%
III. Physics	0006–0009	6–9	40%
IV. Science Instruction and Assessment	0010	10	10%

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

**Physical 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 physical science 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**

**Physical science teachers have a comprehensive understanding of the core ideas in other science 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 basic concepts and major principles of life science
- 2.3** the basic concepts and major principles of Earth and space science
- 2.4** the basic characteristics, principles, and goals of the engineering, or technological, design process
- 2.5** the interconnections between the various disciplines of science
- 2.6** the interrelationships between science and technology
- 2.7** the social, cultural, and ethical aspects of science and technology
- 2.8** the historical development of important ideas in science from different periods and cultures

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### **Standard 3: Atomic Structure, the Properties of Matter, and Nuclear Processes**

**Physical science teachers have a broad and comprehensive understanding of models of atomic structure, the periodic table, the properties of matter, and nuclear processes, 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** atomic orbitals and the electron configuration of atoms and ions
- 3.4** the properties of the different states of matter, kinetic molecular theory, and the gas laws
- 3.5** distinguishing characteristics of elements, compounds, and mixtures
- 3.6** nuclear processes and the characteristics and properties of nuclear materials

### **Standard 4: Chemical Bonding, Chemical Reactions, and Stoichiometry**

**Physical science teachers have a broad and comprehensive understanding of chemical bonding, chemical reactions, and stoichiometry, including:**

- 4.1** types and characteristics of chemical bonds and their effects on the properties of matter
- 4.2** principles of chemical bonding
- 4.3** types and characteristics of intermolecular forces and their effects on the properties of matter
- 4.4** types and characteristics of chemical reactions and factors that affect reaction rates and equilibrium
- 4.5** the principles of chemical kinetics and chemical equilibrium
- 4.6** the principles of stoichiometry and the law of conservation of mass, and their use in balancing chemical equations
- 4.7** the mole concept and its use in chemical calculations
- 4.8** principles and applications of electrochemistry and the different definitions of acids and bases and their characteristic properties

### **Standard 5: Energy Transformations, Energy Transfers, and Thermochemistry**

**Physical science teachers have a broad and comprehensive understanding of energy transformations, energy transfers, and thermochemistry, including:**

- 5.1** forms of energy and the transformation of energy from one form to another
- 5.2** the concepts of heat and temperature and the principles of calorimetry
- 5.3** principles and applications of the first and second laws of thermodynamics
- 5.4** the transfer of energy through convection, conduction, and radiation
- 5.5** energy changes associated with physical processes and chemical reactions
- 5.6** free energy and the spontaneity of chemical reactions

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## **Standard 6: Motion and Forces**

**Physical science teachers have a broad and comprehensive understanding of motion and forces, including:**

- 6.1** Newton's laws of motion and universal gravitation and their application
- 6.2** the vector nature of force and motion and the concepts of displacement, velocity, and acceleration
- 6.3** graphical and mathematical representations of motion
- 6.4** characteristics of the gravitational force, frictional forces, elastic forces, and centripetal force and how they affect real-world systems
- 6.5** the conservation of mechanical energy in isolated systems and the principles of work, energy, and power
- 6.6** the characteristics and uses of simple machines

## **Standard 7: Mechanical Waves**

**Physical science teachers have a broad and comprehensive understanding of the properties and propagation of mechanical waves, including:**

- 7.1** characteristics of energy transfer by mechanical waves in air, water, and Earth materials
- 7.2** the amplitude, wavelength, frequency, and period of mechanical waves
- 7.3** properties of sound waves and their propagation in different media
- 7.4** the refraction and reflection of mechanical waves
- 7.5** types of seismic waves and their properties

## **Standard 8: Electromagnetic Energy, Electricity, and Magnetism**

**Physical science teachers have a broad and comprehensive understanding of electromagnetism, electricity, and magnetism, including:**

- 8.1** the electromagnetic spectrum and the propagation of electromagnetic energy
- 8.2** the refraction, absorption, and reflection of electromagnetic waves
- 8.3** the nature of light and the properties and operation of lenses and mirrors
- 8.4** electrostatics, conservation of charge, and Coulomb's law
- 8.5** electricity, electric current, potential difference, resistance, and parallel and series circuits
- 8.6** principles and applications of electromagnetic induction
- 8.7** the properties of permanent magnets

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### **Standard 9: Energy and Society**

**Physical 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:**

- 9.1** the benefits and risks associated with the extraction, use, and management of nonrenewable energy resources, such as coal, oil, natural gas, and uranium
- 9.2** 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
- 9.3** the production and transmission of electric power from different types of power plants to homes and businesses
- 9.4** the use of energy in homes, different types of industries, and transportation and strategies for reducing energy use through technological innovation and conservation
- 9.5** 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

### **Standard 10: Science Instruction and Assessment**

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

- 10.1** the Indiana Revised Academic Standards for Science
- 10.2** 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
- 10.3** instructional strategies and resources for promoting students' development of conceptual understanding, inquiry skills, and scientific habits of mind
- 10.4** strategies and skills for planning and designing science instruction, including the use of techniques and approaches that meet the needs of diverse learners
- 10.5** instructional strategies and communication methods that encourage active inquiry, supportive interaction, and collaboration in the science classroom
- 10.6** strategies and resources for promoting students' reading, writing, and mathematics skills in science
- 10.7** strategies and skills for selecting, adapting, and using technological resources to enhance teaching and learning in science
- 10.8** procedures, resources, and guidelines for maintaining a safe science learning environment
- 10.9** strategies and skills for effectively assessing student understanding and mastery of essential science concepts and skills