



## **Field 047: Science—Physics 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—Forces and Energy**

- 0003 Motion and Forces (Standard 3)
- 0004 Energy and Momentum (Standard 4)

### **Domain III—Electricity, Magnetism, and Waves**

- 0005 Electricity and Magnetism (Standard 6)
- 0006 Vibrations and Waves (Standard 7)

### **Domain IV—Thermodynamics and Modern Physics**

- 0007 Thermodynamics and Kinetic Theory (Standard 5)
- 0008 Modern Physics (Standard 8)

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

- 0009 Science Instruction and Assessment (Standard 9)

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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. Forces and Energy	0003–0004	3–4	30%
III. Electricity, Magnetism, and Waves	0005–0006	6–7	30%
IV. Thermodynamics and Modern Physics	0007–0008	5, 8	20%
V. Science Instruction and Assessment	0009	9	10%

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

**Physics 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 physics 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 the safe storage and disposal of 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**

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

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### **Standard 3: Motion and Forces**

**Physics teachers have a broad and comprehensive understanding of motion, forces, and Newton's laws in one and two dimensions, including:**

- 3.1** the representation of motion using graphs, motion maps, algebra, trigonometry, and calculus
- 3.2** the vector nature of force and motion in two dimensions
- 3.3** characteristics of the gravitational force, frictional forces, and elastic forces
- 3.4** applications of Newton's laws to a variety of situations on Earth and in space
- 3.5** torque and its application to static and dynamic systems
- 3.6** properties of fluids and applications of the principles of Archimedes, Pascal, and Bernoulli

### **Standard 4: Energy and Momentum**

**Physics teachers have a broad and comprehensive understanding of the conservation of energy and momentum, including:**

- 4.1** the interrelationships between force, work, energy, and power
- 4.2** conservation of energy and the work-energy theorem
- 4.3** the interrelationships between force, impulse, and momentum
- 4.4** the conservation of momentum in one and two dimensions
- 4.5** the conservation of rotational energy and angular momentum

### **Standard 5: Thermodynamics and Kinetic Theory**

**Physics teachers have a broad and comprehensive understanding of the laws of thermodynamics and the kinetic theory of matter, including:**

- 5.1** heat and temperature, specific heat, phase changes, thermal expansion, and methods of heat transfer
- 5.2** the mechanical equivalence of heat, thermodynamic work, and the first law of thermodynamics
- 5.3** the kinetic theory of matter and the description of macroscopic quantities in terms of molecular interactions
- 5.4** heat engines, entropy, energy conversions and efficiency, and the second law of thermodynamics

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## **Standard 6: Electricity and Magnetism**

**Physics teachers have a broad and comprehensive understanding of electricity and magnetism, including:**

- 6.1** electric charge, electrostatics, the electric force, and Coulomb's law
- 6.2** the electric field and the motion of charged particles in an electric field
- 6.3** conservative fields, electrostatic potential energy, and electric potential
- 6.4** properties of the magnetic field, the motion of charged particles in magnetic fields, and magnetism in matter
- 6.5** Faraday's law of induction, Lenz's law, and induced electric fields and electromotive force
- 6.6** Ohm's law, capacitance, resistivity and resistance, and the analysis of electric circuits using Kirchhoff's laws
- 6.7** qualitative aspects of the generation of electromagnetic waves and characteristics of the electromagnetic spectrum
- 6.8** basic characteristics of alternating current and the operation of devices such as electric motors, generators, and transformers

## **Standard 7: Vibrations and Waves**

**Physics teachers have a broad and comprehensive understanding of vibrations and waves and the application of wave properties to sound and light, including:**

- 7.1** the application of force and energy principles to simple harmonic motion and oscillating systems
- 7.2** the properties of waves and the transfer of energy and momentum by transverse and longitudinal waves
- 7.3** the production, propagation, and properties of sound waves
- 7.4** the superposition principle, resonance, and the production of standing waves for various boundary conditions
- 7.5** the production, propagation, reflection, and refraction of light waves
- 7.6** geometric optics and image formation in thin lenses and mirrors
- 7.7** physical optics and the interference, diffraction, and polarization of light waves

## **Standard 8: Modern Physics**

**Physics teachers have a broad and comprehensive understanding of the fundamental ideas of modern physics, including:**

- 8.1** energy of light quanta and the photoelectric effect
- 8.2** historic and contemporary models of the atom
- 8.3** the wave-particle duality, the uncertainty principle, and interactions between light and matter
- 8.4** fundamentals of the special theory of relativity
- 8.5** the structure of the nucleus, binding energy, stability, and nuclear reactions

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## **Standard 9: Science Instruction and Assessment**

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

- 9.1** the Indiana Revised Academic Standards for Science
- 9.2** the National Science Education Standards, the NCATE/NSTA Standards for Science Teacher Preparation, the Common Core State Standards for English Language Arts & Literacy in Science and Technical Subjects, and the ISTE National Educational Technology Standards for Teachers
- 9.3** instructional strategies and resources for promoting students' development of conceptual understanding, inquiry skills, and scientific habits of mind
- 9.4** strategies and skills for planning and designing science instruction, including the use of techniques and approaches that meet the needs of diverse learners
- 9.5** instructional strategies and communication methods that encourage active inquiry, supportive interaction, and collaboration in the science classroom
- 9.6** strategies and resources for promoting students' reading, writing, and mathematics skills in science
- 9.7** strategies and skills for selecting, adapting, and using technological resources to enhance teaching and learning in science
- 9.8** procedures, resources, and guidelines for maintaining a safe science learning environment
- 9.9** strategies and skills for effectively assessing student understanding and mastery of essential science concepts and skills