Field 046: Science—Physical Science
REPA Educator Standards

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

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

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

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