

## PHYSICAL SCIENCE STANDARDS

- Standard I.** The science teacher manages classroom, field, and laboratory activities to ensure the safety of all students and the ethical care and treatment of organisms and specimens.
- Standard II.** The science teacher understands the correct use of tools, materials, equipment, and technologies.
- Standard III.** The science teacher understands the process of scientific inquiry and its role in science instruction.
- Standard IV.** The science teacher has theoretical and practical knowledge about teaching science and about how students learn science.
- Standard V.** The science teacher knows the varied and appropriate assessments and assessment practices to monitor science learning.
- Standard VI.** The science teacher understands the history and nature of science.
- Standard VII.** The science teacher understands how science affects the daily lives of students and how science interacts with and influences personal and societal decisions.
- Standard VIII.** The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.
- Standard IX.** *Teachers of physical science are not responsible for this standard.*
- Standard X.** *Teachers of physical science are not responsible for this standard.*
- Standard XI.** The science teacher knows unifying concepts and processes that are common to all sciences.

**Standard I. The science teacher manages classroom, field, and laboratory activities to ensure the safety of all students and the ethical care and treatment of organisms and specimens.**

<p><b>Teacher Knowledge: What Teachers Know</b></p>	<p><b>Application: What Teachers Can Do</b></p>
<p><i>Teachers of Students in Grades 8–12</i></p>	<p><i>Teachers of Students in Grades 8–12</i></p>
<p>The beginning teacher knows and understands:</p>	<p>The beginning teacher is able to:</p>
<p>1.1k safety regulations and guidelines for science facilities;</p>	<p>1.1s employ safe practices in designing, planning, and implementing all instructional activities (e.g., laboratory, field, demonstrations);</p>
<p>1.2k safety regulations and guidelines for science instruction;</p>	<p>1.2s determine sufficient space and classroom arrangement for carrying out laboratory activities;</p>
<p>1.3k procedures for the appropriate storage, handling, use, disposal, care, and maintenance of chemicals, materials, specimens, and equipment;</p>	<p>1.3s provide students with continuous instruction and training in safe techniques and procedures for all laboratory and field activities, student demonstrations, and independent projects;</p>
<p>1.4k sources of information about laboratory safety;</p>	<p>1.4s read and interpret safety information about chemicals on a Materials Safety Data Sheet (MSDS) and on other chemical labels, including household products;</p>
<p>1.5k procedures for the safe handling and ethical care and treatment of organisms and specimens;</p>	<p>1.5s check equipment for safety (e.g., cracks in glassware, proper grounding of electrical equipment) prior to use;</p>
<p>1.6k procedures for responding to an accident in the laboratory, including first aid;</p>	<p>1.6s create, implement, and enforce rules and safety procedures to promote and maintain a safe learning environment during laboratory and field activities;</p>
<p>1.7k legal issues associated with accidents and injuries that occur in the classroom, field, or laboratory;</p>	<p>1.7s implement regular procedures to inventory and maintain appropriate safety equipment; and</p>
<p>1.8k potential safety hazards in the field (e.g., insect bites, poisonous plants); and</p>	<p>1.8s optimize quick and safe access to all safety equipment (e.g., eyewash station, sink, safety shower, fire blanket, and extinguisher).</p>
<p>1.9k the importance of providing laboratory space and equipment for all students, including those with special needs.</p>	

**Standard II. The science teacher understands the correct use of tools, materials, equipment, and technologies.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12*

The beginning teacher knows and understands:

- 2.1k procedures for the storing, securing, and routine maintenance of scientific equipment used in instructional activities;
- 2.2k correct and safe operating procedures for scientific equipment used in instructional activities;
- 2.3k concepts of precision, accuracy, and error with regard to reading and recording numerical data from a scientific instrument;
- 2.4k the international system of measurement (i.e., metric system);
- 2.5k the use of grade-appropriate equipment and technology for gathering, analyzing, and reporting data; and
- 2.6k the use of technology to acquire, assess, analyze, interpret, and communicate information.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12*

The beginning teacher is able to:

- 2.1s select and use appropriate tools, technology, materials, and equipment needed for instructional activities;
- 2.2s instruct and monitor students' use of materials, tools, and instruments;
- 2.3s make science resources accessible to all students;
- 2.4s recycle, reuse, and conserve laboratory resources as appropriate;
- 2.5s use the appropriate number of significant figures to record and report numerical data;
- 2.6s perform unit conversions within the international system of measurement (i.e., metric system);
- 2.7s perform conversions within and across measurement systems;
- 2.8s use techniques to calibrate measuring devices as appropriate;
- 2.9s organize, display, and communicate data in a variety of ways (e.g., charts, tables, graphs, diagrams, written reports, oral presentations);
- 2.10s gather, organize, display, and communicate data using appropriate technology (e.g., Internet, graphing calculators, spreadsheets); and
- 2.11s evaluate the validity of data and data sources.

**Standard III. The science teacher understands the process of scientific inquiry and its role in science instruction.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12*

The beginning teacher knows and understands:

- 3.1k how scientists use different types of investigation, depending on the questions they are trying to answer;
- 3.2k principles and procedures for designing and conducting an inquiry-based scientific investigation;
- 3.3k the characteristics of various types of scientific investigations (e.g., descriptive studies, controlled experiments, comparative data analysis);
- 3.4k how current knowledge and theories guide scientific investigations;
- 3.5k the use of technology in scientific research; and
- 3.6k appropriate methods of statistical analysis and measures (e.g., mean, median, mode, correlation).

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12*

The beginning teacher is able to:

- 3.1s design and conduct inquiry-based scientific investigations, including nonexperimental and experimental designs;
- 3.2s plan and implement instruction that provides opportunities for all students to engage in scientific inquiry by using various appropriate combinations of the following processes:
  - ask a scientific question;
  - formulate a testable hypothesis;
  - select appropriate equipment and technology for gathering information related to the hypothesis;
  - make observations and collect data taking accurate and precise measurements;
  - organize, analyze, and evaluate data to find data trends and patterns and make inferences; and
  - communicate and defend a valid conclusion about the hypothesis under investigation;
- 3.3s link inquiry investigations to students' prior knowledge and experience;
- 3.4s focus inquiry-based instruction on questions and issues that are relevant to students;
- 3.5s use strategies to assist students in identifying, refining, and focusing scientific ideas and questions guiding an inquiry activity;
- 3.6s guide students in making systematic observations and measurements;
- 3.7s use a variety of tools and techniques to access, gather, store, retrieve, organize, and analyze data;

**Standard III. The science teacher understands the process of scientific inquiry and its role in science instruction.**

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12 (continued)*

- 3.8s provide opportunities for students to use higher-order thinking skills, logical reasoning, and scientific problem solving to reach conclusions based on evidence;
- 3.9s develop, analyze, and evaluate different explanations for a given scientific result;
- 3.10s identify potential sources of error in a given inquiry-based investigation; and
- 3.11s develop criteria for assessing student participation in and understanding of the inquiry process.

**Standard IV. The science teacher has theoretical and practical knowledge about teaching science and about how students learn science.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12*

The beginning teacher knows and understands:

- 4.1k theories about how students develop scientific understanding;
- 4.2k how the developmental characteristics of students influence science learning;
- 4.3k the statewide curriculum as defined in the Texas Essential Knowledge and Skills (TEKS);
- 4.4k methods of planning and implementing an inquiry-based science program;
- 4.5k how students' prior knowledge and attitudes about science may affect their learning;
- 4.6k common student misconceptions in science and effective ways to address these misconceptions;
- 4.7k how to establish a collaborative scientific community among students that supports actively engaged learning;
- 4.8k the importance of planning activities that are inclusive and accommodate the needs of all students;
- 4.9k strategies that students with diverse strengths and needs can use to determine word meaning in content-related texts;
- 4.10k strategies that students with diverse strengths and needs can use to develop content-area vocabulary;
- 4.11k strategies that students with diverse strengths and needs can use to facilitate comprehension before, during, and after reading content-related texts;
- 4.12k the design and management of learning environments that provide the time, space, and resources needed for learning science;

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12*

The beginning teacher is able to:

- 4.1s use lab and field investigations to enable students to develop an understanding of science;
- 4.2s sequence learning activities in a way that allows students to build upon their prior knowledge and challenges them to expand their understanding of science;
- 4.3s model active learning and inquiry processes for students;
- 4.4s encourage students' self-motivation in their own learning;
- 4.5s display and model scientific attributes, such as curiosity, openness to new ideas, and skepticism;
- 4.6s design and adapt curricula and select content to meet the interests, knowledge, understanding, abilities, experiences, and needs of students;
- 4.7s use a variety of instructional strategies to ensure all students' reading comprehension of content-related texts, including helping students link the content of texts to their lives and connect related ideas across different texts;
- 4.8s teach students how to locate, retrieve, and retain content-related information from a range of texts and technologies;
- 4.9s teach students how to locate the meanings and pronunciations of unfamiliar content-related words using appropriate sources, such as dictionaries, thesauruses, and glossaries;
- 4.10s use questioning strategies to move students from concrete to more abstract understanding;
- 4.11s respect student diversity and encourage all students to participate fully in science learning;

**Standard IV. The science teacher has theoretical and practical knowledge about teaching science and about how students learn science.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12 (continued)*

- 4.13k the importance of ongoing assessment of student learning and one’s own teaching practice in the science classroom; and
- 4.14k the teacher’s role in the ongoing evaluation and development of science in the total school program.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12 (continued)*

- 4.12s manage time to provide adequate opportunity for all students to participate in investigations;
- 4.13s create an environment to focus and support student inquiries;
- 4.14s use individual, small-group, and whole-class strategies to support student learning;
- 4.15s foster collaboration among students; and
- 4.16s implement science activities to incorporate schoolwide objectives.

**Standard V. The science teacher knows the varied and appropriate assessments and assessment practices to monitor science learning.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12*

The beginning teacher knows and understands:

- 5.1k the relationships among curriculum, assessment, and instruction;
- 5.2k characteristics of various assessments, such as reliability, validity, and the absence of bias;
- 5.3k the purposes, characteristics, and uses of various types of assessments in science, including formative and summative assessments;
- 5.4k the importance of carefully selecting or designing formative and summative assessments for the specific decisions they are intended to inform;
- 5.5k the importance of monitoring and assessing students' science understanding and skills on a regular, ongoing basis;
- 5.6k ways in which assessment results inform instructional practice;
- 5.7k strategies for assessing students' prior knowledge and misconceptions about science;
- 5.8k questioning strategies designed to elicit higher-level thinking;
- 5.9k the importance of sharing evaluation criteria with students;
- 5.10k the role of assessments as learning experiences; and
- 5.11k strategies for engaging students in meaningful self-assessment.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12*

The beginning teacher is able to:

- 5.1s use formal and informal assessments of science performance and products (e.g., rubrics, portfolios, student profiles, checklists) to evaluate student participation in and understanding of the inquiry process;
- 5.2s select or design a variety of appropriate assessment instruments and/or methods (e.g., formal/informal, formative/summative) to monitor student understanding and progress;
- 5.3s design assessments that match each learning objective;
- 5.4s base decisions regarding instructional content, methods, and practice on information about students' strengths and needs gathered through assessment;
- 5.5s select assessment instruments and methods that provide students with adequate opportunities to demonstrate their achievements;
- 5.6s evaluate assessment materials and procedures for reliability, validity, absence of bias, and clarity of language;
- 5.7s encourage use of self-assessment strategies in science;
- 5.8s use a variety of strategies (e.g., pre-testing, reviewing student journals, monitoring discussions, asking questions) to gain insight about students' prior knowledge and misconceptions about science;
- 5.9s state evaluation criteria clearly so that students can understand and derive meaning from them; and
- 5.10s evaluate the quality of data obtained from an assessment and determine what decisions can appropriately be made based on the data.

**Standard VI. The science teacher understands the history and nature of science.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12*

The beginning teacher knows and understands:

- 6.1k the limitations of the scope of science and the use and limitations of physical, mathematical, and conceptual models to describe and analyze scientific ideas about the natural world;
- 6.2k that science is a human endeavor influenced by societal, cultural, and personal views of the world;
- 6.3k that scientific ideas and explanations must be consistent with observational and experimental evidence;
- 6.4k how logical reasoning is used in the process of developing, evaluating, and validating scientific hypotheses and theories;
- 6.5k the roles that publishing and peer review play in developing and validating scientific knowledge;
- 6.6k principles of scientific ethics in reporting data and in experimenting with living organisms, including human subjects;
- 6.7k that scientific theories have predictive power;
- 6.8k that scientific theories are constantly being modified to conform more closely to new observational and experimental evidence about the natural world;
- 6.9k the historical development of science and the contributions that diverse cultures and individuals of both genders have made to scientific knowledge; and
- 6.10k the relationship between science and technology.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12*

The beginning teacher is able to:

- 6.1s provide students with opportunities to examine the types of questions that science can and cannot answer;
- 6.2s design and conduct scientific investigations to answer questions;
- 6.3s analyze, review, and critique the strengths and weaknesses of scientific explanations, hypotheses, and theories using scientific evidence and information;
- 6.4s analyze ways in which personal or societal bias can affect the direction, support, and use of scientific research;
- 6.5s use key events and knowledge of individuals from throughout the history of science to illustrate scientific concepts;
- 6.6s design instruction that accounts for the contributions to science of individuals from a variety of cultures; and
- 6.7s use examples from the history of science to demonstrate the changing nature of scientific theories and knowledge.

**Standard VII. The science teacher understands how science affects the daily lives of students and how science interacts with and influences personal and societal decisions.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12*

The beginning teacher knows and understands:

- 7.1k that human decisions about the use of science and technology are based on factors such as ethical standards, economics, and societal and personal needs;
- 7.2k scientific concepts and principles relating to personal and societal health, including the physiological and psychological effects and risks associated with the use of substances and substance abuse;
- 7.3k concepts related to changes in populations and to characteristics of human population growth;
- 7.4k types and uses of natural resources and the effects of human consumption on the renewal and depletion of resources;
- 7.5k the properties of natural ecosystems and how natural and human processes can influence changes in environments;
- 7.6k the principles of risk and benefit analysis and how it is used in the process of personal and societal decision making; and
- 7.7k the role science can play in helping resolve personal, societal, and global challenges.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12*

The beginning teacher is able to:

- 7.1s use situations from students' daily lives to develop instructional materials that investigate how science can be used to make informed decisions;
- 7.2s apply scientific principles and processes to analyze factors that influence personal choices concerning fitness and health;
- 7.3s analyze factors that affect the severity of disease and methods for preventing, controlling, or curing diseases and ailments;
- 7.4s analyze how factors such as population growth, resource use, population distribution, overconsumption, technological capacity, poverty, and societal views can influence changes in environments;
- 7.5s apply scientific principles and the theory of probability to analyze the advantages, disadvantages, or alternatives to a given decision or course of action; and
- 7.6s demonstrate how science can be used to help make informed decisions about societal and global issues.

**Standard VIII. The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades EC–4\**

**Physical Science**

The beginning teacher knows and understands:

- 8.1k properties of objects and materials;
- 8.2k concepts of force and motion;
- 8.3k concepts of heat, light, electricity, and magnetism; and
- 8.4k conservation of energy and energy transformations.

\*See 8.5k below.

**Application: What Teachers Can Do**

*Teachers of Students in Grades EC–4\**

**Physical Science**

The beginning teacher is able to:

- 8.1s select appropriate techniques, procedures, and tools to observe and record properties of materials (e.g., size, shape, temperature, magnetism, hardness, mass, conduction, density);
- 8.2s analyze changes in the position and motion of an object subject to an unbalanced force;
- 8.3s apply properties of fundamental forces (e.g., push or pull, friction, gravity, electric force, magnetic force) to analyze common objects (e.g., toys, playground equipment), experiences, and situations;
- 8.4s describe and analyze changes in the states of matter caused by the addition or removal of heat energy; and
- 8.5s describe the properties of various forms of energy (e.g., mechanical, sound, heat, light) and analyze how energy is transformed from one form to another in a variety of everyday situations.

\*See 8.6s below.

**Standard VIII. The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 4–8\*\**

**Physical Science**

The beginning teacher knows and understands:

- 8.5k all content specified for teachers in grades EC–4;
- 8.6k the relationship between force and motion;
- 8.7k physical and chemical properties and changes in matter;
- 8.8k energy and energy transformations; and
- 8.9k the conservation of matter and energy.

\*\*See italicized text below.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 4–8\*\**

**Physical Science**

The beginning teacher is able to:

- 8.6s apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8;
- 8.7s measure, graph, and describe changes in motion and analyze the relationship between force and motion in a variety of situations including simple machines, the flow of blood through the human body, and geologic processes;
- 8.8s investigate physical properties of solids, liquids, and gases;
- 8.9s analyze physical and chemical changes in matter;
- 8.10s apply properties and characteristics of waves to analyze sound, light, and other wave phenomena;
- 8.11s interpret the periodic table and chemical formulas and equations;
- 8.12s apply the law of conservation of energy to analyze a variety of phenomena (e.g., specific heat, chemical and nuclear reactions, efficiency of simple machines);
- 8.13s apply the law of conservation of matter to analyze a variety of phenomena (e.g., water cycle, decomposition); and
- 8.14s analyze the transfer of energy in a variety of situations (e.g., the production of heat, light, sound, and magnetic effects by electrical energy; the process of photosynthesis; weather processes).

\*\*See 8.15s & 8.37s below.

**Standard VIII. The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12*

*Teachers of science in grades 8–12 will have a broad knowledge of all science disciplines (i.e., physical science, life science, Earth and space science) required of teachers of grades EC–8 and a deep understanding of the concepts in the science discipline(s) they teach.*

**Physics**

The beginning teacher knows and understands:

- 8.10k motion and forces: motion occurs when a net force is applied, and gravitation, electricity, and magnetism are universal forces;
- 8.11k conservation of energy and increase in disorder: energy is kinetic or potential, and everything becomes less orderly over time; and
- 8.12k interactions of energy and matter: waves and particles can transfer energy, and energy occurs in discrete quantities.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12*

**Physics**

The beginning teacher is able to:

- 8.15s apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 8–12;
- 8.16s create, analyze, and interpret graphs describing the motion of a particle;
- 8.17s analyze examples of uniform and accelerated motion, including linear, projectile, and circular motion;
- 8.18s create and analyze free-body diagrams;
- 8.19s apply Newton’s laws to solve a variety of practical problems;
- 8.20s apply the law of universal gravitation to solve a variety of practical problems;
- 8.21s apply the inverse square law to calculate electrostatic forces, fields, and potentials;
- 8.22s describe the source of the magnetic force and analyze the magnetic field for various current distributions;
- 8.23s describe the relationship between electricity and magnetism;
- 8.24s design and analyze series and parallel electric circuits in terms of current, resistance, voltage, and power;

**Standard VIII. The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.**

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12 (continued)*

**Physics (continued)**

- 8.25s analyze the operation of electromagnets, motors, and generators;
- 8.26s apply the work-energy theorem to analyze and solve a variety of practical problems;
- 8.27s solve problems involving the conservation of energy in a physical system;
- 8.28s apply the first law of thermodynamics to investigate energy transformations in a variety of everyday situations;
- 8.29s describe the concept of entropy and its relationship to the second law of thermodynamics;
- 8.30s compare and contrast transverse and longitudinal waves;
- 8.31s relate concepts of amplitude, frequency, velocity, and wavelength to the properties of sound and light waves (e.g., pitch, color);
- 8.32s apply the properties of wave reflection, refraction, and interference to analyze and explain acoustical and optical phenomena;
- 8.33s describe the electromagnetic spectrum and explain how electromagnetic waves are produced;
- 8.34s interpret wave particle duality and the uncertainty principle;
- 8.35s analyze the photoelectric effect; and
- 8.36s use the quantum model of the atom to describe the line spectra from gas-discharge tubes.

**Standard VIII. The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12 (continued)*

**Chemistry**

The beginning teacher knows and understands:

- 8.13k structure and properties of matter: atoms and molecules interact with one another through bonding and forces;
- 8.14k structure of atoms: matter is made up of atoms, which are themselves made up of smaller components;
- 8.15k conservation of matter and energy: matter and energy are conserved in chemical and physical changes; and
- 8.16k chemical reactions: chemical reactions release or consume energy.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12 (continued)*

**Chemistry**

The beginning teacher is able to:

- 8.37s apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 8–12;
- 8.38s differentiate between physical and chemical properties of matter;
- 8.39s describe and create models to explain the molecular structure of solids, liquids, and gases;
- 8.40s use the periodic table to predict and explain the physical and chemical properties of an element;
- 8.41s apply the gas laws to predict gas behavior in a variety of situations;
- 8.42s describe the properties of the bonds and the arrangement of atoms in molecules, ionic crystals, polymers, and metallic substances;
- 8.43s compare and contrast the chemical properties of ionic and covalent compounds;
- 8.44s describe the physical and chemical properties of covalent compounds in terms of intermolecular forces in the bonds;
- 8.45s predict the kind of interaction between molecules of a given substance;
- 8.46s solve problems involving moles and stoichiometry;
- 8.47s analyze factors that affect solubility;
- 8.48s determine the molarity, molality, and percent composition of aqueous solutions;

**Standard VIII. The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.**

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12 (continued)*

**Chemistry (continued)**

- 8.49s analyze and describe models to explain the structural properties of water;
- 8.50s evaluate the significance of water as a solvent in living organisms and the environment;
- 8.51s describe the atom in terms of protons, neutrons, and electron clouds;
- 8.52s analyze relationships among electron energy levels, photons, and atomic spectra;
- 8.53s relate electronic configuration to physical and chemical properties and reactivity;
- 8.54s describe the relationship between the kinetic theory and the universal gas law;
- 8.55s analyze and describe the effects of energy transformations that occur in phase changes;
- 8.56s identify and analyze the effects of energy transformations that occur in chemical reactions to enable students to make predictions about other reactions;
- 8.57s analyze and describe models to explain the process of radioactivity and radioactive decay;
- 8.58s compare fission and fusion reactions in terms of the mass of the reactants and products and the amount of energy released in the reactions;
- 8.59s use the half-life of radioactive elements to solve real-world problems;
- 8.60s evaluate the risks and benefits of the commercial uses of nuclear energy and the medical uses of radioisotopes;

**Standard VIII. The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.**

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12 (continued)*

**Chemistry (continued)**

- 8.61s evaluate environmental issues associated with the storage, containment, and disposal of nuclear wastes;
- 8.62s interpret and balance chemical and nuclear equations using number of atoms, mass, and charge;
- 8.63s analyze processes occurring during redox reactions using applications from everyday life;
- 8.64s determine oxidation numbers and balance redox equations in order to determine if the reaction will occur;
- 8.65s describe the operating principles of an electrochemical cell and the process of electroplating metals;
- 8.66s describe the effect of solution concentration on the properties and chemical reactivity of a variety of aqueous solutions;
- 8.67s analyze and interpret relationships among ionic and covalent compounds, electrical conductivity, and colligative properties of water;
- 8.68s illustrate the relationship between the hydronium ion concentration and the pH for various acids and bases;
- 8.69s apply the principles of solution concentration and stoichiometry to analyze characteristics of a neutralization reaction;
- 8.70s analyze and apply the principles of acid-base titration;
- 8.71s analyze examples from the real world that illustrate the effects of acids and bases on an ecological system;

**Standard VIII. The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in physical science.**

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12 (continued)*

**Chemistry (continued)**

- 8.72s apply the law of conservation of energy to evaluate the energy exchange that occurs during a chemical reaction;
- 8.73s analyze factors that affect the rate of a chemical reaction; and
- 8.74s analyze and describe the chemical properties of a variety of household chemicals in order to predict potential for chemical reactivity.

*Standard IX. Teachers of physical science are not responsible for this standard.*

*Standard X. Teachers of physical science are not responsible for this standard.*

**Standard XI. The science teacher knows unifying concepts and processes that are common to all sciences.**

**Teacher Knowledge: What Teachers Know**

*Teachers of Students in Grades 8–12*

The beginning teacher knows and understands:

- 11.1k how systems and subsystems can be used as a conceptual framework to organize and unify the common themes of science and technology;
- 11.2k how patterns in observations and data which explain natural phenomena allow predictions to be made;
- 11.3k how the concepts and processes listed below provide a unifying framework across the science disciplines:
- systems, order, and organization;
  - evidence, models, and explanation;
  - change, constancy, and measurements;
  - evolution and equilibrium; and
  - form and function;
- 11.4k properties and patterns of systems can be described in terms of space, time, energy, and matter;
- 11.5k how change and constancy occur in systems;
- 11.6k the complementary nature of form and function in a given system; and
- 11.7k how models are used to represent the natural world and how to evaluate the strengths and limitations of a variety of scientific models (e.g., physical, conceptual, mathematical).

**Application: What Teachers Can Do**

*Teachers of Students in Grades 8–12*

The beginning teacher is able to:

- 11.1s apply the systems model to identify and analyze common themes that occur in physical science, life science, and Earth and space science;
- 11.2s analyze a system (e.g., a cell, the ocean, an ideal gas) in terms of cycles, structure, and processes;
- 11.3s analyze the general features of systems (e.g., input, process, output, feedback);
- 11.4s analyze the interactions that occur between the components of a given system or subsystem;
- 11.5s analyze the interactions and interrelationships between various systems and subsystems; and
- 11.6s use the systems model to analyze the concepts of constancy (e.g., conservation of mass, energy, and momentum) and change (e.g., evolution).