Texas Education Agency

TEXAS EDUCATOR CERTIFICATION

TExES/ExCET | TExMaT | TASC/TASC-ASL

TExES | Texas Examinations of Educator Standards

Preparation Manual

136 Science 8–12

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Chapter 1

Introduction to the Science 8–12 Test and Suggestions for Using This Test Preparation Manual

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OVERVIEW

The State Board for Educator Certification (SBEC) has approved Texas educator standards that delineate what the beginning educator should know and be able to do. These standards, which are based on the state-required curriculum for students — the Texas Essential Knowledge and Skills (TEKS) — form the basis for the Texas Examinations of Educator Standards® (TExES®) program. This initiative, administered by Texas Education Agency (TEA), will affect all areas of Texas education — from the more than 170 approved Texas Educator Preparation Programs (EPPs) to the more than 7,000 Texas school campuses. This standards-based system reflects SBEC's commitment to help align Texas education from kindergarten through college. SBEC and TEA's roles in this K–16 initiative will ensure that newly certified Texas educators have the essential knowledge and skills to teach the TEKS to the state's public school students.

This manual is designed to help examinees prepare for the TExES test in this field. Its purpose is to familiarize examinees with the competencies to be tested, test question formats and pertinent study resources. EPP staff may also find this information useful as they help examinees prepare for careers as Texas educators.

KEY FEATURES OF THE MANUAL

- *List of competencies that will be tested*
- *Strategies for answering multiple-choice questions*
- *Sample test questions and answer key*

If you have any questions after reading this preparation manual or you would like additional information about the TExES tests or the educator standards, please visit the TEA website at **www.tea.state.tx.us**.

USING THE TEST FRAMEWORK

The Texas Examinations of Educator Standards (TExES) tests measure the content knowledge required of an entry-level educator in a particular field in Texas public schools. This manual is designed to guide your preparation by helping you become familiar with the material to be covered on the test you are planning to take, identify areas where you feel you may be weak and increase your knowledge in those areas by helping you design a study plan.

When preparing for this test, you should focus on the competencies and descriptive statements, which delineate the content that is eligible for testing. A portion of the content is represented in the sample questions that are included in this manual. These test questions represent only a sampling of questions. Thus, your test preparation should focus on the competencies and descriptive statements and not simply on the sample questions.

ORGANIZATION OF THE TExES TEST FRAMEWORK

The test framework is based on the educator standards for this field.

The content covered by this test is organized into broad areas of content called domains. Each domain covers one or more of the educator standards for this field. Within each domain, the content is further defined by a set of competencies. Each competency is composed of two major parts:

1. the **competency statement**, which broadly defines what an entry-level educator in this field in Texas public schools should know and be able to do, and
2. the **descriptive statements**, which describe in greater detail the knowledge and skills eligible for testing.

The educator standards being assessed within each domain are listed for reference at the beginning of the test framework, which begins on page 12. These are followed by a complete set of the framework's competencies and descriptive statements.

An example of a competency and its accompanying descriptive statements is provided below.

SAMPLE COMPETENCY

Science 8–12

COMPETENCY 001

THE TEACHER UNDERSTANDS HOW TO SELECT AND MANAGE LEARNING ACTIVITIES TO ENSURE THE SAFETY OF ALL STUDENTS AND THE CORRECT USE AND CARE OF ORGANISMS, NATURAL RESOURCES, MATERIALS, EQUIPMENT AND TECHNOLOGIES.

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SAMPLE DESCRIPTIVE STATEMENTS

The beginning teacher:

A. Uses current sources of information about laboratory safety, including safety regulations and guidelines for the use of science facilities.

B. Recognizes potential safety hazards in the laboratory and in the field and knows how to apply procedures, including basic first aid, for responding to accidents.

C. Employs safe practices in planning, implementing and managing all instructional activities and designs, and implements rules and procedures to maintain a safe learning environment.

D. Understands procedures for selecting, maintaining and safely using chemicals, tools, technologies, materials, specimens and equipment, including procedures for the recycling, reuse and conservation of laboratory resources and for the safe handling and ethical treatment of organisms.

E. Knows how to use appropriate equipment and technology (e.g., Internet, spreadsheet, calculator) for gathering, organizing, displaying and communicating data in a variety of ways (e.g., charts, tables, graphs, diagrams, maps, satellite images, written reports, oral presentations).

F. Understands how to use a variety of tools, techniques and technology to gather, organize and analyze data, perform calculations and how to apply appropriate methods of statistical measures and analyses.

G. Knows how to apply techniques to calibrate measuring devices and understands concepts of precision, accuracy and error with regard to reading and recording numerical data from scientific instruments (e.g., significant figures).

H. Uses the International System of Units (i.e., metric system) and performs unit conversions within and across measurement systems.

STUDYING FOR THE TExES TEST

The following steps may be helpful in preparing for the TExES test.

1. Identify the information the test will cover by reading through the test competencies (see Chapter 3). Within each domain of this TExES test, each competency will receive approximately equal coverage.
2. Read each competency with its descriptive statements in order to get a more specific idea of the knowledge you will be required to demonstrate on the test. You may wish to use this review of the competencies to set priorities for your study time.
3. Review the "Preparation Resources" section of this manual (Appendix B) for possible resources to consult. Also, compile key materials from your preparation course work that are aligned with the competencies.
4. Study this manual for approaches to taking the TExES test.
5. When using resources, concentrate on the key skills and important abilities that are discussed in the competencies and descriptive statements.
6. Use the study plan sheet (Appendix A) to help you plan your study.

NOTE: This preparation manual is the only TExES test study material endorsed by Texas Education Agency (TEA) for this field. Other preparation materials may not accurately reflect the content of the test or the policies and procedures of the TExES program.

Chapter 2

Background Information on the TExES Testing Program

THE TExES TESTS FOR TEXAS TEACHERS

As required by the Texas Education Code §21.048, successful performance on educator certification examinations is required for the issuance of a Texas educator certificate. Each TExES test is a criterion-referenced examination designed to measure the knowledge and skills delineated in the corresponding TExES test framework. Each test framework is based on standards that were developed by Texas educators and other education stakeholders.

Each TExES test is designed to measure the requisite knowledge and skills that an entry-level educator in this field in Texas public schools must possess. The tests include both individual (stand-alone) test questions and questions that are arranged in clustered sets based on real-world situations faced by educators.

DEVELOPMENT OF THE NEW TExES TESTS

Committees of Texas educators and members of the community guide the development of the new TExES tests by participating in each stage of the test development process. These working committees are composed of Texas educators from public and charter schools, university and EPP faculty, education service center staff, representatives from professional educator organizations, content experts and members of the business community. The committees are balanced in terms of position, affiliation, years of experience, ethnicity, gender and geographical location. The committee membership is rotated during the development process so that numerous Texas stakeholders may be actively involved. The steps in the process to develop the TExES tests are described below.

1. **Develop Standards.** Committees are established to recommend what the beginning educator should know and be able to do. Using the Texas Essential Knowledge and Skills (TEKS) as the focal point, draft standards are prepared to define the knowledge and skills required of the beginning educator.

2. **Review Standards.** Committees review and revise the draft standards. The revised draft standards are then placed on the TEA website for public review and comment. These comments are used to prepare a final draft of the standards that will be presented to the SBEC Board for discussion, the State Board of Education (SBOE) for review and comment and the SBEC Board for approval. Standards not based specifically on the TEKS, such as those for librarians and counselors, are proposed as rule by the SBEC Board; sent to the SBOE for its 90-day review; and, if not rejected by the SBOE, adopted by the SBEC Board.

3. **Develop Test Frameworks.** Committees review and revise draft test frameworks that are based on the standards. These frameworks outline the specific competencies to be measured on the new TExES tests. Draft frameworks are not finalized until after the standards are approved and the job analysis/content validation survey (see #4) is complete.

4. **Conduct Job Analysis/Content Validation Surveys.** A representative sample of Texas educators who practice in or prepare individuals for each of the fields for which an educator certificate has been proposed are surveyed to determine the relative job importance of each competency outlined in the test framework for that content area. Frameworks are revised as needed following an analysis of the survey responses.

5. **Develop and Review New Test Questions.** The test contractor develops draft questions that are designed to measure the competencies described in the test framework. Committees review the newly developed test questions that have been written to reflect the competencies in the new test framework. Committee members scrutinize the draft questions for appropriateness of content and difficulty; clarity; match to the competencies; and potential ethnic, gender and regional bias.

6. **Conduct Pilot Test of New Test Questions.** All of the newly developed test questions that have been deemed acceptable by the question review committees are then administered to an appropriate sample of candidates for certification.

7. **Review Pilot Test Data.** Pilot test results are reviewed to ensure that the test questions are valid, reliable and free from bias.

8. **Administer TExES Tests.** New TExES tests are constructed to reflect the competencies, and the tests are administered to candidates for certification.

9. **Set Passing Standard.** A Standard Setting Committee convenes to review performance data from the initial administration of each new TExES test and to recommend a final passing standard for that test. The SBEC Board considers this recommendation as it establishes a passing score on the test.

TAKING THE TExES TEST AND RECEIVING SCORES

Please refer to the current TExES *Registration Bulletin* or the ETS TExES website at **www.texes.ets.org** for information on test dates, test centers, fees, registration procedures and program policies.

Your score report will be available to you in your testing account on the ETS TExES online registration system by 5 p.m. Central time on the score reporting date indicated in the *Registration Bulletin*. The report will indicate whether you have passed the test and will include:

- A total test scaled score. Scaled scores are reported to allow for the comparison of scores on the same content-area test taken on different test administration dates. The total scaled score is not the percentage of questions answered correctly and is not determined by averaging the number of questions answered correctly in each domain.
  - For all TExES tests, the score scale is 100–300 with a scaled score of 240 as the minimum passing score. This score represents the minimum level of competency required to be an entry-level educator in this field in Texas public schools.
- Your performance in the major content domains of the test and in the specific content competencies of the test.
  - This information may be useful in identifying strengths and weaknesses in your content preparation and can be used for further study or for preparing to retake the test. However, it is important to use caution when interpreting scores reported by domain and competency as these scores are typically based on a smaller number of items than the total score and therefore may not be as reliable as the total score.
- A link to information to help you understand the score scale and interpret your results.

A score report will not be available to you if you are absent or choose to cancel your score.

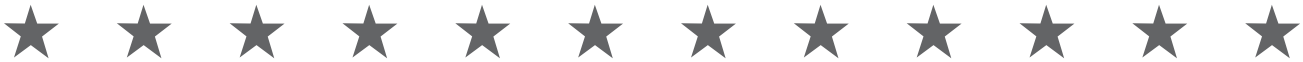
For more information about scores or to access scores online, go to **www.texes.ets.org**.

EDUCATOR STANDARDS

Complete, approved educator standards are posted on the TEA website at **www.tea.state.tx.us**.

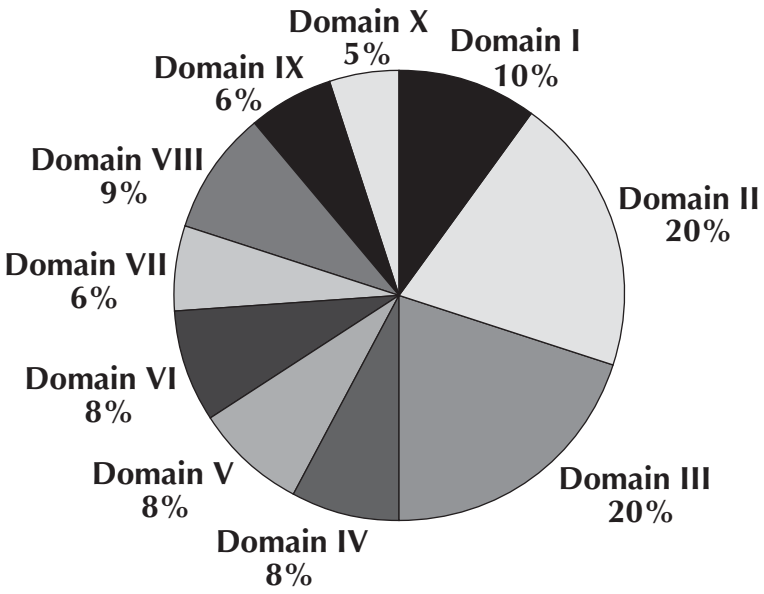
Chapter 3

Study Topics



TEST FRAMEWORK FOR FIELD 136: SCIENCE 8–12

THE DOMAINS



- **Domain I: Scientific Inquiry and Processes**
  Standards Assessed: Science I–III, VI–VII, XI
- **Domain II: Physics**
  Standard Assessed: Science VIII
- **Domain III: Chemistry**
  Standard Assessed: Science VIII
- **Domain IV: Cell Structure and Processes**
  Standard Assessed: Science IX
- **Domain V: Heredity and Evolution of Life**
  Standard Assessed: Science IX
- **Domain VI: Diversity of Life**
  Standard Assessed: Science IX
- **Domain VII: Interdependence of Life and Environmental Systems**
  Standard Assessed: Science IX
- **Domain VIII: Earth's History and the Structure and Function of Earth Systems**
  Standard Assessed: Science X
- **Domain IX: Components and Properties of the Solar System and the Universe**
  Standard Assessed: Science X
- **Domain X: Science Learning, Instruction and Assessment**
  Standards Assessed: Science IV–V

TOTAL TEST BREAKDOWN

- Exam is offered as a paper-based or computer-administered test
- 130 Multiple-Choice Questions (120 Scored Questions*)

*The number of scored questions will not vary; however, the number of questions that are not scored may vary in the actual test. Your final scaled score will be based only on scored questions.

THE STANDARDS

DOMAIN I — SCIENTIFIC INQUIRY AND PROCESSES (approximately 10% of the test)

SCIENCE 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.

SCIENCE STANDARD II:
The science teacher understands the correct use of tools, materials, equipment and technologies.

SCIENCE STANDARD III:
The science teacher understands the process of scientific inquiry and its role in science instruction.

SCIENCE STANDARD VI:
The science teacher understands the history and nature of science.

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.

SCIENCE STANDARD XI:
The science teacher knows unifying concepts and processes that are common to all sciences.

DOMAIN II — PHYSICS (approximately 20% of the test)

SCIENCE 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.

DOMAIN III — CHEMISTRY (approximately 20% of the test)

SCIENCE 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.

DOMAIN IV — CELL STRUCTURE AND PROCESSES (approximately 8% of the test)

SCIENCE STANDARD IX:
The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in life science.

DOMAIN V — HEREDITY AND EVOLUTION OF LIFE (approximately 8% of the test)

SCIENCE STANDARD IX:
The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in life science.

DOMAIN VI — DIVERSITY OF LIFE (approximately 8% of the test)

SCIENCE STANDARD IX:
The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in life science.

DOMAIN VII — INTERDEPENDENCE OF LIFE AND ENVIRONMENTAL SYSTEMS (approximately 6% of the test)

SCIENCE STANDARD IX:
The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in life science.

DOMAIN VIII — EARTH'S HISTORY AND THE STRUCTURE AND FUNCTION OF EARTH SYSTEMS (approximately 9% of the test)

SCIENCE STANDARD X:
The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in Earth and space science.

DOMAIN IX — COMPONENTS AND PROPERTIES OF THE SOLAR SYSTEM AND THE UNIVERSE (approximately 6% of the test)

SCIENCE STANDARD X:
The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in Earth and space science.

DOMAIN X — SCIENCE LEARNING, INSTRUCTION AND ASSESSMENT (approximately 5% of the test)

SCIENCE STANDARD IV:
The science teacher has theoretical and practical knowledge about teaching science and about how students learn science.

SCIENCE STANDARD V:
The science teacher knows the varied and appropriate assessments and assessment practices to monitor science learning.

COMPETENCIES

DOMAIN I — SCIENTIFIC INQUIRY AND PROCESSES

COMPETENCY 001

THE TEACHER UNDERSTANDS HOW TO SELECT AND MANAGE LEARNING ACTIVITIES TO ENSURE THE SAFETY OF ALL STUDENTS AND THE CORRECT USE AND CARE OF ORGANISMS, NATURAL RESOURCES, MATERIALS, EQUIPMENT AND TECHNOLOGIES.

The beginning teacher:

A. Uses current sources of information about laboratory safety, including safety regulations and guidelines for the use of science facilities.

B. Recognizes potential safety hazards in the laboratory and in the field and knows how to apply procedures, including basic first aid, for responding to accidents.

C. Employs safe practices in planning, implementing and managing all instructional activities and designs, and implements rules and procedures to maintain a safe learning environment.

D. Understands procedures for selecting, maintaining and safely using chemicals, tools, technologies, materials, specimens and equipment, including procedures for the recycling, reuse and conservation of laboratory resources and for the safe handling and ethical treatment of organisms.

E. Knows how to use appropriate equipment and technology (e.g., Internet, spreadsheet, calculator) for gathering, organizing, displaying and communicating data in a variety of ways (e.g., charts, tables, graphs, diagrams, maps, satellite images, written reports, oral presentations).

F. Understands how to use a variety of tools, techniques and technology to gather, organize and analyze data, perform calculations and how to apply appropriate methods of statistical measures and analyses.

G. Knows how to apply techniques to calibrate measuring devices and understands concepts of precision, accuracy and error with regard to reading and recording numerical data from scientific instruments (e.g., significant figures).

H. Uses the International System of Units (i.e., metric system) and performs unit conversions within and across measurement systems.

COMPETENCY 002

THE TEACHER UNDERSTANDS THE NATURE OF SCIENCE, THE PROCESS OF SCIENTIFIC INQUIRY AND THE UNIFYING CONCEPTS THAT ARE COMMON TO ALL SCIENCES.

The beginning teacher:

A. Understands the nature of science, the relationship between science and technology, the predictive power of science and limitations to the scope of science (i.e., the types of questions that science can and cannot answer).

B. Knows the characteristics of various types of scientific investigations (e.g., descriptive studies, controlled experiments, comparative data analysis) and how and why scientists use different types of scientific investigations.

C. Understands principles and procedures for designing and conducting a variety of scientific investigations, with emphasis on inquiry-based investigations, and how to communicate and defend scientific results.

D. Understands how logical reasoning, verifiable observational and experimental evidence and peer review are used in the process of generating and evaluating scientific knowledge.

E. Understands how to identify potential sources of error in an investigation, evaluate the validity of scientific data and develop and analyze different explanations for a given scientific result.

F. Knows the characteristics and general features of systems; how properties and patterns of systems can be described in terms of space, time, energy and matter; and how system components and different systems interact.

G. Knows how to apply and analyze the systems model (e.g., interacting parts, boundaries, input, output, feedback, subsystems) across the science disciplines.

H. Understands how shared themes and concepts (e.g., systems, order and organization; evidence, models and explanation; change, constancy and measurements; evolution and equilibrium; and form and function) provide a unifying framework in science.

I. Understands the difference between a theory and a hypothesis, 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).

COMPETENCY 003

THE TEACHER UNDERSTANDS THE HISTORY OF SCIENCE, HOW SCIENCE IMPACTS THE DAILY LIVES OF STUDENTS AND HOW SCIENCE INTERACTS WITH AND INFLUENCES PERSONAL AND SOCIETAL DECISIONS.

The beginning teacher:

A. Understands the historical development of science, key events in the history of science and the contributions that diverse cultures and individuals of both genders have made to scientific knowledge.

B. Knows how to use examples from the history of science to demonstrate the changing nature of scientific theories and knowledge (i.e., that scientific theories and knowledge are always subject to revision in light of new evidence).

C. Knows that science is a human endeavor influenced by societal, cultural and personal views of the world, and that decisions about the use and direction of science are based on factors such as ethical standards, economics and personal and societal biases and needs.

D. Understands the application of scientific ethics to the conducting, analyzing and publishing of scientific investigations.

E. Applies scientific principles to analyze factors (e.g., diet, exercise, personal behavior) that influence personal and societal choices concerning fitness and health (e.g., physiological and psychological effects and risks associated with the use of substances and substance abuse).

F. Applies scientific principles, the theory of probability and risk/benefit analysis to analyze the advantages of, disadvantages of or alternatives to a given decision or course of action.

G. Understands the role science can play in helping resolve personal, societal and global issues (e.g., recycling, population growth, disease prevention, resource use, evaluating product claims).

DOMAIN II — PHYSICS

COMPETENCY 004
THE TEACHER UNDERSTANDS THE DESCRIPTION OF MOTION IN ONE AND TWO DIMENSIONS.

The beginning teacher:

A. Generates, analyzes and interprets graphs describing the motion of a particle.

B. Applies vector concepts to displacement, velocity and acceleration in order to analyze and describe the motion of a particle.

C. Solves problems involving uniform and accelerated motion using scalar (e.g., speed) and vector (e.g., velocity) quantities.

D. Analyzes and solves problems involving projectile motion.

E. Analyzes and solves problems involving uniform circular and rotary motion.

F. Understands motion of fluids.

G. Understands motion in terms of frames of reference and relativity concepts.

COMPETENCY 005
THE TEACHER UNDERSTANDS THE LAWS OF MOTION.

The beginning teacher:

A. Identifies and analyzes the forces acting in a given situation and constructs a free-body diagram.

B. Solves problems involving the vector nature of force (e.g., resolving forces into components, analyzing static or dynamic equilibrium of a particle).

C. Identifies and applies Newton's laws to analyze and solve a variety of practical problems (e.g., properties of frictional forces, acceleration of a particle on an inclined plane, displacement of a mass on a spring, forces on a pendulum).

COMPETENCY 006

THE TEACHER UNDERSTANDS THE CONCEPTS OF GRAVITATIONAL AND ELECTROMAGNETIC FORCES IN NATURE.

The beginning teacher:

A. Applies the Law of Universal Gravitation to solve a variety of problems (e.g., determining the gravitational fields of the planets, analyzing properties of satellite orbits).

B. Calculates electrostatic forces, fields and potentials.

C. Understands the properties of magnetic materials and the molecular theory of magnetism.

D. Identifies the source of the magnetic field and calculates the magnetic field for various simple current distributions.

E. Analyzes the magnetic force on charged particles and current-carrying conductors.

F. Understands induced electric and magnetic fields and analyzes the relationship between electricity and magnetism.

G. Understands the electromagnetic spectrum and the production of electromagnetic waves.

COMPETENCY 007

THE TEACHER UNDERSTANDS APPLICATIONS OF ELECTRICITY AND MAGNETISM.

The beginning teacher:

A. Analyzes common examples of electrostatics (e.g., a charged balloon attached to a wall, behavior of an electroscope, charging by induction).

B. Understands electric current, resistance and resistivity, potential difference, capacitance and electromotive force in conductors and circuits.

C. Analyzes series and parallel DC circuits in terms of current, resistance, voltage and power.

D. Identifies basic components and characteristics of AC circuits.

E. Understands the operation of an electromagnet.

F. Understands the operation of electric meters, motors, generators and transformers.

COMPETENCY 008

THE TEACHER UNDERSTANDS THE CONSERVATION OF ENERGY AND MOMENTUM.

The beginning teacher:

A. Understands the concept of work.

B. Understands the relationships among work, energy and power.

C. Solves problems using the conservation of mechanical energy in a physical system (e.g., determining potential energy for conservative forces, conversion of potential to kinetic energy, analyzing the motion of a pendulum).

D. Applies the work-energy theorem to analyze and solve a variety of practical problems (e.g., finding the speed of an object given its potential energy, determining the work done by frictional forces on a decelerating car).

E. Understands linear and angular momentum.

F. Solves a variety of problems (e.g., collisions) using the conservation of linear and angular momentum.

COMPETENCY 009

THE TEACHER UNDERSTANDS THE LAWS OF THERMODYNAMICS.

The beginning teacher:

A. Understands methods of heat transfer (i.e., convection, conduction, radiation).

B. Understands the molecular interpretation of temperature and heat.

C. Solves problems involving thermal expansion, heat capacity and the relationship between heat and other forms of energy.

D. Applies the first law of thermodynamics to analyze energy transformations in a variety of everyday situations (e.g., electric light bulb, power generating plant).

E. Understands the concept of entropy and its relationship to the second law of thermodynamics.

COMPETENCY 010

THE TEACHER UNDERSTANDS THE CHARACTERISTICS AND BEHAVIOR OF WAVES.

The beginning teacher:

A. Understands interrelationships among wave characteristics such as velocity, frequency, wavelength and amplitude and relates them to properties of sound and light (e.g., pitch, color).

B. Compares and contrasts transverse and longitudinal waves.

C. Describes how various waves are propagated through different media.

D. Applies properties of reflection and refraction to analyze optical phenomena (e.g., mirrors, lenses, fiber-optic cable).

E. Applies principles of wave interference to analyze wave phenomena, including acoustical (e.g., harmonics) and optical phenomena (e.g., patterns created by thin films and diffraction gratings).

F. Identifies and interprets how wave characteristics and behaviors are used in medical, industrial and other real-world applications.

COMPETENCY 011

THE TEACHER UNDERSTANDS THE FUNDAMENTAL CONCEPTS OF QUANTUM PHYSICS.

The beginning teacher:

A. Interprets wave-particle duality.

B. Identifies examples and consequences of the Uncertainty Principle.

C. Understands the photoelectric effect.

D. Uses the quantum model of the atom to describe and analyze absorption and emission spectra (e.g., line spectra, blackbody radiation).

E. Explores real-world applications of quantum phenomena (e.g., lasers, photoelectric sensors, semiconductors, superconductivity).

DOMAIN III — CHEMISTRY

COMPETENCY 012

THE TEACHER UNDERSTANDS THE CHARACTERISTICS OF MATTER AND ATOMIC STRUCTURE.

The beginning teacher:

A. Differentiates between physical and chemical properties and changes of matter.

B. Explains the structure and properties of solids, liquids and gases.

C. Identifies and analyzes properties of substances (i.e., elements and compounds) and mixtures.

D. Models the atom in terms of protons, neutrons and electron clouds.

E. Identifies elements and isotopes by atomic number and mass number and calculates average atomic mass of an element.

F. Understands atomic orbitals and electron configurations and describes the relationship between electron energy levels and atomic structure.

G. Understands the nature and historical significance of the periodic table.

H. Applies the concept of periodicity to predict the physical (e.g., atomic and ionic radii) and chemical properties (e.g., electronegativity, ionization energy) of an element.

COMPETENCY 013

THE TEACHER UNDERSTANDS THE PROPERTIES OF GASES.

The beginning teacher:

A. Understands interrelationships among temperature, moles, pressure and volume of gases contained within a closed system.

B. Analyzes data obtained from investigations with gases in a closed system and determines whether the data are consistent with the ideal gas law.

C. Applies the gas laws (e.g., Charles's law, Boyle's law, combined gas law) to describe and calculate gas properties in a variety of situations.

D. Applies Dalton's law of partial pressure in various situations (e.g., collecting a gas over water).

E. Understands the relationship between Kinetic Molecular Theory and the ideal gas law.

F. Knows how to apply the ideal gas law to analyze mass relationships between reactants and products in chemical reactions involving gases.

COMPETENCY 014

THE TEACHER UNDERSTANDS PROPERTIES AND CHARACTERISTICS OF IONIC AND COVALENT BONDS.

The beginning teacher:

A. Relates the electron configuration of an atom to its chemical reactivity.

B. Compares and contrasts characteristics of ionic and covalent bonds.

C. Applies the "octet" rule to construct Lewis structures.

D. Identifies and describes the arrangement of atoms in molecules, ionic crystals, polymers and metallic substances.

E. Understands the influence of bonding forces on the physical and chemical properties of ionic and covalent substances.

F. Identifies and describes intermolecular and intramolecular forces.

G. Uses intermolecular forces to explain the physical properties of a given substance (e.g., melting point, crystal structure).

H. Applies the concepts of electronegativity, electron affinity and oxidation state to analyze chemical bonds.

I. Evaluates energy changes in the formation and dissociation of chemical bonds.

J. Understands the relationship between chemical bonding and molecular geometry.

COMPETENCY 015

THE TEACHER UNDERSTANDS AND INTERPRETS CHEMICAL EQUATIONS AND CHEMICAL REACTIONS.

The beginning teacher:

A. Identifies elements, common ions and compounds using scientific nomenclature.

B. Uses and interprets symbols, formulas and equations in describing interactions of matter and energy in chemical reactions.

C. Understands mass relationships involving percent composition, empirical formulas and molecular formulas.

D. Interprets and balances chemical equations using conservation of mass and charge.

E. Understands mass relationships in chemical equations and solves problems using calculations involving moles, limiting reagents and reaction yield.

F. Identifies factors (e.g., temperature, pressure, concentration, catalysts) that influence the rate of a chemical reaction and describes their effects.

G. Understands principles of chemical equilibrium and solves problems involving equilibrium constants.

H. Identifies the chemical properties of a variety of common household chemicals (e.g., baking soda, bleach, ammonia) in order to predict the potential for chemical reactivity.

COMPETENCY 016

THE TEACHER UNDERSTANDS TYPES AND PROPERTIES OF SOLUTIONS.

The beginning teacher:

A. Analyzes factors that affect solubility (e.g., temperature, pressure, polarity of solvents and solutes) and rate of dissolution (e.g., surface area, agitation).

B. Identifies characteristics of saturated, unsaturated and supersaturated solutions.

C. Determines the molarity, molality, normality and percent composition of aqueous solutions.

D. Analyzes precipitation reactions and derives net ionic equations.

E. Understands the colligative properties of solutions (e.g., vapor pressure lowering, osmotic pressure changes, boiling-point elevation, freezing-point depression).

F. Understands the properties of electrolytes and explains the relationship between concentration and electrical conductivity.

G. Understands methods for measuring and comparing the rates of reaction in solutions of varying concentration.

H. Analyzes models to explain the structural properties of water and evaluates the significance of water as a solvent in living organisms and the environment.

COMPETENCY 017

THE TEACHER UNDERSTANDS ENERGY TRANSFORMATIONS THAT OCCUR IN PHYSICAL AND CHEMICAL PROCESSES.

The beginning teacher:

A. Analyzes the energy transformations that occur in phase transitions.

B. Solves problems in calorimetry (e.g., determining the specific heat of a substance, finding the standard enthalpy of formation and reaction of substances).

C. Applies the law of conservation of energy to analyze and evaluate energy exchanges that occur in exothermic and endothermic reactions.

D. Understands thermodynamic relationships among spontaneous reactions, entropy, enthalpy, temperature and Gibbs free energy.

COMPETENCY 018

THE TEACHER UNDERSTANDS NUCLEAR FISSION, NUCLEAR FUSION AND NUCLEAR REACTIONS.

The beginning teacher:

A. Uses models to explain radioactivity and radioactive decay (i.e., alpha, beta, gamma).

B. Interprets and balances equations for nuclear reactions.

C. Compares and contrasts fission and fusion reactions (e.g., relative energy released in the reactions, mass distribution of products).

D. Knows how to use the half-life of radioactive elements to solve real-world problems (e.g., carbon dating, radioactive tracers).

E. Understands stable and unstable isotopes.

F. Knows various issues associated with using nuclear energy (e.g., medical, commercial, environmental).

COMPETENCY 019

THE TEACHER UNDERSTANDS OXIDATION AND REDUCTION REACTIONS.

The beginning teacher:

A. Determines the oxidation state of ions and atoms in compounds.

B. Identifies and balances oxidation and reduction reactions.

C. Uses reduction potentials to determine whether a redox reaction will occur spontaneously.

D. Explains the operation and applications of electrochemical cells.

E. Analyzes applications of oxidation and reduction reactions from everyday life (e.g., combustion, rusting, electroplating, batteries).

COMPETENCY 020

THE TEACHER UNDERSTANDS ACIDS, BASES AND THEIR REACTIONS.

The beginning teacher:

A. Identifies the general properties of, and relationships among, acids, bases and salts.

B. Identifies acids and bases using models of Arrhenius, Brønsted-Lowry and Lewis.

C. Differentiates between strong and weak acids and bases.

D. Applies the relationship between hydronium ion concentration and pH for acids and bases.

E. Understands and analyzes acid-base equilibria and buffers.

F. Analyzes and applies the principles of acid-base titration.

G. Analyzes neutralization reactions based on the principles of solution concentration and stoichiometry.

H. Describes the effects of acids and bases in the real world (e.g., acid precipitation, physiological buffering).

DOMAIN IV — CELL STRUCTURE AND PROCESSES

COMPETENCY 021

THE TEACHER UNDERSTANDS THE STRUCTURE AND FUNCTION OF BIOMOLECULES.

The beginning teacher:

A. Identifies the chemical elements necessary for life and understands how these elements combine to form biologically important compounds.

B. Relates the physical and chemical properties of water and carbon to the significance of these properties in basic life processes.

C. Analyzes how a molecule's biological function is related to its shape (e.g., enzymes, tRNA, DNA, receptors, neurotransmitters, lipids).

D. Understands the importance of chemical reactions in the synthesis and degradation of biomolecules.

E. Identifies and compares the structures and functions of different types of biomolecules, including carbohydrates, lipids, proteins and nucleic acids.

F. Explains how enzymes function in synthesis and degradation of biomolecules (e.g., DNA, food).

COMPETENCY 022

THE TEACHER UNDERSTANDS THAT CELLS ARE THE BASIC STRUCTURES OF LIVING THINGS AND HAVE SPECIALIZED PARTS THAT PERFORM SPECIFIC FUNCTIONS.

The beginning teacher:

A. Differentiates among viruses, prokaryotic cells and eukaryotic cells (e.g., structure and function).

B. Describes the basic components of prokaryotic and eukaryotic cells (e.g., cell membrane, cell wall, ribosomes, nucleus, mitochondrion, chloroplast), the functions and the interrelationships of these components.

C. Identifies differences in cell structure and function in different types of organisms (e.g., differences in plant and animal cells).

D. Analyzes specialization of structure and function in different types of cells in living organisms (e.g., skin, nerve and muscle cells in animals; root, stem and leaf cells in plants).

COMPETENCY 023

THE TEACHER UNDERSTANDS HOW CELLS CARRY OUT LIFE PROCESSES.

The beginning teacher:

A. Analyzes how cells maintain homeostasis (e.g., the effects of concentration gradients, rate of movement and surface area/volume ratio).

B. Understands processes by which cells transport water, nutrients and wastes across cell membranes (e.g., osmosis, diffusion, transport systems).

C. Analyzes energy flow in the processes of photosynthesis and cellular respiration.

D. Compares and contrasts anaerobic and aerobic respiration and their products.

COMPETENCY 024

THE TEACHER UNDERSTANDS HOW SPECIALIZED CELLS, TISSUES, ORGANS, ORGAN SYSTEMS AND ORGANISMS GROW AND DEVELOP.

The beginning teacher:

A. Understands factors (e.g., hormones, cell size) that regulate the cell cycle and the effects of unregulated cell growth (e.g., cancer).

B. Analyzes the role of cell differentiation in the development of tissues, organs, organ systems and living organisms.

C. Analyzes factors (e.g., genetics, disease, nutrition, exposure to toxic chemicals) affecting cell differentiation and the growth and development of organisms.

D. Identifies the different levels of organization in multicellular organisms and relates the parts to each other and to the whole.

DOMAIN V — HEREDITY AND EVOLUTION OF LIFE

COMPETENCY 025

THE TEACHER UNDERSTANDS THE STRUCTURES AND FUNCTIONS OF NUCLEIC ACIDS IN THE MECHANISMS OF GENETICS.

The beginning teacher:

A. Relates the structure of DNA (e.g., bases, sugars, phosphates) to the nature, function and relationships of genes, chromatin and chromosomes.

B. Relates the structures of DNA and RNA to the processes of replication, transcription, translation and genetic regulation.

C. Compares and contrasts the organization and control of the genome in viruses, prokaryotic cells and eukaryotic cells.

D. Understands the types, biological significance and causes of mutations.

E. Identifies methods and applications of genetic identification and manipulation (e.g., production of recombinant DNA, cloning, PCR).

F. Analyzes human karyotypes in order to identify chromosomal disorders and sex.

COMPETENCY 026

THE TEACHER UNDERSTANDS THE CONTINUITY AND VARIATIONS OF TRAITS FROM ONE GENERATION TO THE NEXT.

The beginning teacher:

A. Applies the laws of probability to determine genotypic and phenotypic frequencies in Mendelian inheritance (e.g., using Punnett squares, pedigree charts).

B. Compares the processes of meiosis and mitosis (in plants and animals) and describes their roles in sexual and asexual reproduction.

C. Recognizes factors influencing the transmission of genes from one generation to the next (e.g., linkage, position of genes on a chromosome, crossing over, independent assortment).

D. Understands how the genotype of an organism influences the expression of traits in its phenotype (e.g., dominant and recessive traits; monogenic, polygenic and polytypic inheritance; genetic disorders).

E. Analyzes the effects of environmental factors (e.g., light, nutrition, moisture, temperature) on the expression of traits in the phenotype of an organism.

COMPETENCY 027

THE TEACHER UNDERSTANDS THE THEORY OF BIOLOGICAL EVOLUTION.

The beginning teacher:

A. Understands stability and change in populations (e.g., Hardy-Weinberg equilibrium) and analyzes factors leading to genetic variation and evolution in populations (e.g., mutation, gene flow, genetic drift, recombination, nonrandom mating, natural selection).

B. Analyzes the effects of natural selection on adaptations and diversity in populations and species.

C. Understands the role of intraspecific and interspecific competition in evolutionary change.

D. Compares and contrasts the different effects of selection (e.g., directional, stabilizing, diversifying) on a variable characteristic.

E. Analyzes processes that contribute to speciation (e.g., natural selection, founder effect, reproductive isolation).

F. Analyzes the development of isolating mechanisms that discourage hybridization between species (e.g., species' recognition marks, behavioral displays, ecological separation, seasonal breeding).

COMPETENCY 028

THE TEACHER UNDERSTANDS EVIDENCE FOR EVOLUTIONARY CHANGE DURING EARTH'S HISTORY.

The beginning teacher:

A. Analyzes how fossils, DNA sequences, anatomical similarities, physiological similarities and embryology provide evidence of both common origin and change in populations and species.

B. Understands the relationship between environmental change, mutations and adaptations of an organism over many generations.

C. Identifies major developments in the evolutionary history of life (e.g., formation of organic molecules, self-replication, backbones, vascular tissue, colonization of the land).

D. Understands theories regarding the causes of extinction of species and the pace and mode of evolutionary change (e.g., punctuated equilibrium, mass extinctions, adaptive radiation).

DOMAIN VI — DIVERSITY OF LIFE

COMPETENCY 029

THE TEACHER UNDERSTANDS SIMILARITIES AND DIFFERENCES BETWEEN LIVING ORGANISMS AND HOW TAXONOMIC SYSTEMS ARE USED TO ORGANIZE AND INTERPRET THE DIVERSITY OF LIFE.

The beginning teacher:

A. Compares and contrasts structural and physiological adaptations of plants and animals living in various aquatic and terrestrial environments (e.g., freshwater and marine; forest and plain; desert and tundra).

B. Understands the relationship between environmental changes in aquatic and terrestrial ecosystems and adaptive changes in organisms inhabiting these ecosystems.

C. Explains the uses and limitations of classification schemes.

D. Relates taxonomic classification to evolutionary history and knows how to distinguish between traits that are taxonomically useful (e.g., homologous traits) and those that are not (e.g., convergent traits).

E. Analyzes relationships among organisms to develop a model of a hierarchical classification system and knows how to classify aquatic and terrestrial organisms at several taxonomic levels (e.g., species, phylum/division, kingdom) using dichotomous keys.

F. Identifies distinguishing characteristics of domains and kingdoms, including eubacteria, archaebacteria, protists, fungi, plants and animals.

COMPETENCY 030

THE TEACHER UNDERSTANDS THAT, AT ALL LEVELS OF NATURE, LIVING SYSTEMS ARE FOUND WITHIN OTHER LIVING SYSTEMS, EACH WITH ITS OWN BOUNDARIES AND LIMITS.

The beginning teacher:

A. Identifies the basic requirements (e.g., nutrients, oxygen, water, carbon dioxide) necessary for various organisms to carry out life functions.

B. Compares how various organisms obtain, transform, transport, release, eliminate and store energy and matter.

C. Analyzes characteristics, functions and relationships of systems in animals including humans (e.g., digestive, circulatory, nervous, endocrine, reproductive, integumentary, skeletal, respiratory, muscular, excretory, immune systems).

D. Analyzes characteristics, functions and relationships of systems in plants (e.g., transport, control, reproductive, nutritional, structural systems).

E. Identifies methods of reproduction, growth and development of various plants and animals.

COMPETENCY 031

THE TEACHER UNDERSTANDS THE PROCESSES BY WHICH ORGANISMS MAINTAIN HOMEOSTASIS.

The beginning teacher:

A. Explains the importance of maintaining a stable internal environment.

B. Describes the relationships among internal feedback mechanisms in maintaining homeostasis.

C. Identifies anatomical structures and physiological processes in a variety of organisms that function to maintain homeostasis in the face of changing environmental conditions.

D. Analyzes the importance of nutrition, environmental conditions and physical exercise on health in humans and other organisms.

E. Analyzes the role of viruses and microorganisms in maintaining or disrupting homeostasis in different organisms (e.g., the role of bacteria in digestion, diseases of plants and animals).

COMPETENCY 032

THE TEACHER UNDERSTANDS THE RELATIONSHIP BETWEEN BIOLOGY AND BEHAVIOR.

The beginning teacher:

A. Understands how the behavior of organisms, including humans, responds to internal and external stimuli.

B. Recognizes that behavior in many animals is determined by a combination of genetic and learned factors.

C. Identifies adaptive advantages of innate and learned patterns of behavior.

D. Explains mediating factors in innate (e.g., imprinting, hormonal system) and learned (e.g., classical conditioning, play) behavior.

E. Understands concepts linking behavior and natural selection (e.g., kin selection, courtship behavior, altruism).

DOMAIN VII — INTERDEPENDENCE OF LIFE AND ENVIRONMENTAL SYSTEMS

COMPETENCY 033

THE TEACHER UNDERSTANDS THE RELATIONSHIPS BETWEEN ABIOTIC AND BIOTIC FACTORS OF TERRESTRIAL AND AQUATIC ECOSYSTEMS, HABITATS AND BIOMES, INCLUDING THE FLOW OF MATTER AND ENERGY.

The beginning teacher:

A. Analyzes types, sources and flow of energy through different trophic levels (e.g., producers, consumers, decomposers) and between organisms and the physical environment in aquatic and terrestrial ecosystems.

B. Analyzes the flow of energy and the cycling of matter through biogeochemical cycles (e.g., carbon, water, oxygen, nitrogen, phosphorus) in aquatic and terrestrial ecosystems.

C. Understands the concept of limiting factors (e.g., light intensity, temperature, mineral availability) and the effects that they have on the productivity and complexity of different ecosystems (e.g., tropical forest vs. taiga, continental shelf vs. deep ocean).

D. Explains the relationship among abiotic characteristics of different biomes and the adaptations, variations, tolerances and roles of indigenous plants and animals in these biomes.

COMPETENCY 034

THE TEACHER UNDERSTANDS THE INTERDEPENDENCE AND INTERACTIONS OF LIVING THINGS IN TERRESTRIAL AND AQUATIC ECOSYSTEMS.

The beginning teacher:

A. Understands the concepts of ecosystem, biome, community, habitat and niche.

B. Analyzes interactions of organisms, including humans, in the production and consumption of energy (e.g., food chains, food webs, food pyramids) in aquatic and terrestrial ecosystems.

C. Understands interspecific interactions in aquatic and terrestrial ecosystems (e.g., predator-prey relationships, competition, parasitism, commensalism, mutualism) and how they affect ecosystem structure.

D. Identifies indigenous plants and animals, assesses their roles in an ecosystem and describes their relationships in different types of environments (e.g., fresh water, continental shelf, deep ocean, forest, desert, plains, tundra).

E. Analyzes how the introduction, removal or reintroduction of an organism may alter the food chain, affect existing populations and influence natural selection in terrestrial and aquatic ecosystems.

F. Evaluates the importance of biodiversity in an ecosystem and identifies changes that may occur if biodiversity is increased or reduced in an ecosystem.

G. Understands types and processes of ecosystem change over time in terrestrial and aquatic ecosystems (e.g., equilibrium, cyclical change, succession) and the effects of human activity on ecosystem change.

H. Explains the significance of plants in different types of terrestrial and aquatic ecosystems.

COMPETENCY 035

THE TEACHER UNDERSTANDS THE RELATIONSHIP BETWEEN CARRYING CAPACITY AND CHANGES IN POPULATIONS AND ECOSYSTEMS.

The beginning teacher:

A. Identifies basic characteristics of populations in an ecosystem (e.g., age pyramid, density, patterns of distribution).

B. Compares concepts of population dynamics, including exponential growth, logistic (i.e., limited) growth and cycling (e.g., boom-and-bust cycles).

C. Relates carrying capacity to population dynamics, including human population growth.

D. Analyzes the impact of density-dependent and density-independent factors (e.g., geographic locales, natural events, diseases, birth and death rates) on populations.

E. Compares *r*- and *K*-selected reproductive strategies (e.g., survivorship curves).

DOMAIN VIII — EARTH'S HISTORY AND THE STRUCTURE AND FUNCTION OF EARTH SYSTEMS

COMPETENCY 036

THE TEACHER UNDERSTANDS STRUCTURE AND FUNCTION OF THE GEOSPHERE.

The beginning teacher:

A. Analyzes the internal structure and composition of Earth and methods used to investigate Earth's interior (e.g., seismic waves, chemical composition of rocks).

B. Classifies rocks according to how they are formed as described by the rock cycle (e.g., igneous, sedimentary, metamorphic) and identifies the economic significance of rocks and minerals.

C. Uses physical properties (e.g., density, hardness, streak, cleavage) to identify common minerals and understands processes affecting rock and mineral formation (e.g., temperature, pressure, rate of cooling).

D. Identifies different types of landforms and topographic features on the surface of Earth, including the ocean floor (e.g., faults, volcanoes, mid-ocean ridges, deltas).

E. Identifies the types, characteristics and uses of Earth's renewable and nonrenewable resources, including marine resources (e.g., ores, minerals, soil, fossil fuels).

F. Identifies sources and reservoirs for matter and energy (e.g., carbon, nitrogen, water, solar radiation, radioactive decay).

G. Analyzes the cycling and transformation of matter and energy through the geosphere (e.g., mantle convection).

H. Relates the principles of conservation of mass and energy to processes that occur in the geosphere (e.g., the melting of rock).

COMPETENCY 037

THE TEACHER UNDERSTANDS PROCESSES OF PLATE TECTONICS, WEATHERING, EROSION AND DEPOSITION THAT CHANGE EARTH'S SURFACE.

The beginning teacher:

A. Understands how the theory of plate tectonics explains the movement and structure of Earth's crustal plates (e.g., sea-floor spreading, major tectonic plates, subduction).

B. Understands evidence for plate movement (e.g., magnetic reversals, distribution of earthquakes, GPS measurements).

C. Describes the historical development of the theory of plate tectonics (e.g., Wegener's continental drift hypothesis).

D. Analyzes the effects of plate movement, including faulting, folding, mineral formation, earthquakes and volcanic activity.

E. Knows the processes (e.g., freezing/thawing, chemical reactions) and products of weathering (e.g., soils, karst features) and compares and contrasts chemical and mechanical weathering.

F. Identifies the causes (e.g., wind, water, gravity, glaciers) and effects of erosion and deposition (e.g., removal of topsoil, sedimentation).

COMPETENCY 038

THE TEACHER UNDERSTANDS THE FORMATION AND HISTORY OF EARTH.

The beginning teacher:

A. Knows the historical development of scientific theories relating to the origin and development of Earth (e.g., Hutton's uniformitarianism).

B. Understands how Earth's geosphere, hydrosphere and atmosphere have changed over time and analyzes the significance of these changes (e.g., formation of oxygen in the atmosphere).

C. Understands the organization of the geologic time scale and methods of relative (e.g., superposition, fossils) and absolute (e.g., radiometric, dendrochronology) dating.

D. Identifies important events in the history of Earth (e.g., formation of major mountain chains, breakup of continents, appearance of life, appearance of multicellular organisms) and locates these events on the geologic time scale.

E. Understands relationships between physical changes during Earth's history and biological evolution (e.g., plate movement and biogeography; meteoric impacts, global temperature changes, extinctions, adaptive radiations, formation of ozone layer) and predict future effects (e.g., changing ocean temperatures).

F. Analyzes processes involved in the formation of fossils and how fossils are used to interpret the history of Earth.

COMPETENCY 039

THE TEACHER UNDERSTANDS STRUCTURE AND FUNCTION OF THE HYDROSPHERE.

The beginning teacher:

A. Identifies the components and distribution of hydrologic systems (e.g., rivers, lakes, aquifers, oceans) and compares and contrasts the chemical composition (e.g., salinity, acidity) and physical attributes (e.g., density, turbidity) of fresh, brackish and salt water.

B. Understands the water cycle and processes by which water moves through the water cycle (e.g., infiltration, runoff, evaporation, condensation, transpiration) and quantifies the dynamics of surface and groundwater movement.

C. Identifies and uses the tools and procedures needed to collect and analyze quantitative data (e.g., pH, salinity, temperature, mineral content, nitrogen compounds, turbidity, dissolved oxygen) from hydrologic systems and describes the impact of these measured conditions on the quality of an ecosystem.

D. Knows how to use principles of fluid statics and dynamics (e.g., Archimedes' principle, turbulence, viscosity, hydrostatic pressure) to analyze hydrologic systems.

E. Identifies characteristics of a local watershed and the effects of natural events (e.g., floods, droughts) and human activities (e.g., irrigation, industrial use, municipal use) on a local watershed.

F. Analyzes patterns of ocean circulation (e.g., upwelling, surface currents) and factors that influence these patterns (e.g., winds, heating).

G. Understands the relationship between ocean depth and temperature, pressure, density and light penetration.

H. Analyzes the causes and effects of waves, tides, tidal bores and tsunamis.

I. Identifies the characteristics of different ocean zones (e.g., coastal, lighted, deep, estuaries, bays).

COMPETENCY 040

THE TEACHER UNDERSTANDS STRUCTURE AND FUNCTION OF THE ATMOSPHERE.

The beginning teacher:

A. Understands the composition of Earth's atmosphere.

B. Understands the range of atmospheric conditions that organisms will tolerate (e.g., types of gases, temperature, particulate matter, moisture).

C. Identifies the layers of the atmosphere (e.g., troposphere, ionosphere, mesophere) and the characteristics of each layer.

D. Recognizes that the sun is the ultimate source of energy for the atmosphere.

E. Understands processes of energy transfer (e.g., convection, radiation, conduction, phase changes of water) within the atmosphere and at the boundaries between the atmosphere, landmasses and oceans.

F. Knows types, characteristics and processes of formation of clouds (e.g., cumulus, stratus, cirrus) and precipitation (e.g., rain, snow, hail).

G. Knows the characteristics of air masses (e.g., temperature, moisture) and how air masses form and interact (e.g., fronts).

H. Understands the types (e.g., blizzards, hurricanes, tornadoes), characteristics and causes of severe weather.

I. Identifies the types, characteristics and distribution of climates and the factors (e.g., latitude, maritime effect, deforestation) that affect local and global climate.

J. Identifies the effects of global phenomena (e.g., jet stream, El Niño) on local weather patterns.

K. Understands weather maps and the principles, procedures and technology of weather forecasting (e.g., satellite technology, computer models).

L. Understands that climate changes over time (e.g., ice ages, carbon dioxide level) and understands the evidence for those changes.

COMPETENCY 041

THE TEACHER UNDERSTANDS THE EFFECTS OF NATURAL EVENTS AND HUMAN ACTIVITY ON EARTH SYSTEMS.

The beginning teacher:

A. Analyzes issues (e.g., economic impact, environmental effects, availability) regarding the use of Earth resources (e.g., fossil fuels, renewable and nonrenewable resources).

B. Analyzes the effects of natural events (e.g., fires, hurricanes, volcanic eruptions) and human activity (e.g., mining, fishing, reforestation, ocean dumping, municipal development) on aquatic and terrestrial ecosystems.

C. Demonstrates an understanding of factors affecting the quality, use and conservation of water (e.g., floods, droughts, agriculture, dams).

D. Evaluates methods of land use and understands issues in land-use management (e.g., development of barrier islands).

E. Identifies the sources (e.g., burning of fossil fuels, industrial production of heavy metals, release of chlorofluorocarbons) and effects of pollution (e.g., mercury contamination of fish, acid rain, lead poisoning, ozone depletion).

F. Recognizes that Earth is composed of interacting systems and that regional changes in the environment may have global effects (e.g., weather changes due to reforestation, global warming).

G. Demonstrates an understanding of how individuals, communities and governments can conserve, protect and restore habitats and ecosystems.

DOMAIN IX — COMPONENTS AND PROPERTIES OF THE SOLAR SYSTEM AND THE UNIVERSE

COMPETENCY 042

THE TEACHER UNDERSTANDS THE IMPLICATIONS OF EARTH'S PLACEMENT AND ORIENTATION IN THE SOLAR SYSTEM.

The beginning teacher:

A. Analyzes the relationship between Earth's placement in the solar system and the conditions on Earth that enable organisms to survive.

B. Demonstrates an understanding of the sun's effects (e.g., gravitational, electromagnetic, solar wind, solar flares) on Earth.

C. Understands the effects of Earth's rotation, revolution and tilt of axis on its environment (e.g., day/night length, seasons).

D. Identifies the effects of the moon and sun on tides.

E. Analyzes information about lunar phases and lunar and solar eclipses to model the Earth, moon and sun system.

COMPETENCY 043

THE TEACHER UNDERSTANDS THE ROLE OF THE SUN IN THE SOLAR SYSTEM AND THE CHARACTERISTICS OF PLANETS AND OTHER OBJECTS THAT ORBIT THE SUN.

The beginning teacher:

A. Knows the approximate size, mass, motion, temperature, structure and composition of the sun.

B. Compares and contrasts conditions essential to life on Earth (e.g., temperature, water, mass, gases) to conditions on other planets.

C. Compares and contrasts the planets in terms of orbit, mass, size, composition, rotation, atmosphere, moons and geologic activity.

D. Identifies objects other than planets that orbit the sun (e.g., asteroids, comets) and analyzes their characteristics (e.g., mass, size, composition, trajectory, origin).

E. Relates gravitational force to the motion and interactions of objects within the solar system (e.g., sun, planets, moons, comets, meteors).

F. Understands theories of the formation of the solar system (e.g., planets, the Moon).

COMPETENCY 044

THE TEACHER UNDERSTANDS COMPOSITION, HISTORY AND PROPERTIES OF THE UNIVERSE.

The beginning teacher:

A. Describes how nuclear fusion produces energy in stars, such as the sun.

B. Identifies different types of stars, their characteristics and motions (e.g., temperature, age, relative size, composition, magnitude and radial velocity) and understands the use of spectral analysis to determine these characteristics.

C. Describes the characteristics of the stages in the life cycle of stars using the Hertzsprung-Russell diagram.

D. Compares and contrasts characteristics of different types of galaxies.

E. Interprets data to make inferences about the formation of stars and galaxies.

F. Identifies types, characteristics and significance of other deep-space objects in the universe (e.g., pulsars, nebulae, black holes, extra-solar planets).

G. Interprets empirical data and scientific theories regarding the estimated age, origin and evolution of the universe (e.g., big bang, inflation, role of dark matter and dark energy).

H. Describes the role of supernovas on the chemical composition of the universe (e.g., origin of carbon on Earth).

COMPETENCY 045

THE TEACHER UNDERSTANDS THE HISTORY AND METHODS OF ASTRONOMY.

The beginning teacher:

A. Recognizes that all of science including current theories of the origin and evolution of the universe are based on the assumption that the fundamental laws of nature do not change over space and time.

B. Describes the historical origins of the perceived patterns of constellations and their role in navigation.

C. Describes the historical development and significance of the law of universal gravitation and planetary motion, the big bang theory of the origin of the universe and the theory of special relativity.

D. Recognizes and explains the patterns of movement of the sun, moon, planets and stars in the sky.

E. Demonstrates the use of units of measurement in astronomy (e.g., light year, astronomical units).

F. Explains how various technologies (e.g., Earth- and space-based telescopes, deep-space probes, artificial satellites, human space flight) are used in advancing knowledge about the universe.

G. Understands how mathematical models, computer simulations and data collected by the space and other science programs have contributed to scientific knowledge about Earth, the solar system and the universe.

DOMAIN X — SCIENCE LEARNING, INSTRUCTION AND ASSESSMENT

COMPETENCY 046

THE TEACHER UNDERSTANDS RESEARCH-BASED THEORETICAL AND PRACTICAL KNOWLEDGE ABOUT TEACHING SCIENCE, HOW STUDENTS LEARN SCIENCE AND THE ROLE OF SCIENTIFIC INQUIRY IN SCIENCE INSTRUCTION.

The beginning teacher:

A. Knows research-based theories about how students develop scientific understanding and how developmental characteristics, prior knowledge, experience and attitudes of students influence science learning.

B. Understands the importance of respecting student diversity by planning activities that are inclusive and selecting and adapting science curricula, content, instructional materials and activities to meet the interests, knowledge, understanding, abilities, possible career paths and experiences of all students, including English-language learners.

C. Knows how to plan and implement strategies to encourage student self-motivation and engagement in their own learning (e.g., linking inquiry-based investigations to students' prior knowledge, focusing inquiry-based instruction on issues relevant to students, developing instructional materials using situations from students' daily lives, fostering collaboration among students).

D. Knows how to use a variety of instructional strategies to ensure all students comprehend content-related texts, including how to locate, retrieve and retain information from a range of texts and technologies.

E. Understands the science teacher's role in developing the total school program by planning and implementing science instruction that incorporates schoolwide objectives and the statewide curriculum as defined in the Texas Essential Knowledge and Skills (TEKS).

F. Knows how to design and manage the learning environment (e.g., individual, small-group, whole-class settings) to focus and support student inquiries and to provide the time, space and resources for all students to participate in field, laboratory, experimental and nonexperimental scientific investigation.

G. Understands the rationale for using active learning and inquiry methods in science instruction and how to model scientific attitudes such as curiosity, openness to new ideas and skepticism.

H. Knows principles and procedures for designing and conducting an inquiry-based scientific investigation (e.g., making observations; generating questions; researching and reviewing current knowledge in light of existing evidence; choosing tools to gather and analyze evidence; proposing answers, explanations and predictions; and communicating and defending results).

I. Knows how to assist students with generating, refining, focusing and testing scientific questions and hypotheses.

J. Knows strategies for assisting students in learning to identify, refine and focus scientific ideas and questions guiding an inquiry-based scientific investigation; to develop, analyze and evaluate different explanations for a given scientific result; and to identify potential sources of error in an inquiry-based scientific investigation.

K. Understands how to implement inquiry strategies designed to promote the use of higher-level thinking skills, logical reasoning and scientific problem solving in order to move students from concrete to more abstract understanding.

L. Knows how to guide students in making systematic observations and measurements.

M. Knows how to sequence learning activities in a way that uncovers common misconceptions, allows students to build upon their prior knowledge and challenges them to expand their understanding of science.

COMPETENCY 047

THE TEACHER KNOWS HOW TO MONITOR AND ASSESS SCIENCE LEARNING IN LABORATORY, FIELD AND CLASSROOM SETTINGS.

The beginning teacher:

A. Knows how to use formal and informal assessments of student performance and products (e.g., projects, laboratory and field journals, rubrics, portfolios, student profiles, checklists) to evaluate student participation in and understanding of inquiry-based scientific investigations.

B. Understands the relationship between assessment and instruction in the science curriculum (e.g., designing assessments to match learning objectives, using assessment results to inform instructional practice).

C. Knows the importance of monitoring and assessing students' understanding of science concepts and skills on an ongoing basis by using a variety of appropriate assessment methods (e.g., performance assessment, self-assessment, peer assessment, formal/informal assessment).

D. Understands the purposes, characteristics and uses of various types of assessment in science, including formative and summative assessments, and the importance of limiting the use of an assessment to its intended purpose.

E. Understands strategies for assessing students' prior knowledge and misconceptions about science and how to use these assessments to develop effective ways to address these misconceptions.

F. Understands characteristics of assessments, such as reliability, validity and the absence of bias in order to evaluate assessment instruments and their results.

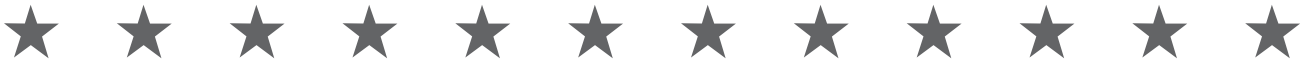
G. Understands the role of assessment as a learning experience for students and strategies for engaging students in meaningful self-assessment.

H. Recognizes the importance of selecting assessment instruments and methods that provide all students with adequate opportunities to demonstrate their achievements.

I. Recognizes the importance of clarifying teacher expectations by sharing evaluation criteria and assessment results with students.

Chapter 4

Succeeding on Multiple-Choice Questions



APPROACHES TO ANSWERING MULTIPLE-CHOICE QUESTIONS

The purpose of this section is to describe multiple-choice question formats that you will see on the Science 8–12 test and to suggest possible ways to approach thinking about and answering the multiple-choice questions. However, these approaches are not intended to replace familiar test-taking strategies with which you are already comfortable and that work for you.

The Science 8–12 test is designed to include a total of 130 multiple-choice questions, out of which 120 are scored. The number of scored questions will not vary; however, the number of questions that are not scored may vary in the actual test. Your final scaled score will be based only on scored questions. The questions that are not scored are being pilot tested in order to collect information about how these questions will perform under actual testing conditions. These questions are not identified on the test.

All multiple-choice questions on this test are designed to assess your knowledge of the content described in the test framework. In most cases, you are expected to demonstrate more than just your ability to recall factual information. You may be asked to think critically about the information, to analyze it, consider it carefully, compare it to other knowledge you have or make a judgment about it.

When you are ready to respond to a multiple-choice question, you must choose one of four answer options labeled A, B, C and D. Leave no questions unanswered. Nothing is subtracted from your score if you answer a question incorrectly. Questions for which you mark no answer or more than one answer are counted as incorrect. Your score will be determined by the number of questions for which you select the best answer.

Calculators. Scientific calculators will be provided at the test center. See the TExES *Registration Bulletin* for the brand and model of the calculator that will be available.

Definitions and Physical Constants. A set of definitions and physical constants will be provided as part of the test. A copy of those definitions and physical constants is provided in Chapter 5 of this preparation manual.

Periodic Table of the Elements. A Periodic Table of the Elements will be provided as part of the test for use on science questions. A copy of this periodic table is provided in Chapter 5.

QUESTION FORMATS

You may see the following types of multiple-choice questions on the test.

— Single Questions
— Questions with Stimulus Materials
— Clustered Questions

On the following pages, you will find descriptions of these commonly used question formats, along with suggested approaches for responding to each type of question. In the actual testing situation, if you are taking the paper-based version of the test, you may mark the test questions and/or write in the margins of your test booklet. **Your final response must be indicated on the answer sheet provided.** If you are taking the test via computer, you may write on the scratch paper provided at the testing center. **Your final response must be selected on the computer.**

SINGLE QUESTIONS

In the single-question format, a problem is presented as a direct question or an incomplete statement, and four answer options appear below the question. The following question is an example of this type. It tests knowledge of Science 8–12 Competency 017: *The teacher understands energy transformations that occur in physical and chemical processes*.

EXAMPLE

For a given reaction, ΔH = 13.6 kJ and ΔS = 145 J/K. Assuming these values are independent of temperature, at what temperature will the reaction become spontaneous?

A. 94 K

B. 94ºC

C. 11 K

D. 11ºC

SUGGESTED APPROACH

Read the question carefully and critically. Think about what it is asking and the situation it is describing. Eliminate any obviously wrong answers, select the correct answer choice and mark your answer.

The first step in this problem is to consider the information given and the question being asked. In this case, the change in enthalpy (ΔH) and change in disorder or entropy (ΔS) are given for a chemical reaction, and you are asked for the temperature at which the reaction occurs spontaneously. The spontaneity of a reaction can be determined by calculating the Gibbs free energy of a system (ΔG). The free energy of a system is the maximum useful energy obtainable in the form of work from a given reaction at constant temperature and pressure. If $\Delta G > 0$, then the reaction is nonspontaneous. If $\Delta G < 0$, then the reaction is spontaneous. The system is at equilibrium when there is no net gain or loss of free energy within the system ($\Delta G = 0$). Equilibrium is also the threshold at which the reaction becomes spontaneous. The expression for the free energy is $\Delta G = \Delta H - T\Delta S$, where T, the temperature, is expressed using the Kelvin scale.

Thus, the question requires that you determine at what temperature the reaction will become spontaneous, $\Delta G = 0$.

Since $\Delta G = 0$, then $T\Delta S = \Delta H$, and $T = \Delta H/\Delta S$.

Inserting the given values gives $T = \frac{13.6\,\text{kJ}}{145\,\text{J/K}}$. Converting kilojoules to joules, 13.6 kJ = 13,600 J, and simplifying results in $T = \frac{13{,}600\,\text{J}}{145\,\text{J/K}} = 93.8\,\text{K}$. **This answer is closest to response option A.**

Option B comes from confusing the Celsius and Kelvin temperature scales. Option C results from incorrectly solving the expression for $\Delta G = 0$ and obtaining $T = \Delta S/\Delta H$. Option D comes from both incorrectly solving the equation and using the incorrect temperature scale.

QUESTIONS WITH STIMULUS MATERIAL

Some questions on this test are preceded by stimulus material that relates to the question. Some types of stimulus material included on the test are reading passages, descriptions of experiments, graphics, tables or a combination of these. In such cases, you will generally be given information followed by questions that ask you to analyze the material, solve a problem or make a decision.

You can use several different approaches to respond to these types of questions. Some commonly used strategies are listed below.

Strategy 1	Skim the stimulus material to understand its purpose, its arrangement and/or its content. Then read the question and refer again to the stimulus material to verify the correct answer.
Strategy 2	Read the question *before* considering the stimulus material. The theory behind this strategy is that the content of the question will help you identify the purpose of the stimulus material and locate the information you need to answer the question.
Strategy 3	Use a combination of both strategies. Apply the "read the stimulus first" strategy with shorter, more familiar stimuli and the "read the question first" strategy with longer, more complex or less familiar stimuli. You can experiment with the sample questions in this manual and then use the strategy with which you are most comfortable when you take the actual test.

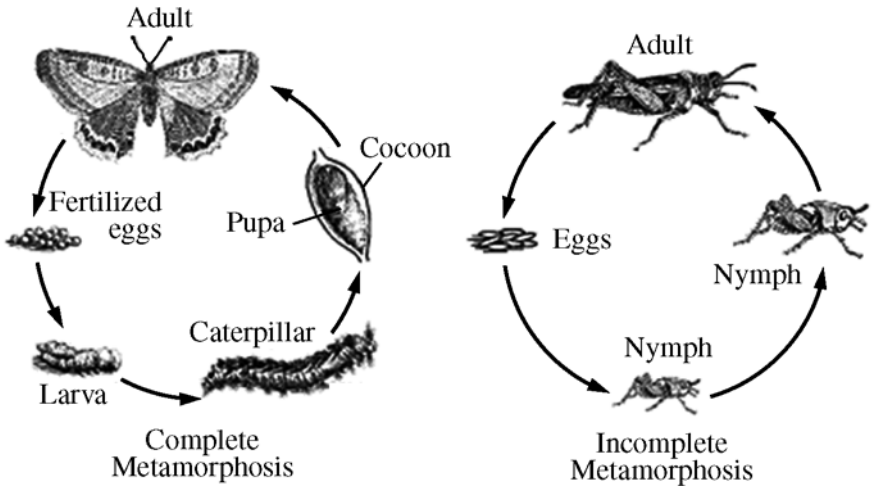
Whether you read the stimulus before or after you read the question, you should read it carefully and critically. If you are taking the paper-based version of the test, you may want to underline its important parts to help you answer the question.

As you consider questions set in educational contexts, try to enter into the identified teacher's frame of mind and use that teacher's point of view to answer the questions that accompany the stimulus. Be sure to consider the questions in terms of only the information provided in the stimulus — not in terms of your own class experiences or individual students you may have known.

EXAMPLE 1

The following question tests knowledge of Science 8–12 Competency 030: *The teacher understands that, at all levels of nature, living systems are found within other living systems, each with its own boundaries and limits.*

Use the illustrations below to answer the question that follows.



Compared to incomplete metamorphosis, complete metamorphosis in an insect species most likely contributes to the survival and reproductive success of the species in which of the following ways?

A. In species with complete metamorphosis, immature members of the species can avoid predators more easily

B. In species with complete metamorphosis, growth and development occurs more rapidly and the individual reaches sexual maturity at an earlier age

C. In species with complete metamorphosis, immature members of the species can disperse over a wider area after hatching

D. In species with complete metamorphosis, immature and adult life stages can utilize different parts of the larger environment

SUGGESTED APPROACH

Read the question carefully and critically. Think about what it is asking and the situation it is describing. Eliminate any obviously wrong answers, select the correct answer choice and mark your answer.

For example, the diagram given with this question illustrates differences between the life cycles of insect species that undergo complete metamorphosis as they grow and those species in which metamorphosis is incomplete. It is clear from the diagram that a major difference between the two types of life cycles is the degree to which immature members of the species resemble adults. In species with complete metamorphosis, immature individuals are very different in appearance from adults. In contrast, in species with incomplete metamorphosis, immature individuals and adults differ in size but are very similar in appearance. Now look at the response options and consider how this difference between the life cycles relates to each of the responses. **The correct response is option D.**

Option A suggests that in species with complete metamorphosis, immature individuals can avoid predators more easily. In fact, the opposite is more likely to be true, since the nymphs in species with incomplete metamorphosis are likely to be much more mobile than the larvae, caterpillars and pupae in species with complete metamorphosis.

Option B suggests that in species with complete metamorphosis, immature individuals grow and develop more rapidly. In fact, the rate of growth in an insect species is not determined by the type of metamorphosis, but by the adaptive strategy of the individual species. Some species with incomplete metamorphosis grow rapidly and reach maturity quickly, while others grow much more slowly. Some species with complete metamorphosis can grow and reach maturity in a single season, while others winter over as cocoons.

Option C suggests that in species with complete metamorphosis, immature individuals can disperse over a wider area after hatching. In fact, the mobile nymphs in species with incomplete metamorphosis are more able to disperse than the larvae, caterpillars and pupae of species with complete metamorphosis.

Option D, which is the correct response, suggests that in species with complete metamorphosis, immature and adult individuals can utilize different parts of the environment. Since immature individuals and adults in species with complete metamorphosis differ strongly in morphology, they can exploit different ecological niches. For example, caterpillars eat leaves and other vegetation, while butterflies primarily eat nectar. In species with incomplete metamorphosis, immature individuals resemble adults and are more likely to exploit similar ecological niches.

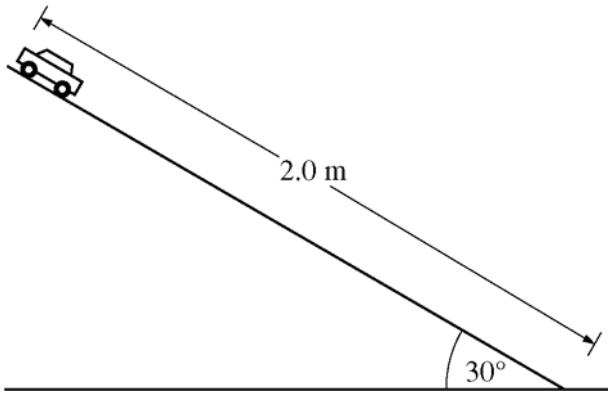
EXAMPLE 2

First read the stimulus (a description of a physics experiment along with a data table).

Use the illustration below to answer the two questions that follow.

A group of students is measuring how long it takes a toy car released from rest to roll down a straight inclined track. The data from the experiment are summarized below.

Mass of car	0.10 kg
Length of incline	2.0 m
Slope of incline	30°
Average time	1.2 s



Now you are prepared to address the first of the two questions associated with this stimulus. The first question measures Science 8–12 Competency 005: *The teacher understands the laws of motion.*

1. What is the magnitude of the gravitational force acting on the car in the direction of the toy car's motion down the track?

   A. 0.10 N

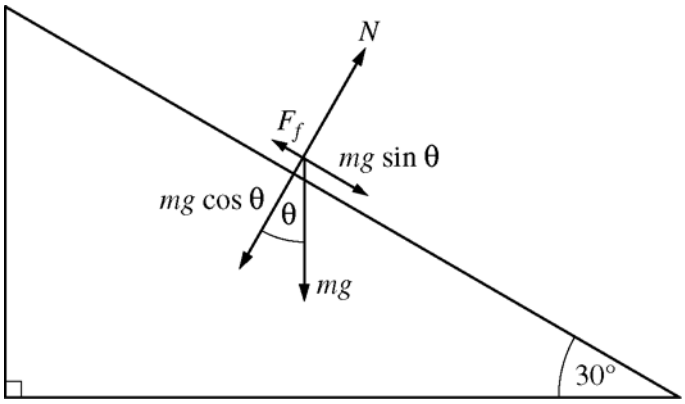
   B. 0.49 N

   C. 0.85 N

   D. 0.98 N

SUGGESTED APPROACH

The first step is to identify the forces acting on the car. In this case, the forces acting on the car are the force of gravity, the force of friction and the normal force from the inclined plane on the car. The next step is to draw a free body diagram showing these forces resolved into their appropriate components.



To determine the magnitude of the gravitational force acting on the car in the direction of the car's motion down the track, it is necessary to determine the component of the gravitational force along the incline. For an inclined plane, this component is given by $F = mg \sin \theta$, where m is the mass of the car, g is the acceleration due to gravity (9.8 m/s^2), and sin θ is the sine of the angle of the incline with the horizontal. Substituting the given values into the expression and using the fact that sin 30° = 0.5 results in the numerical value for the force component acting along the plane, or F = 0.49 N. This is option B.

Option A is the mass of the car and is therefore incorrect. Option C results from incorrectly using mg cos 30° for the component of the gravitational force in the direction of the car's motion. Option D is the weight of the car, which is equal to the magnitude of the gravitational force mg toward the center of the earth.

Now you are ready to answer the next question. The second question also measures Science 8–12 Competency 005: *The teacher understands the laws of motion.*

2. Assuming the acceleration of the car down the track is constant, what is the net force acting on the car in the direction of the car's motion down the track?

   A. 0.21 N

   B. 0.28 N

   C. 0.56 N

   D. 0.98 N

SUGGESTED APPROACH

The second question for this stimulus asks for the net force acting on the car in the direction of the car's motion. According to Newton's second law of motion, the net force on any object in the direction of the object's motion is equal to the object's mass multiplied by its acceleration, or $F_{net} = ma$. Since the mass of the car is known, it is necessary to find the acceleration of the car. The question tells us to assume the acceleration is constant. Also, it is given from the original stimulus data that the car starts from rest and travels a distance of 2.0 m in 1.2 s. The expression for the distance traveled by an object undergoing constant acceleration, $x = \frac{1}{2}at^2 + v_0t + x_0$, simplifies to $x = \frac{1}{2}at^2$. In this problem, therefore, solving for a yields $a = \frac{2x}{t^2} = \frac{2(2.0)}{(1.2)^2} = 2.8\ \mathrm{m/s^2}$. Multiplying this value by the mass of the car results in 0.28 N, which is option B.

Option A results from incorrectly calculating the acceleration as the distance the object travels divided by the time required, or $\frac{2.0}{1.2}$, and using this value to find the force. Option C results from correctly determining the acceleration and multiplying the result by the mass of the car, but then incorrectly trying to find the component of the force parallel to the plane by dividing the result by sin 30°, or 0.5. Option D is the force of gravity on the object.

EXAMPLE 3

First read the stimulus (a description of a classroom activity, building a compost heap).

> **Read the description below of a classroom activity; then answer the two questions that follow.**
>
> As part of a unit on recycling, a high school science class builds a compost heap with lawn clippings, garden residue and litter from the cages of guinea pigs and other class pets. After several weeks of turning the heap and keeping it moist, the class produces a quantity of finished compost.

Now you are prepared to address the first of the two questions associated with this stimulus. The first question measures Science 8–12 Competency 033: *The teacher understands the relationships between abiotic and biotic factors of terrestrial and aquatic ecosystems, habitats and biomes, including the flow of matter and energy.*

1. Some of the students wonder why the volume of the finished compost is considerably smaller than that of the plant residues and animal wastes used to form the original heap. Which of the following is the best explanation for this result?

   A. Bacterial digestion shreds the coarse material in the heap into finer particles that can be more closely packed

   B. Bacterial respiration converts some of the carbon in the heap to carbon dioxide that is released into the atmosphere

   C. Heat produced by spontaneous combustion in the heap converts much of the original mass into energy

   D. Bacterial digestion converts the large molecules of cellulose and other carbon compounds in the heap to smaller and simpler carbon compounds

SUGGESTED APPROACH

Consider carefully the information presented in the stimulus about how the students build and maintain the compost heap. Then read and consider this first question, which asks why the volume of the finished compost is smaller than that of the material used to form the original heap. Consider which of the response options correctly explains the reduction in the size of the heap as composting proceeds. **The correct response is option B.**

Option A suggests that bacteria shred the materials into finer particles during the composting process. However, bacteria process their food chemically rather than physically and have no mechanisms that allow physical shredding of materials.

Option B, which is the correct response, suggests that the heap decreases in size as bacterial respiration converts some of the carbon in the heap to carbon dioxide gas. According to the stimulus, the students turn the heap, which would keep it aerated. Aerobic decomposition involves respiration, and carbon dioxide is a byproduct of this process. During the decomposition of the compost heap, the solid form of carbon that is bound in tissues of plants and animals is converted to carbon dioxide and lost from the heap to the atmosphere.

Option C suggests that heat produced by spontaneous combustion in the heap converts mass into energy. The conversion of mass into energy is characteristic of nuclear reactions, which are not occurring in the compost heap.

Option D suggests that bacteria convert the large molecules of cellulose and other compounds into smaller and simpler carbon compounds. While this statement is true, this process would not lead to a reduction in the quantity of matter during decomposition. Furthermore, the size of a piece of matter is not necessarily related to the size of its constituent molecules. Conversion of cellulose to simpler compounds does not imply that individual pieces of matter in the heap are reduced in size, allowing them to pack more closely and reduce the volume of the heap.

Now you are ready to answer the next question. The second question measures Science 8–12 Competency 046: *The teacher understands research-based theoretical and practical knowledge about teaching science, how students learn science and the role of scientific inquiry in science instruction.*

2. The classroom activity described previously would most likely help students satisfy which of the following student expectations from the Texas Essential Knowledge and Skills (TEKS) statements?

   A. The student knows that relationships exist between properties of matter and its components

   B. The student uses scientific methods during field and laboratory investigations

   C. The student knows that interdependence and interactions occur within an ecosystem

   D. The student knows the significance of plants in the environment

SUGGESTED APPROACH

Again, consider carefully the information presented in the stimulus, especially with regard to identifying instructional goals of the composting activity. Then read and consider this second question, which asks which student expectation from the Texas Essential Knowledge and Skills (TEKS) statements would most likely be satisfied by this activity. **The correct response is option C.**

Option A suggests that the activity would help the student know that relationships exist between properties of matter and its components. However, the activity does not involve learning about either the properties of matter or the components of matter.

Option B suggests that the activity teaches students how to use scientific methods during field and laboratory investigations. However, the activity, as it is stated, does not involve application of any scientific methodology involving the development and testing of a hypothesis.

Option C suggests that the activity helps students know that interdependence and interactions occur within an ecosystem. Option C is the correct answer because the composting activity illustrates the role of decomposers in recycling nutrients through an ecosystem so that they can be used by other organisms.

Option D suggests that the activity helps students know the significance of plants in the environment. However, this activity does not involve analysis of plants or their role in the environment.

CLUSTERED QUESTIONS

You may have one or more questions related to a single stimulus. When you have at least two questions related to a single stimulus, the group of questions is called a cluster.

Chapter 5

Multiple-Choice Practice Questions

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SAMPLE MULTIPLE-CHOICE QUESTIONS

This section presents some sample test questions for you to review as part of your preparation for the test. To demonstrate how each competency may be assessed, each sample question is accompanied by the competency that it measures. While studying, you may wish to read the competency before and after you consider each sample question. Please note that the competency statements will not appear on the actual test.

An answer key follows the sample questions. The answer key lists the question number and correct answer for each sample test question. Please note that the answer key also lists the competency assessed by each question and that the sample questions are not necessarily presented in competency order.

The sample questions are included to illustrate the formats and types of questions you will see on the test; however, your performance on the sample questions should not be viewed as a predictor of your performance on the actual test.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.0079																	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.811	6 **C** 12.011	7 **N** 14.007	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.179
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.974	16 **S** 32.06	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.938	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.91	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.02	89 **†Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (277)	109 **Mt** (268)	110 **Ds** (271)	111 **Rg** (272)	112 **§** (277)						

§Not yet named

*Lanthanide Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
†Actinide Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** 237.05	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

Definitions and Physical Constants for Science 8–12

The value of 9.8 m/s^2 is used for the acceleration of gravity near Earth's surface.

The universal gas constant is 8.314 J/K-mol or 0.08206 L-atm/K-mol.

Planck's constant is 6.6256×10^{-34} J-s.

Avogadro's number is 6.022×10^{23}.

The right-hand rule is used with conventional current (the flow of positive charge from the positive terminal to the negative terminal).

END OF DEFINITIONS AND PHYSICAL CONSTANTS

COMPETENCY 001

1. **Use the table below to answer the question that follows.**

	Gun A	Gun B
Mean Distance	141.3 cm	138.5 cm
Standard Deviation	2.4 cm	3.1 cm

The table gives data on the horizontal distance traveled by a ball fired from two different spring guns under identical conditions. Which of the following statements best describes the data?

A. The data collected for Gun A are more precise than the data collected for Gun B

B. The data collected for Gun A are more accurate than the data collected for Gun B

C. The data collected for Gun A show a greater random error than the data collected for Gun B

D. The data collected for Gun A show a greater amount of experimental design error than the data collected for Gun B

COMPETENCY 001

2. Students in a science class measure the heights of plant specimens and record their measurements to the nearest centimeter. The students then use calculators to determine the average height of the plants. The teacher notices that many students write down averages that extend to tenths or hundredths of centimeters and asks them to round the averages only to the nearest centimeter. Which of the following statements is the best explanation of why students should round their averages to the nearest centimeter?

A. The amount of variation due to any inaccuracies in taking the measurements must be less than the actual differences in plant height

B. Comparison of student results would be facilitated if all students calculate averages to the same number of places

C. Extra digits are likely to make further calculations using the students' averages more difficult and time consuming

D. Calculations based on the measurements of plant height can be only as precise as the original measurements

COMPETENCY 001

3. As part of a project on the effects of pollution on ecosystems, students in a science class measure air, soil and water quality in the area surrounding the school. They also make daily counts of various animal and plant species in the area. Which of the following types of computer software would be most useful for storing and analyzing the students' data?

   A. Web development software

   B. Spreadsheet software

   C. Interactive multimedia software

   D. Word processing software

COMPETENCY 002

4. **Use the information below to answer the question that follows.**

   In an experiment designed to test the effects of solutes on temperature, students label four beakers A, B, C and D and add 50 mL of distilled water at room temperature to each. They then add 5 g of table sugar to beaker B, 10 g to beaker C and 15 g to beaker D. No sugar is added to beaker A. The students measure the temperature of the contents of each beaker. After heating each beaker for the same amount of time on a hot plate at the same setting, the students measure the temperature again. The change in temperature is recorded.

   Beaker A is included in this investigation for which of the following reasons?

   A. To determine the expected average temperature of beakers B, C and D to compare to the average of the actual observed results

   B. As a trial run to confirm the proper functioning of the apparatus and calibration of the thermometer

   C. To be certain that the specified amount of heating time will not be enough to bring the water to the boiling point

   D. As a control to establish the standard against which to compare the temperature changes in the other beakers

COMPETENCY 002

5. **Use the description of an experiment below to answer the question that follows.**

   Tape a pencil to the edge of a table so that half of the pencil is hanging over the edge. Hang a rubber band on the pencil and attach a paper clip to the bottom of the rubber band. Measure the initial length of the rubber band. Attach a washer to the paper clip and measure the length of the band. Repeat with 2, 3, 4 and 5 identical washers. Graph your results.

   Which of the following is the independent variable in the experiment above?

   A. The initial length of the rubber band

   B. The length of the rubber band after each washer is added

   C. The number of washers attached to the paper clip

   D. The mass of a single washer

COMPETENCY 002

6. A researcher has documented a decline in the population of wood frogs in an area in which bullfrogs have been introduced. According to the researcher's data, the wood frog population began to decline soon after the introduction of the bullfrogs, and the decline has accelerated since the bullfrog population began growing more rapidly. The researcher notes that bullfrogs are much larger and more aggressive than wood frogs and concludes that the wood frogs are being driven from their breeding areas. This conclusion is questionable because the researcher

   A. has not shown a correlation between the size of bullfrogs and the size of wood frogs.

   B. has not shown a causal relationship between the establishment of the bullfrog population and the decline of the wood frog population.

   C. has not suggested a mechanism for the proposed effect of the bullfrog population on the wood frog population.

   D. has not developed a hypothesis that can be experimentally tested.

COMPETENCY 003

7. At the end of a unit on Newton's laws, a teacher introduces students to the fundamental concepts of the theory of special relativity and compares and contrasts relativity with Newtonian mechanics. Which of the following is a possible benefit of this approach?

   A. It demonstrates how the direction of scientific research is influenced by cultural biases

   B. It is a good example of how and why scientists use different types of scientific investigations

   C. It illustrates the role of uncertainty and probability in modern physics as compared to classical physics

   D. It is a good example of how scientific theories are subject to revision in light of new evidence

COMPETENCY 003

8. Which of the following is one of the most important principles guiding the ethical conduct of research with human subjects?

   A. Subjects must be chosen to represent the racial, ethnic and gender composition of the population at large

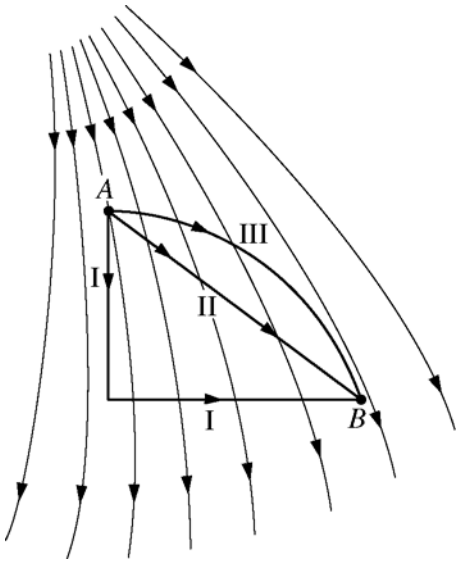
   B. Before beginning the study, subjects must be informed of any known risks associated with participation

   C. Any treatments given to subjects must be known to improve their medical conditions

   D. Before beginning the study, subjects must sign a waiver limiting the legal responsibility of the researcher

COMPETENCY 006

9. **Use the diagram below to answer the question that follows.**



The diagram shows the lines of force for an electric field, and three different paths linking points *A* and *B*. The work required to move a positive charge from point *A* to point *B* is evaluated over the three different paths. Which of the following statements about the work required to move the charge from *A* to *B* is true?

   A. The amount of work will be the same for all of the paths

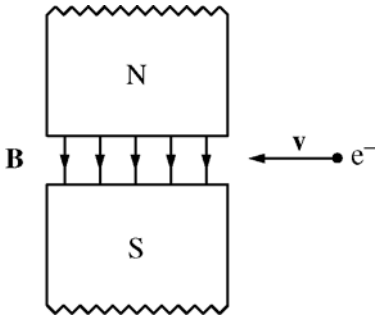
   B. The amount of work will be equal to zero for path I

   C. The amount of work will be greater for path II than for path III

   D. The amount of work will be greater for path III than for path II

COMPETENCY 006

10. **Use the diagram below to answer the question that follows.**



An electron with velocity vector **v** enters a magnetic field. The velocity vector is perpendicular to the magnetic field vector. What is the initial direction of the force on the electron?

A. Into the page

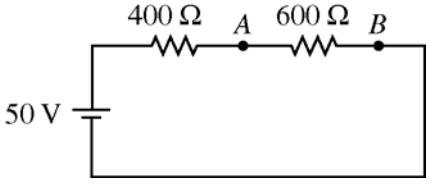
B. Out of the page

C. Toward the north pole of the magnet

D. Toward the south pole of the magnet

COMPETENCY 007

11. **Use the diagram below to answer the question that follows.**



What is the potential difference across *AB*?

A. 20 V

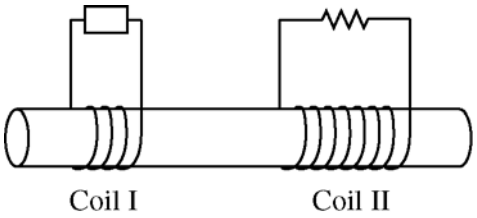
B. 30 V

C. 33 V

D. 50 V

COMPETENCY 007

12. **Use the diagram below to answer the question that follows.**



Two coils of wire are wrapped around an iron bar. A current from an external power source flows through Coil I. Coil II is attached to a resistor. Which of the following statements must be true for this apparatus to function as a transformer?

A. The capacitance of Coil II must be negligible

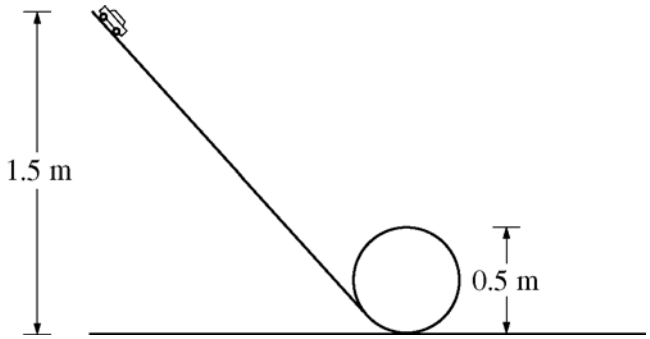
B. The iron core must be a permanent magnet

C. The number of turns in Coil II must be greater than the number in Coil I

D. The current through Coil I must vary with time

COMPETENCY 008

13. **Use the diagram below to answer the question that follows.**



A toy car is released from rest at the top of the track shown above. The car goes down the slope and through the loop-de-loop. If friction is neglected, what is the speed of the car at the top of the loop?

A. 4.4 m/s

B. 4.9 m/s

C. 14.7 m/s

D. 19.6 m/s

COMPETENCY 009

14. An ideal gas in a piston absorbs heat from an external heat bath. The gas expands from volume V_1 to volume V_2 and does work by pushing against the piston. The temperature remains constant during this process. Which of the following is true for this process?

A. The heat capacity of the gas increases

B. The average momentum of the gas molecules increases

C. The entropy of the gas increases

D. The average kinetic energy of the gas molecules increases

COMPETENCY 010

15. Which of the following waves always transmit momentum to the particles of the wave medium at right angles to the direction of wave propagation?

A. Longitudinal waves

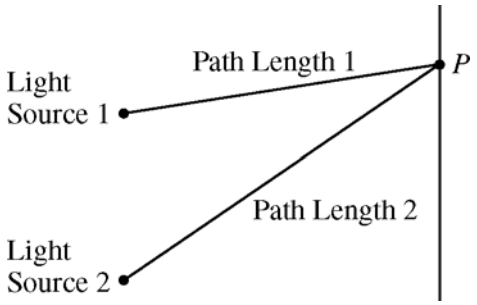
B. Transverse waves

C. Standing waves

D. Matter waves

COMPETENCY 010

16. **Use the diagram below to answer the question that follows.**



The diagram represents two coherent light sources emitting light of equal intensity and wavelength λ. The intensity of the light at point *P* is zero. Which of the following could be the difference in path length taken by the light in traveling from each source to point *P*?

A. 0

B. $\frac{1}{4}\lambda$

C. $\frac{1}{2}\lambda$

D. λ

COMPETENCY 011

17. A neon lamp emits red light of frequency *f*. How many photons are emitted by a 100-watt neon light during a time period of 5 seconds (*h* = Planck's constant)?

A. $20hf$

B. $\frac{hf}{20}$

C. $500hf$

D. $\frac{500}{hf}$

COMPETENCY 011

18. **Use the information below to answer the question that follows.**

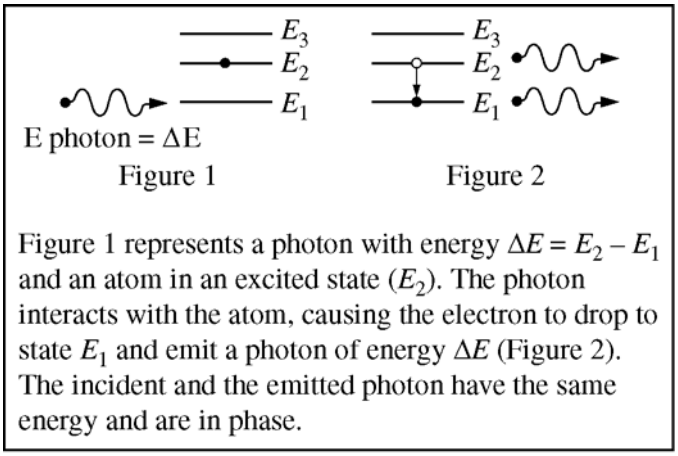


Figure 1 represents a photon with energy $\Delta E = E_2 - E_1$ and an atom in an excited state (E_2). The photon interacts with the atom, causing the electron to drop to state E_1 and emit a photon of energy ΔE (Figure 2). The incident and the emitted photon have the same energy and are in phase.

The passage above describes the operation of which of the following?

A. Laser

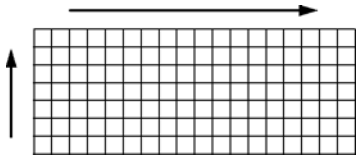
B. Photodetector

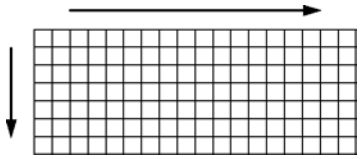
C. Superconductor

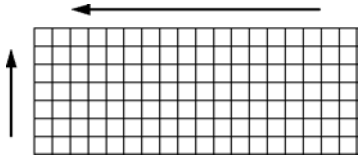
D. Spectrograph

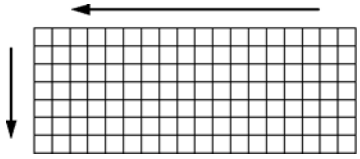
COMPETENCY 012

19. Which of the following diagrams shows the general trend of increasing atomic radius in the periodic table?

A. 

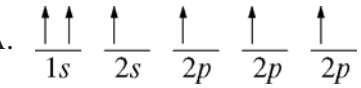
C. 

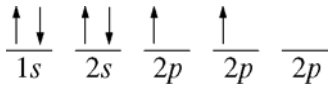
B. 

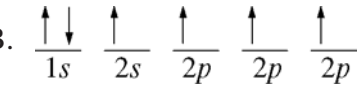
D. 

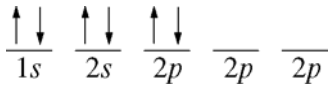
COMPETENCY 012

20. Which of the following orbital notations shows the correct electron arrangement of a neutral carbon atom in its ground state?

A. 

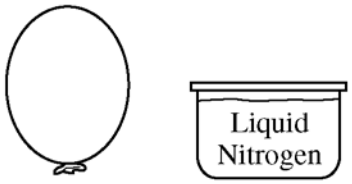
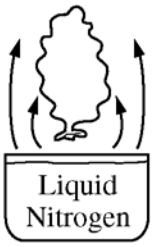
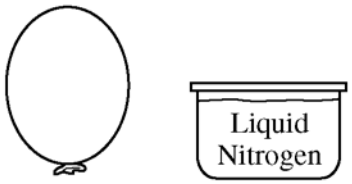
C. 

B. 

D. 

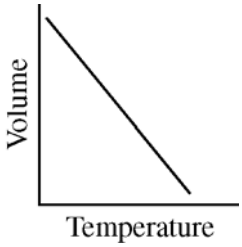
COMPETENCY 013

21. **Use the demonstration below to answer the question that follows.**

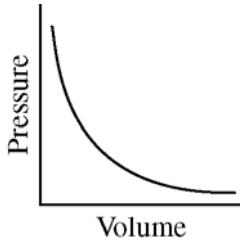
Step 1	A balloon is inflated at room temperature.	
Step 2	The balloon is cooled by placing it over liquid nitrogen.	
Step 3	The balloon is moved away from the liquid nitrogen and allowed to return to room temperature.	

Which of the following graphs best shows the behavior of the gas in the balloon in this demonstration?

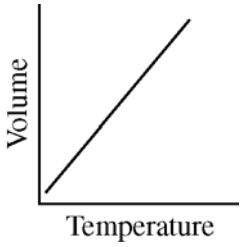
A.



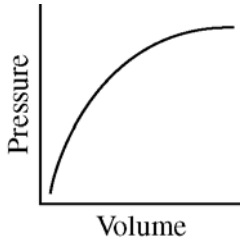
C.



B.



D.



COMPETENCY 013

22. A gas-filled balloon with a volume of 3.00 L at 300.0 K and 1.00 atm rises into the stratosphere where the pressure is 3.00×10^{-3} atm and the temperature is 250.0 K. What is the volume of the balloon?

    A. 250 L

    B. 750 L

    C. 833 L

    D. 1200 L

COMPETENCY 014

23. **Use the information below to answer the question that follows.**

Bond	Bond Energy (kJ/mol)
A — A	336
B — B	363
A — B	358

The table gives the average amount of energy required to break a particular bond. Which of the following equations correctly calculates the energy change, in kJ/mol, for a reaction with the formula $A_2 + B_2 \rightarrow 2\,AB$?

A. 336 + 363 + 358 = 1057

B. 336 + 363 – 358 = 341

C. 336 + 363 – 2(358) = –17

D. 2(336) – 2(363) – 2(358) = –770

COMPETENCY 014

24. Which of the following is the molecular geometry of the NH_3 molecule?

    A. Tetrahedral

    B. Trigonal pyramidal

    C. Trigonal planar

    D. Octahedral

COMPETENCY 015

25. Which of the following is the correct IUPAC name for the ion $Ca_3(PO_4)_2$?

    A. Tricalcium phosphate

    B. Calcium diphosphate

    C. Tricalcium bis(phosphate)

    D. Tricalcium diphosphate

COMPETENCY 015

26. **Use the information below to answer the question that follows.**

Reaction	Equilibrium Concentrations	
$2\ NO(g) + O_2(g) \rightleftharpoons 2\ NO_2$	NO	0.0813 M
	O_2	0.1905 M
	NO_2	28.47 M

The table gives the equilibrium concentrations for the reaction. What is the equilibrium constant for the reaction?

A. $\dfrac{(0.0813)^2(0.1905)}{(28.47)^2}$

B. $\dfrac{(0.0813)^2(0.1905)^2}{(28.47)}$

C. $\dfrac{(28.47)^2}{(0.0813)^2(0.1905)}$

D. $\dfrac{(28.47)}{(0.0813)^2(0.1905)^2}$

COMPETENCY 018

27. The isotope $^{14}_{6}C$ undergoes beta decay. What is the product of this decay process?

A. $^{13}_{5}B$

B. $^{14}_{5}B$

C. $^{14}_{7}N$

D. $^{15}_{7}N$

COMPETENCY 018

28. Which of the following characteristics of nuclear fission makes a chain reaction possible?

A. The nuclear disintegration series of uranium-235

B. The large amount of energy released

C. The release of neutrons as fission products

D. The creation of strontium-90 and xenon-143 radioisotopes

COMPETENCY 020

29. The pH of several solutions with the same molar concentration is measured and recorded in the table below.

Solution	pH
I	2.3
II	4.5
III	9.8
IV	11.6

Which solution is the most basic?

A. Solution I

B. Solution II

C. Solution III

D. Solution IV

COMPETENCY 020

30. **Use the equation below to answer the question that follows.**

$$H^+(aq) + NH_3(aq) \rightarrow NH_4^+(aq)$$

In this reaction, the $NH_3(aq)$ can be considered a Brønsted base because it

A. has an oxidation number equal to 0.

B. contains a metal and a nonmetal.

C. reacts with hydroxide ions.

D. acts as a proton acceptor.

COMPETENCY 021

31. Sucrase is an enzyme that catalyzes only one particular reaction, the splitting of sucrose molecules into glucose and fructose. Sucrase recognizes sucrose as its substrate, distinguishing it even from other closely related sugar molecules. This specificity depends on which of the following?

A. The relative concentrations of sucrose, glucose and fructose

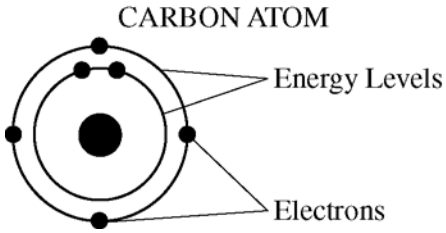
B. The fit between the shape of the sucrase molecule's active site and the shape of the sucrose molecule

C. The amount of energy released when a sucrose molecule is broken down

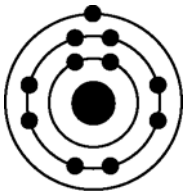
D. The existence of optimal temperature and pH conditions for sucrase activity

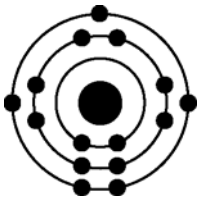
COMPETENCY 021

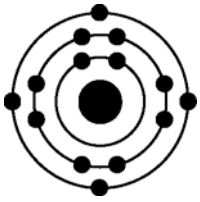
32. **Use the figure below to answer the question that follows.**

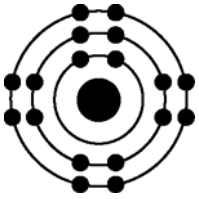


The electron configuration of carbon atoms is responsible for the characteristics that make carbon the basis for known living systems. On a planet where carbon is absent or in short supply, another element might conceivably become the building block for a system of life. Which of the following elements most closely matches those properties of carbon that are relevant for living systems?

A. 

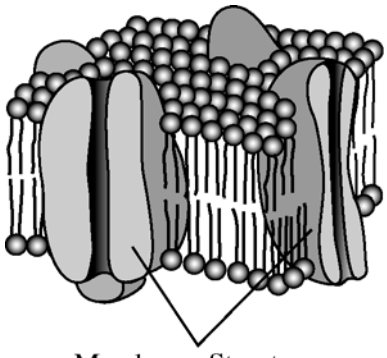
C. 

B. 

D. 

COMPETENCY 022

33. **Use the diagram below to answer the question that follows.**



Membrane Structure

The diagram is a model of a cell membrane. The most likely function of the labeled structure is to

A. synthesize the molecules comprising the membrane.

B. facilitate the transport of molecules through the membrane.

C. induce the formation of a lipid bilayer.

D. catalyze the production of energy for the membrane.

COMPETENCY 023

34. One difference between aerobic and anaerobic respiration is that

A. energy is released by aerobic respiration but consumed by anaerobic respiration.

B. net metabolic energy from aerobic respiration is higher than net metabolic energy from anaerobic respiration.

C. aerobic respiration occurs in eukaryotic cells and anaerobic respiration in prokaryotic cells.

D. aerobic respiration is used to obtain oxygen from air and anaerobic respiration is used to obtain oxygen from water.

COMPETENCY 023

35. Which of the following statements best describes how oxygen moves from the bloodstream into the cells where it is used in metabolic processes?

A. Oxygen moves up the concentration gradient across cell membranes by facilitated diffusion

B. Oxygen binds to protein molecules that transport it across cell membranes

C. Oxygen is forced into the cells by the higher osmotic pressure of the blood

D. Oxygen diffuses passively into the cells without the expenditure of energy

COMPETENCY 024

36. Which of the following examples best illustrates that cellular differentiation is, in certain instances, a reversible process?

A. Vertebrate embryos resemble the adults of ancestral species

B. In some plants, removing the terminal bud stimulates the growth of axillary buds

C. In some animals, body parts that are lost from injury can be regenerated

D. In plants, growth is indeterminate and continues throughout the lifetime of a plant

COMPETENCY 024

37. It has been observed that a prolonged episode of malnutrition has more severe and less reversible effects on human brain development if it occurs during the first year after birth, compared to an episode that occurs later in infancy or childhood. Which of the following is the most likely explanation for this observation?

A. Brain cells can only form synaptic connections with other cells of the nervous system during the first year after birth

B. The ratio of brain size to body weight is greatest for the first year after birth and decreases as the infant gets older

C. Brain cells continue to divide rapidly during the first year after birth, while active cell division slows markedly after this time

D. The functions of the different brain hemispheres are established during the first year after birth and cannot be extensively altered after this time

COMPETENCY 025

38. **Use the summary below of a life cycle to answer the question that follows.**

Step 1:	*X* attaches itself to the surface of a cell.
Step 2:	*X* then injects its own genetic material into the cell.
Step 3:	This destroys the host cell's genetic material.
Step 4:	The genetic material of *X* reprograms the host cell's metabolic activities to make multiple copies of *X*.
Step 5:	The host cell then breaks open, releasing the new copies of *X*.

X is best described as

A. a prokaryote.

B. an antigen.

C. a plasmid.

D. a virus.

COMPETENCY 025

39. A team of researchers has isolated a chemical from a tropical tree that causes insects to die when they ingest it. The researchers determine that the chemical deactivates the enzyme RNA polymerase. This chemical likely causes the insects to die by interfering directly with

A. transcription of RNA from the DNA template.

B. transport of RNA from the nucleus to the cytoplasm.

C. translation of polypeptides from RNA molecules.

D. excision of transcribed introns from an RNA molecule.

COMPETENCY 026

40. When red-flowered snapdragons are crossed with white-flowered snapdragons, all of the offspring have pink flowers. When these pink-flowered snapdragons are crossed, one-fourth of the F_2 offspring will have red flowers, one-fourth will have white flowers and one-half will have pink flowers. This pattern of inheritance is most likely due to

    A. codominance of both the red and white alleles.

    B. dominance of the red allele over the white allele.

    C. incomplete dominance of either the red or the white allele.

    D. crossing over of the two alleles during meiosis.

COMPETENCY 026

41. In 1909, Karl Correns found that the presence or absence of white or yellow patches on the leaves of an otherwise green plant was determined only by the maternal parent. Which of the following is the most likely explanation for this observation?

    A. The gene for colored patches is located in DNA found in the plastids of the cell rather than in the nucleus

    B. Colored patches are determined by a dominant allele located on the X chromosome

    C. The gene for colored patches is only expressed when the individual is exposed to female plant hormones

    D. Colored patches are produced by a viral infection of the ovum before fertilization by the pollen

COMPETENCY 027

42. *Geospiza fuliginosa* and *Geospiza fortis* are species of Galápagos finch with overlapping ranges. When only one of the two species is found on an island, it has a medium-sized beak. However, on islands where both species are found, *G. fuliginosa* has a smaller beak and *G. fortis* a larger one. This phenomenon is an example of

    A. interference competition.

    B. competitive exclusion.

    C. Batesian mimicry.

    D. character displacement.

COMPETENCY 027

43. Which of the following is the best example of the effects of balancing selection?

    A. In regions where malaria is endemic, individuals who are heterozygous for the sickle cell allele are more fit than either homozygote

    B. The range of genetic variation in humans is greater than that in all other species of primates

    C. In some species of deer, more female than male offspring are produced in times of stress

    D. Complex ecosystems such as tropical forests contain many more species than are found in simpler ecosystems

COMPETENCY 028

44. In the study of evolution, which of the following observations is likely to provide evidence in favor of the theory of *punctuated equilibrium*?

    A. A subpopulation that becomes geographically isolated from its parent population often undergoes rapid genetic change

    B. Natural selection takes place both at the species level and at higher levels of taxonomic classification

    C. Many effects of evolution occur at the molecular level without overtly affecting morphology or behavior

    D. Two species that could produce viable offspring may be prevented from interbreeding by geographic isolation

COMPETENCY 028

45. Which of the following adaptations was most essential for enabling aquatic algae to evolve into plants capable of surviving in a variety of terrestrial environments?

    A. The use of chlorophyll in plant leaves to absorb light energy

    B. The development of the calyx as a reproductive structure that protects seeds

    C. The use of turgor pressure to support cell structure

    D. The development of vascular tissue that transports water and nutrients

COMPETENCY 029

46. Which of the following is the most accurate method for classifying two organisms according to their degree of relationship?

    A. Compare similarities and differences in the DNA of both organisms

    B. Identify traits shared by both organisms during early embryonic development

    C. Compare similarities and differences in the behavior of both organisms

    D. Count the number of adaptive morphological traits shared by both organisms

COMPETENCY 029

47. A biologist has hypothesized that a structure in the digestive tract of birds is homologous to a structure in the digestive tract of certain mammals. Which of the following findings would provide the best evidence in favor of this view?

    A. The genes coding for the two structures utilize the same nitrogenous bases

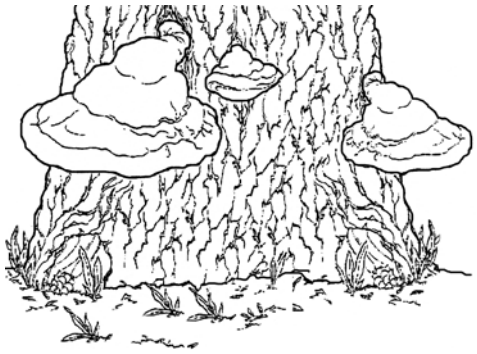
    B. The two structures appear almost identical at an early stage of embryonic development

    C. The structures are vestigial in the digestive tracts of both birds and mammals

    D. The structures perform similar digestive functions in birds and mammals

COMPETENCY 030

48. **Use the diagram below to answer the question that follows.**



On a class field trip, students encounter some brightly colored shelf-like structures attached to the trunk of a dead tree. Which of the following is the best description of how this organism obtains matter and energy from its environment?

    A. It obtains energy from the dead wood and absorbs carbon dioxide and water vapor from the air

    B. It obtains energy from sunlight, absorbs carbon from the dead wood, and obtains water vapor from the air

    C. It obtains energy from sunlight and obtains carbon and water from the dead wood

    D. It obtains energy, carbon and water from the dead wood

COMPETENCY 031

49. Human vegetarians who do not eat any animal products must pay close attention to their diets because

A. many plants lack the nucleic acids needed for the synthesis of human DNA.

B. no single plant species provides enough calories to sustain human metabolism.

C. most plants lack the saturated fats that are essential for storing energy.

D. no single plant species provides all of the amino acids essential for building proteins.

COMPETENCY 031

50. A scientist recruits human volunteers to spend several weeks as experimental subjects in her lab. The subjects will stay in a windowless area with no access to clocks or watches. Their activities will be unstructured, and they will be free to eat, sleep and exercise whenever they choose. The most likely purpose of this experiment is to determine whether

A. a lack of natural light improves or impairs mental functioning.

B. people alter the amount they eat when deprived of natural light.

C. the human wake/sleep cycle is regulated by internal or external signals.

D. behavior patterns will change in the absence of social pressures.

COMPETENCY 032

51. In various species of mammal, if a mother and her offspring are kept apart for a brief period after birth and then reunited, the mother will then reject the offspring. The likely function of this rejection by the mother is to

A. decrease the probability that she will expend resources raising offspring that are not her own.

B. teach the offspring that there are negative consequences to straying from its mother.

C. decrease the probability that harmful learned behaviors will be adopted by her other offspring.

D. protect herself from parasites and diseases that may have been acquired by the offspring.

COMPETENCY 032

52. An ethologist wishes to investigate the relative importance of innate and learned components of canine behavior. Which of the following criteria can be used to distinguish innate behaviors from learned behaviors?

A. The age at which the behavior is first detected

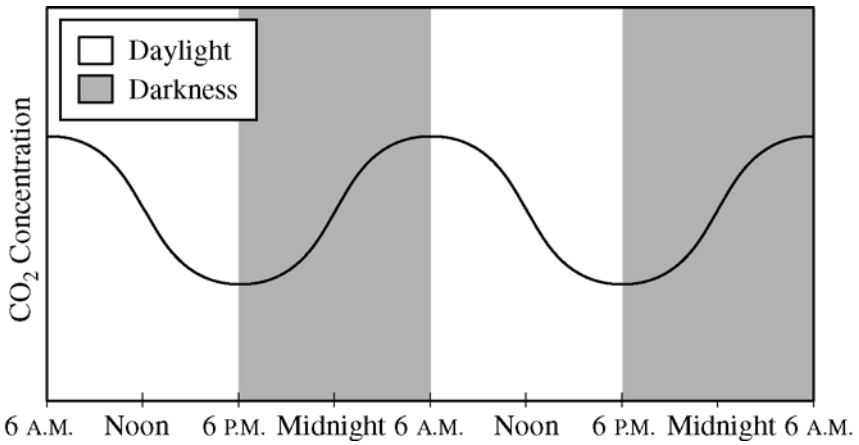
B. The degree to which the behavior can be repeated in a stereotypic manner

C. The success with which the behavior is performed the first time it is attempted

D. The extent to which the behavior can be triggered by releasers in inappropriate circumstances

COMPETENCY 033

53. **Use the graph below to answer the question that follows.**



This graph shows variation in CO_2 level at one location over a two day period. Based on the pattern shown in the graph, it is likely that the measurements of carbon dioxide concentration were taken in which of the following locations?

A. Near dense, actively growing vegetation

B. Above the surface of a body of nutrient-poor water

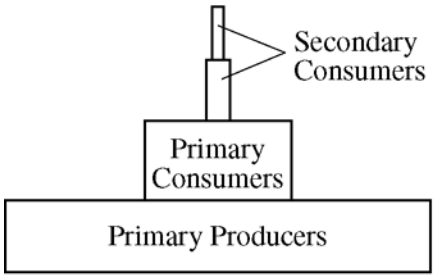
C. At a high elevation with low barometric pressure

D. In an urban environment with high consumption of fossil fuels

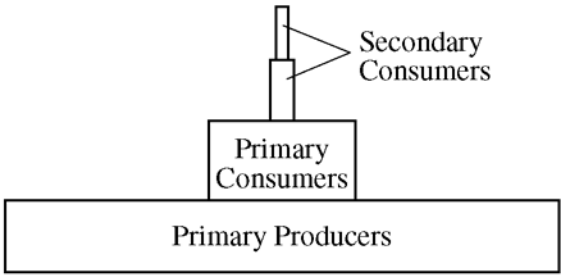
COMPETENCY 034

54. **Use the figures below to answer the question that follows.**

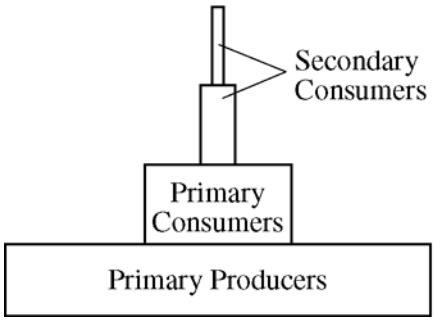
NET PRODUCTIVITY
IN A FLORIDA BOG



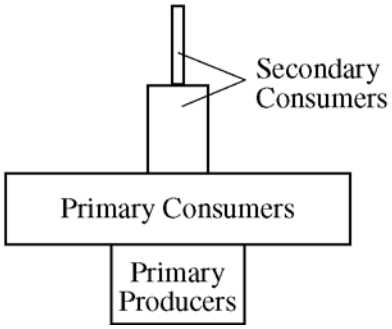
STANDING CROP BIOMASS
IN A FLORIDA BOG



NET PRODUCTIVITY
IN THE ENGLISH CHANNEL



STANDING CROP BIOMASS
IN THE ENGLISH CHANNEL



The above figures compare approximations of net productivity and standing crop biomass in two ecosystems, a Florida bog and the English Channel. The figures for net productivity in both ecosystems and the figure for standing crop biomass in the Florida bog all exhibit similar pyramid shapes, with productivity and biomass decreasing with each trophic level. However, the figure for standing crop biomass in the English Channel exhibits a different shape. Zooplankton, which are the primary consumers, exhibit a higher standing crop biomass than do phytoplankton, which are the primary producers. Which of the following is the most likely explanation for the different shape of the standing crop biomass pyramid for the English Channel?

A. The phytoplankton in the English Channel exhibit a high turnover rate because they are consumed very rapidly by the zooplankton

B. Individual phytoplankton in the English Channel are larger than zooplankton and provide such a rich nutrient source that relatively few are required to support many zooplankton

C. Phytoplankton are eaten by a wide variety of fish and marine mammals, while zooplankton are not

D. Zooplankton feed on detritus produced by other organisms as well as on phytoplankton, so that fewer phytoplankton are needed to support a large population of zooplankton

COMPETENCY 034

55. When an agricultural field is abandoned, it usually undergoes ecological succession involving a sequence of changes in vegetation. In most of North America, species of pine tree tend to be characteristic of early stages of succession, while hardwoods such as oak, beech and maple are more often found in later stages. Which of the following best explains this pattern of succession?

    A. Pines are better adapted to the nutrient levels characteristic of abandoned fields; hardwoods eventually replace the pines when nutrient levels return to more normal levels

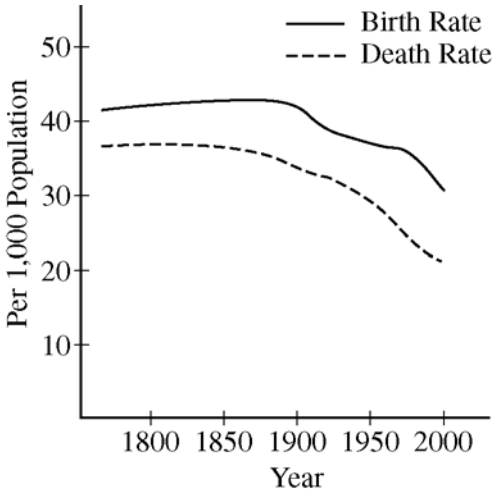
    B. Pine seeds and seedlings germinate and grow more rapidly in open, sunny areas; the shade from the mature pine trees eventually favors the establishment and growth of the shade-tolerant hardwood species

    C. Pine needles are better able to resist the many plant pests initially present in a field ecosystem; hardwoods are eventually able to grow as the insect population decreases

    D. Pine seeds are more abundant than hardwood seeds in abandoned fields; the slow influx of hardwood seeds eventually allows these species to overtake the pines

COMPETENCY 035

56. **Use the graph below to answer the question that follows.**



On this graph, population increase is represented by the

A. solid line.

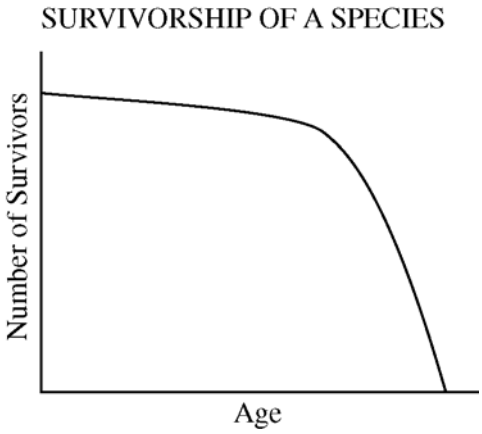
B. dotted line.

C. sum of the solid and dotted lines.

D. distance between the solid and dotted lines.

COMPETENCY 035

57. **Use the graph below to answer the question that follows.**



The graph above shows the survival curve for a particular species. Which of the following inferences is most likely true of the species?

A. It reproduces only once during its lifetime

B. It matures very rapidly

C. Its environment is subject to rapid and extreme fluctuations

D. It produces large numbers of offspring at one time

COMPETENCY 047

58. **Use the Texas Essential Knowledge and Skills (TEKS) student expectation below to answer the question that follows.**

> The student is expected to collect data and make measurements with precision.

Which of the following types of assessment would be most effective for measuring students' achievement of the above objective?

A. A written response, in which students explain significant figures and analyze how measurement errors are propagated through calculations

B. A portfolio, in which samples of students' more recent experimental designs are compared to previous designs in order to evaluate student improvement

C. A performance assessment, in which students input data into a spreadsheet, analyze the data using spreadsheet functions and display the data in appropriate graphic formats

D. A performance assessment, in which students use tools to measure the attributes of various objects at measurement stations located throughout the classroom

COMPETENCY 002

59. **Use the statements below to answer the question that follows.**

Environmental Science	Earth Science	Astronomy
Most scientists predict that over the next few decades global warming will lead to rising sea levels; devastation of coral reefs by warming waters; and an increase in droughts, hurricanes, winter storms and other disruptive weather patterns.	The eruption of the Krakatoa volcano in 1883 ejected huge quantities of ash and dust into the atmosphere. Over the next few years, this led to a decrease of mean global temperature, an increase in acid precipitation, and an increase in the frequency and intensity of spectacularly colored sunsets.	The most spectacular phenomenon related to sunspot activity is solar flares, which are massive amounts of energy released near the sunspot. The energy from solar flares disrupts radio communication and interacts with Earth's magnetic field to cause intensified displays of the *aurora borealis.*

Which of the following unifying concepts in science is best illustrated by the statements given above?

A. How complex systems can change and evolve in unpredictable patterns

B. How changes in one system can lead to changes in other systems

C. How negative feedback acts to maintain stability in a system over time

D. How changes in the input of matter and energy of a system affect the output of matter and energy in the system

COMPETENCY 036

60. Scientists hypothesize that Earth's magnetic field is generated by

A. attractive forces between large deposits of magnetite in the polar regions.

B. movements of molten material in the outer layer of Earth's core.

C. charged particles of the solar wind striking Earth's atmosphere.

D. tidal movements of Earth's oceans in their basins.

COMPETENCY 036

61. Two igneous rocks have similar compositions, but the mineral grains in one rock are much larger than the mineral grains in the other rock. Which of the following explanations best accounts for the difference in the size of the mineral grains in the two rocks?

A. The rock with smaller mineral grains formed under greater pressure

B. The rock with larger mineral grains cooled at a slower rate when it formed

C. The rock with larger mineral grains is older

D. The rock with smaller mineral grains has undergone more weathering

COMPETENCY 037

62. **Use the information below to answer the question that follows.**

Students in a science class are experimenting with a tablet that releases carbon dioxide when placed in water. The students place a tablet in 100 mL of water and measure how long it takes until the tablet stops producing gas bubbles. The students repeat the experiment using a whole tablet broken into halves, a whole tablet broken into quarters, and a whole tablet crushed into powder.

Which of the following questions is most closely related to this experiment?

A. What kind of chemical reactions produce the gases released from volcanoes?

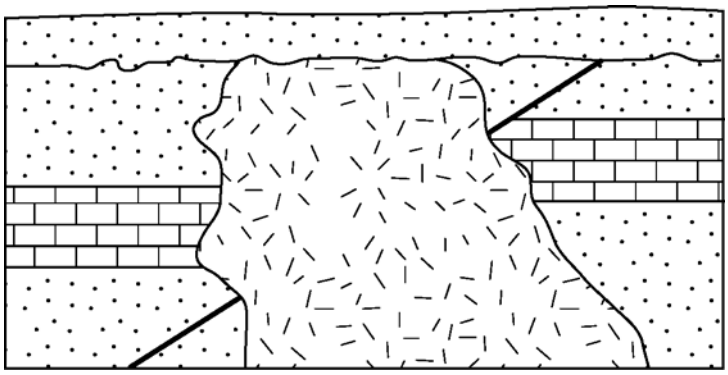
B. How does increasing the surface area of rock by mechanical weathering affect the rate of chemical weathering?

C. How much carbon dioxide gas can be dissolved in 100 mL of ocean water at room temperature?

D. How much carbon dioxide is stored in a given mass of sedimentary rock?

COMPETENCY 038

63. **Use the diagram below to answer the question that follows.**



Based on the cross-sectional diagram above, which of the following sequences of geologic events most likely accounts for the features shown in the diagram?

A. Sedimentation–faulting–intrusion–erosion–sedimentation

B. Sedimentation–intrusion–erosion–faulting–sedimentation

C. Sedimentation–folding–faulting–erosion–sedimentation

D. Sedimentation–erosion–sedimentation–erosion–faulting

COMPETENCY 039

64. Which of the following causes tsunamis?

A. Unusually high tides in narrow inlets

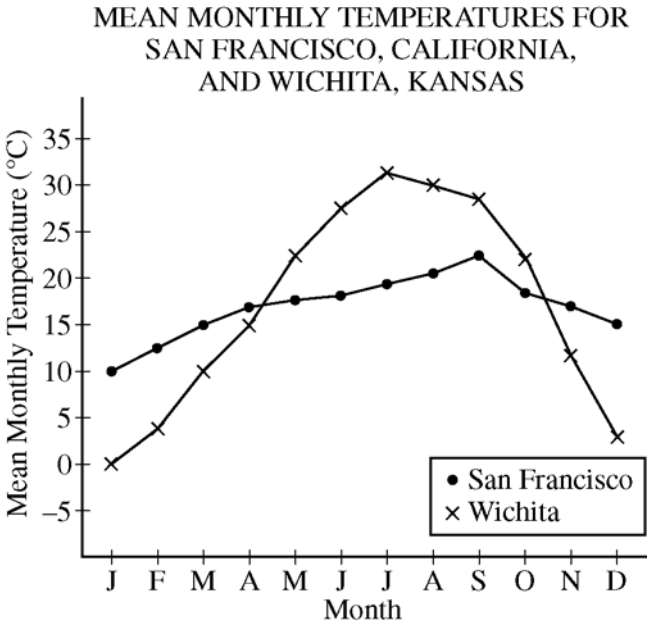
B. Superposition of multiple waves

C. Undersea earthquakes

D. Hurricane-force winds

COMPETENCY 040

65. Use the graph below to answer the question that follows.



Which of the following best explains the difference in the annual range of mean monthly temperatures between San Francisco and Wichita?

A. Large bodies of water heat and cool more slowly than land, which moderates seasonal temperature changes in marine climates

B. Reflectivity of land surfaces is greater than that of water, which leads to more extreme fluctuations in radiational heating and cooling in continental climates

C. High evaporation rates from ocean water lead to increased cloud cover, which moderates both solar heating and radiational heat loss in marine climates

D. Variation in relief of land surfaces leads to uneven heating, which produces more frequent and severe winds in continental climates

COMPETENCY 040

66. A cumulus cloud begins to form in a warm parcel of air that is ascending rapidly into slightly cooler air. Which of the following is the most likely cause of the condensation in the warm air mass?

A. A decrease in temperature caused by a decrease in atmospheric pressure

B. A decrease in temperature caused by compression of the parcel of air

C. An increase in relative humidity caused by an increase in water content

D. An increase in relative humidity caused by an increase in the dew point

COMPETENCY 041

67. A town has detected nitrates in its water supply, which is drawn from a reservoir and from a number of wells that tap a small aquifer. The nitrates have been traced to wells in one area. Which of the following is the most likely source of the contamination?

    A. Leakage from underground gasoline storage tanks

    B. Ash and particulates from upwind industrial stacks

    C. Leachate from naturally occurring minerals

    D. Runoff from farms and feedlots

COMPETENCY 042

68. One side of the Moon always faces Earth, while one side always faces away. Which of the following is the most accurate explanation for this phenomenon?

    A. The Moon rotates about its axis in the opposite direction to Earth's rotation about Earth's axis

    B. The Moon takes the same amount of time to complete one rotation about its axis as it does to complete one revolution around Earth

    C. Unlike Earth, the Moon does not rotate about an axis

    D. The Moon takes the same amount of time to complete one rotation about its axis as Earth takes to complete one rotation about Earth's axis

COMPETENCY 042

69. Which of the following statements would be true if Earth's axis were perpendicular to its orbital plane rather than tilted?

    A. On any particular day, a location on the equator would receive the same intensity of solar radiation as a location at either pole

    B. Each pole would have six months of continuous daylight and six months of continuous darkness each year

    C. At any place on Earth except at high latitudes, each day would have about 12 hours of daylight and 12 hours of darkness throughout the year

    D. Seasonal differences at locations in the high latitudes would be more pronounced

COMPETENCY 043

70. The lunar month is gradually getting longer. Which of the following can be inferred from this gradual change?

    A. The Moon was once closer to Earth

    B. The mass of the Moon was once smaller

    C. The orbit of the Moon was once circular

    D. Earth once rotated more slowly on its axis

COMPETENCY 044

71. An astronomer observes that the light coming from a distant star is shifted toward the red end of the visible spectrum. The best interpretation of this information is that the

    A. star is increasing in diameter.

    B. temperature of the star is increasing.

    C. distance between the star and Earth is increasing.

    D. speed of the rotation of the star on its axis is increasing.

COMPETENCY 044

72. Which of the following observations best supports the big bang theory of the origin of the universe?

    A. Galaxies may be clumped or clustered in a region of space

    B. New stars are being formed continuously from cosmic dust clouds

    C. Microwave background radiation is fairly evenly distributed across space

    D. Large black holes have been found at the centers of some galaxies

COMPETENCY 045

73. Johannes Kepler concluded that the orbits of planets around the Sun were elliptical rather than circular, as Copernicus had thought. Kepler's conclusion was based largely upon which of the following observations?

    A. The planets occasionally exhibit retrograde motion

    B. The planets appear to travel at different speeds at different times of the year

    C. The orbits of the planets are all in the plane of the ecliptic

    D. The planets appear to travel predictably through the zodiacal constellations

COMPETENCY 046

74. Students in a science class are doing a research project on a small pond near their school. The students know from an archive of the local newspaper that the pond once supported a healthy fish population. There are currently no fish in the pond. Which of the following activities would best engage the students in developing a scientific hypothesis?

A. Have students measure the pH of the pond and compare it to the pH of other ponds in the area

B. Ask students to develop a list of possible sources of chemical pollution that could have killed the fish in the pond

C. Have students search the newspaper archives for stories dealing with the declining fish population to identify possible reasons for the decline

D. Ask students to use the Internet to find a method for measuring the oxygen content of the water in the pond

Read the passage below; then answer the two questions that follow.

Some of the most compelling data on the link between lifestyle factors and heart disease come from large-scale studies by public health researchers. The most famous of these studies is the Framingham Heart Study, which has followed 5,209 men and women from the town of Framingham, Massachusetts, since 1948. On the basis of survey data and medical information collected from this group, the Framingham researchers have developed a questionnaire to assess an individual's risk for coronary disease. Respondents are assigned a score on the basis of cholesterol level (which is determined in large part by diet and exercise), age, blood pressure, whether the respondent is a smoker and whether the respondent has diabetes. Men with the fewest risk factors have about a 2% chance of developing coronary disease within the next ten years, while women with the fewest risk factors have about a 1% chance. On the other hand, men with the most risk factors have a greater than 53% chance of developing coronary disease within ten years, while women with the most risk factors have a greater than 27% chance.

COMPETENCY 003

75. Which of the following conclusions about the risk of heart disease can be inferred from the above passage?

    A. Lifestyle factors account for up to 53% of the cases of heart disease in men and up to 27% of the cases in women

    B. Genetic factors play almost no role in determining the risk of heart disease

    C. As a man's risk factors increase, the chance that he will develop heart disease rises by up to 50%

    D. Men are about twice as likely as women to develop heart disease, given similar lifestyles and overall health

COMPETENCY 002

76. A scientist proposes that there is a gene that both predisposes people to smoke and contributes to heart disease. She claims that the association between smoking and heart disease is explained by the presence of this gene, and she disputes the conclusion of the Framingham Study that smoking by itself increases the risk of heart disease. Which of the following types of scientific investigation would provide the best evidence against this scientist's genetic explanation of the link between smoking and heart disease?

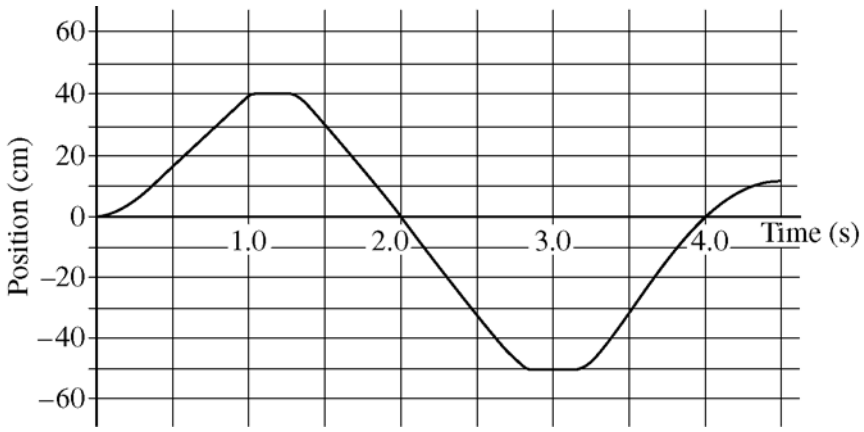
    A. Interviews with smokers indicating that cardiac symptoms are most acute when they have been smoking heavily

    B. Observational studies showing that heart disease risk increases only after an individual has begun smoking

    C. Controlled experiments showing that lab rats exposed to cigarette smoke are more likely to develop heart disease

    D. Gene-sequencing studies indicating that there is a gene related to heart disease that is carried by some nonsmokers

Use the graph below to answer the two questions that follow.



5 The graph shows the position of an object traveling in a straight line with respect to time.

COMPETENCY 004

77. What is the velocity of the object at $t = 2.5$ s?

    A. –7.5 cm/s

    B. –25 cm/s

    C. –45 cm/s

    D. –60 cm/s

COMPETENCY 004

78. Which of the following describes the motion of the particle at $t = 4$ s?

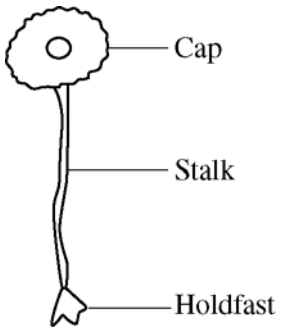
    A. The particle is stationary

    B. The particle is decelerating

    C. The particle is traveling to the right at a constant speed

    D. The particle is moving backward

Use the figure and description below of an experiment to answer the three questions that follow.



Acetabularia are marine algae that grow as single, large cells 2 to 5 cm in length. At one end of the cell is a cap, in the middle a stalk and at the bottom a holdfast. If the cap of a cell is removed, it quickly grows back. Experiments have shown that if a stalk from species 1 is grafted onto a holdfast from species 2, a new cap will grow that is intermediate in shape between the caps of species 1 and 2. However, if this cap is removed, the next cap that grows will be characteristic of species 2, as will all additional caps that are grown if the cap is repeatedly removed.

COMPETENCY 022

79. Given the experimental results described above, it is most likely that the holdfast contains a

    A. mitochondrion.

    B. chloroplast.

    C. lysosome.

    D. nucleus.

COMPETENCY 047

80. Asking students to perform the experiment with *Acetabularia* is most likely to be useful if the students have some prior knowledge of

    A. the mechanisms of genetic control of cellular activity.

    B. the relevance of cell biology to their daily lives.

    C. the relationship between structure and function in cells.

    D. the mechanisms of asexual reproduction.

COMPETENCY 046

81. After students complete the experiment, which of the following questions would be most likely to stimulate higher-level thinking about the experimental results?

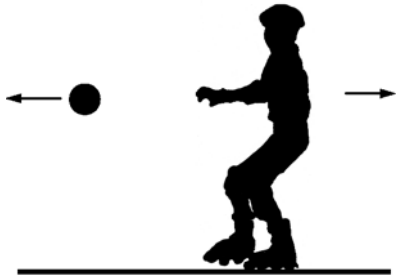
    A. What is the likely result if *Acetabularia* is interbred with another unicellular organism?

    B. Why does the first cap that regenerates have characteristics of both species?

    C. What is the function of the cap in *Acetabularia*?

    D. Why do many lower organisms regenerate, while vertebrates do not?

Use the diagram and the information below to answer the two questions that follow.



A 60 kg teenager on in-line skates initially at rest holds a 0.5 kg ball. The teenager throws the ball horizontally at a speed of 12 m/s relative to the ground and recoils backwards.

COMPETENCY 008

82. Ignoring friction, what is the recoil speed of the skater?

A. 0.02 m/s

B. 0.10 m/s

C. 2.50 m/s

D. 12.00 m/s

COMPETENCY 046

83. The example in the diagram could be used to help students understand the dynamics of which of the following propulsion systems?

A. Automobile

B. Submarine

C. Helicopter

D. Rocket

Use the information below to answer the three questions that follow.

To determine the amount of table salt in a salty liquid food product, 0.2 M silver nitrate solution is slowly added to 50 mL of the food product. A small amount of sodium chromate is also added to the solution as an indicator. The chromate ions react with the excess silver ions to produce an orange/red color.

COMPETENCY 016

84. A total of 25.0 mL of silver nitrate solution is added to the liquid food product before a color change is observed. What is the mass of the silver ions added to the food product?

A. 0.005 g

B. 0.20 g

C. 0.24 g

D. 0.54 g

COMPETENCY 016

85. Which of the following is the net ionic equation that represents the reaction occurring between the silver nitrate and the dissolved table salt in the solution?

A. $AgNO_3(aq) + Na^+(aq) \rightarrow NaNO_3(aq) + Ag(s)$

B. $AgNO_3(aq) + Na^+(aq) \rightarrow Ag(s) + Na^+(aq) + NO_3^-(aq)$

C. $AgNO_3(aq) + Cl^-(aq) \rightarrow ClNO_3(aq) + Ag(s)$

D. $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

COMPETENCY 001

86. Which of the following analytic techniques is used in this analysis?

A. Titration

B. Chromatography

C. Calorimetry

D. Electrolysis

Use the information below to answer the two questions that follow.

To remove tarnish from a silver bracelet, a jeweler loosely wraps the bracelet in aluminum foil and submerges the system in a beaker of water. The jeweler next adds baking soda to the water and gently heats the water. The tarnish is removed by the reaction represented below.

$$2\,Al(s) + 3\,Ag_2S(aq) + 6\,H_2O(l) \rightarrow 6\,Ag(s) + 2\,Al(OH)_3(aq) + 3\,H_2S(g)$$

COMPETENCY 019

87. Which of the following is the change in the oxidation state of Ag in the reaction?

A. $0 \rightarrow +1$

B. $0 \rightarrow +6$

C. $+1 \rightarrow 0$

D. $+1 \rightarrow +6$

COMPETENCY 019

88. In this reaction, which of the following species acts as the reducing agent?

A. A1

B. H_2O

C. S^{2-}

D. OH^-

Use the information below to answer the two questions that follow.

In an introductory unit on solubility, an eighth-grade science teacher gives the students the following materials and asks them to determine whether the materials are soluble in water. The students work in teams of two.

- table salt
- baking powder
- zinc powder
- sugar

COMPETENCY 047

89. The teacher would like to use this investigation as a starting point for an extended inquiry-based unit on solubility. Which of the following assignments would be most appropriate for meeting the teacher's goal?

    A. Carefully describe what you observed and pose at least one scientific question related to solubility that could be investigated by empirical methods

    B. Write a brief essay in which you explain what happens at the molecular level as a substance is dissolved in water

    C. Repeat the experiment using the same materials and procedures as were used in the original experiment

    D. Use the Internet to research the properties of saturated and supersaturated solutions and be prepared to present your research to the class

COMPETENCY 047

90. As the inquiry unit progresses, the students perform an experiment in which they are asked to predict whether adding a solute to water will affect the boiling point of water. The students then design and carry out an experiment to test their predictions. The students are asked to communicate the results of their experiment in a written lab report. Which of the following should be the primary criterion used by the teacher in assessing the section of each team's report where the students state the conclusion of their experiment?

    A. Is the conclusion consistent with accepted scientific knowledge?

    B. Is the conclusion supported by the data collected during the experiment?

    C. Is the conclusion in agreement with the students' predictions?

    D. Is the conclusion in agreement with those of the other teams in the class?

ANSWER KEY

Question Number	Correct Answer	Competency
1	A	001
2	D	001
3	B	001
4	D	002
5	C	002
6	B	002
7	D	003
8	B	003
9	A	006
10	A	006
11	B	007
12	D	007
13	A	008
14	C	009
15	B	010
16	C	010
17	D	011
18	A	011
19	D	012
20	C	012
21	B	013
22	C	013
23	C	014
24	B	014
25	C	015
26	C	015
27	C	018
28	C	018
29	D	020
30	D	020

Question Number	Correct Answer	Competency
31	B	021
32	B	021
33	B	022
34	B	023
35	D	023
36	C	024
37	C	024
38	D	025
39	A	025
40	C	026
41	A	026
42	D	027
43	A	027
44	A	028
45	D	028
46	A	029
47	B	029
48	D	030
49	D	031
50	C	031
51	A	032
52	C	032
53	A	033
54	A	034
55	B	034
56	D	035
57	C	035
58	D	047
59	B	002
60	B	036

ANSWER KEY

Question Number	Correct Answer	Competency
61	B	036
62	B	037
63	A	038
64	C	039
65	A	040
66	A	040
67	D	041
68	B	042
69	C	042
70	A	043
71	C	044
72	C	044
73	B	045
74	C	046
75	D	003

Question Number	Correct Answer	Competency
76	C	002
77	D	004
78	B	004
79	D	022
80	A	047
81	B	046
82	B	008
83	D	046
84	D	016
85	D	016
86	A	001
87	C	019
88	A	019
89	A	047
90	B	047

Chapter 6

Are You Ready? – Last-Minute Tips

PREPARING TO TAKE THE TEST

CHECKLIST

Complete this checklist to determine if you are ready to take your test.

- ✓ Do you know the testing requirements for your teaching field?
- ✓ Have you followed the test registration procedures?
- ✓ Have you reviewed the test center identification document requirements in the *Registration Bulletin* or on the ETS TExES website at **www.texes.ets.org**?
- ✓ Do you know the test frameworks that will be covered in each of the tests you plan to take?
- ✓ Have you used the study plan sheet at the end of this manual to identify what content you already know well and what content you will need to focus on in your studying?
- ✓ Have you reviewed any textbooks, class notes and course readings that relate to the frameworks covered?
- ✓ Do you know how long the test will take and the number of questions it contains? Have you considered how you will pace your work?
- ✓ Are you familiar with the test directions and the types of questions for your test?
- ✓ Are you familiar with the recommended test-taking strategies and tips?
- ✓ Have you practiced by working through the sample test questions at a pace similar to that of an actual test?
- ✓ If constructed-response questions are part of your test, do you understand the scoring criteria for these questions?
- ✓ If you are repeating a test, have you analyzed your previous score report to determine areas where additional study and test preparation could be useful?

THE DAY OF THE TEST

You should have ended your review a day or two before the actual test date. Many clichés you may have heard about the day of the test are true. You should:

- Be well rested.
- Take the appropriate identification document(s) with you to the test center (identification requirements are listed in the *Registration Bulletin* and on the ETS TExES website at **www.texes.ets.org**).
- Take 3 or 4 well-sharpened soft-lead (No. 2 or HD) pencils with good erasers.
- Eat before you take the test.
- Be prepared to stand in line to check in or to wait while other test takers are being checked in.
- Stay calm. You can't control the testing situation, but you can control yourself. Test administrators are well trained and make every effort to provide uniform testing conditions, but don't let it bother you if a test doesn't start exactly on time. You will have the necessary amount of time once it does start. Using the *Reducing Test Anxiety* booklet in the days before you test may be helpful in mentally and emotionally preparing yourself to test. It is available free at **www.texes.ets.org**.

You can think of preparing for this test as training for an athletic event. Once you have trained, prepared and rested, give it everything you've got. Good luck.

Appendix A

Study Plan Sheet

STUDY PLAN						
Content covered on test	**How well do I know the content?**	**What material do I have for studying this content?**	**What material do I need for studying this content?**	**Where can I find the materials I need?**	**Dates planned for study of content**	**Date completed**

Appendix B

Preparation Resources

PREPARATION RESOURCES

The resources listed below may help you prepare for the TExES test in this field. These preparation resources have been identified by content experts in the field to provide up-to-date information that relates to the field in general. You may wish to use current issues or editions to obtain information on specific topics for study and review.

JOURNALS

American Biology Teacher, National Association of Biology Teachers.

American Scientist, Sigma XI, the Scientific Research Society.

ChemMatters, American Chemical Society.

Geology Today, Geologist's Association.

Natural History, American Museum of Natural History.

Nature, The Nature Publishing Group.

Sky and Telescope, Sky Publishing.

Texas Science Teacher, Science Teachers Association of Texas.

The Earth Scientist, National Earth Science Teacher's Association.

The Physics Teacher, American Association of Physics Teachers.

The Science Teacher, National Science Teachers Association.

OTHER RESOURCES

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Wright, R. T. (2008). *Environmental Science: Toward a Sustainable Future*, Ninth Edition. Prentice-Hall.

Zumdahl, S. S., and Zumdahl, S. A. (2007). *Chemistry*, Seventh Edition. Houghton Mifflin.

ONLINE RESOURCES

American Association for the Advancement of Science — www.aaas.org

American Association of Physics Teachers — www.aapt.org

American Astronomical Society — www.aas.org

American Chemical Society — www.acs.org

American Institute of Biological Sciences — www.aibs.org

American Physical Society — www.aps.org

National Association of Biology Teachers — www.nabt.org
National Association of Geoscience Teachers — www.nagt.org
National Science Teachers Association — www.nsta.org
The Geological Society of America — www.geosociety.org

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