Texas Education Agency
TEXAS EDUCATOR CERTIFICATION

TExES/ExCET TExMaT TASC/TASC-ASL

TExES | Texas Examinations of Educator Standards

Preparation Manual

116 Science 4–8

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Chapter 1

Introduction to the Science 4–8 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 10. 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 4–8

COMPETENCY 001

THE TEACHER UNDERSTANDS HOW TO MANAGE LEARNING ACTIVITIES TO ENSURE THE SAFETY OF ALL STUDENTS.

1

SAMPLE DESCRIPTIVE STATEMENTS

The beginning teacher:

A. Understands safety regulations and guidelines for science facilities and science instruction.

B. Knows procedures for and sources of information regarding the appropriate handling, use, conservation, disposal, recycling, care and maintenance of chemicals, materials, specimens and equipment.

C. Knows procedures for the safe handling and ethical care and treatment of organisms and specimens.

STUDYING FOR THE TExES TEST

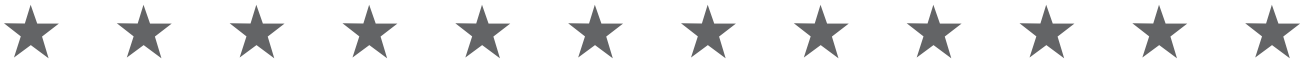
The following steps may be helpful in preparing for the TExES test.

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

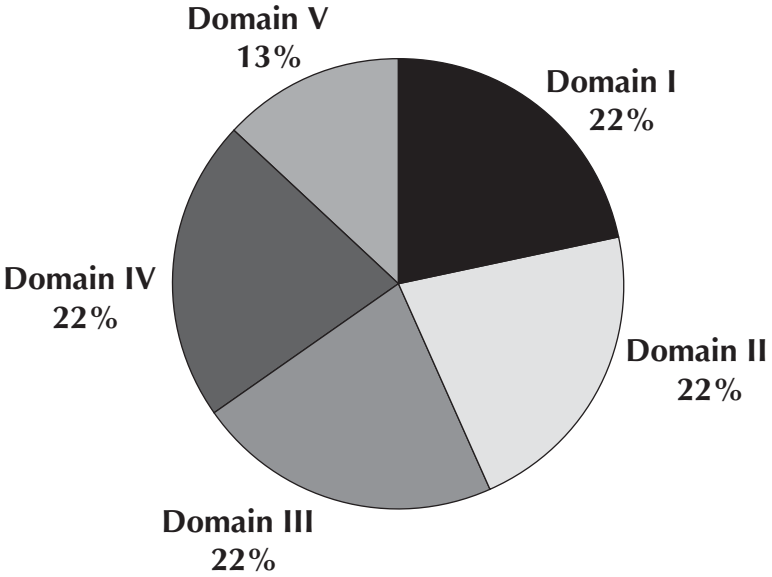
Complete, approved educator standards are posted on the TEA website at **www.tea.state.tx.us**.

Chapter 3

Study Topics

TEST FRAMEWORK FOR FIELD 116: SCIENCE 4–8

THE DOMAINS*



- **Domain I: Scientific Inquiry and Processes**
  Standards Assessed: Science I–III, VI–VII, XI
- **Domain II: Physical Science**
  Standard Assessed: Science VIII
- **Domain III: Life Science**
  Standard Assessed: Science IX
- **Domain IV: Earth and Space Science**
  Standard Assessed: Science X
- **Domain V: Science Learning, Instruction and Assessment**
  Standards Assessed: Science III–V

*Percentages do not add up to 100 due to rounding.

TOTAL TEST BREAKDOWN

- Exam is offered as a paper-based or computer-administered test
- 90 Multiple-Choice Questions (80 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 22% 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 — PHYSICAL SCIENCE (approximately 22% 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 — LIFE SCIENCE (approximately 22% 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 IV — EARTH AND SPACE SCIENCE (approximately 22% 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 V — SCIENCE LEARNING, INSTRUCTION AND ASSESSMENT (approximately 13% of the test)

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

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 MANAGE LEARNING ACTIVITIES TO ENSURE THE SAFETY OF ALL STUDENTS.

The beginning teacher:

A. Understands safety regulations and guidelines for science facilities and science instruction.

B. Knows procedures for and sources of information regarding the appropriate handling, use, conservation, disposal, recycling, care and maintenance of chemicals, materials, specimens and equipment.

C. Knows procedures for the safe handling and ethical care and treatment of organisms and specimens.

COMPETENCY 002
THE TEACHER UNDERSTANDS THE CORRECT USE OF TOOLS, MATERIALS, EQUIPMENT AND TECHNOLOGIES.

The beginning teacher:

A. Selects and safely uses appropriate tools, technologies, materials and equipment needed for instructional activities.

B. Understands concepts of precision, accuracy and error with regard to reading and recording numerical data from a scientific instrument.

C. Understands how to gather, organize, display and communicate data in a variety of ways (e.g., construct charts, tables, graphs, maps, satellite images, diagrams, written reports, oral presentations).

D. Understands the international system of measurement (i.e., metric system) and performs unit conversions within measurement systems.

COMPETENCY 003

THE TEACHER UNDERSTANDS THE PROCESS OF SCIENTIFIC INQUIRY AND THE HISTORY AND NATURE OF SCIENCE.

The beginning teacher:

A. Understands the characteristics of various types of scientific investigations (e.g., descriptive studies, controlled experiments, comparative data analysis).

B. Understands how to design, conduct and communicate the results of a variety of scientific investigations.

C. Understands the historical development of science and the contributions that diverse cultures and individuals of both genders have made to scientific knowledge.

D. Understands the roles that logical reasoning, verifiable empirical evidence, prediction and peer review play in the process of generating and evaluating scientific knowledge.

E. Understands principles of scientific ethics.

F. Develops, analyzes and evaluates different explanations for a given scientific result.

G. Demonstrates an understanding of potential sources of error in inquiry-based investigation and the use of multiple trials to increase reliability.

H. Demonstrates an understanding of how to communicate and defend the results of an inquiry-based investigation.

COMPETENCY 004

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

The beginning teacher:

A. Understands that decisions about the use of science are based on factors such as ethical standards, economics and personal and societal needs.

B. Applies scientific principles and the theory of probability to analyze the advantages of, disadvantages of or alternatives to a given decision or course of action.

C. Applies scientific principles and processes to analyze factors that influence personal choices concerning fitness and health, including physiological and psychological effects and risks associated with the use of substances and substance abuse.

D. Understands concepts, characteristics and issues related to changes in populations and human population growth.

E. Understands the types and uses of natural resources (renewable, non-renewable) and the effects of human consumption on the renewal and depletion of resources.

F. Understands the role science can play in helping resolve personal, societal and global challenges (e.g., recycling, evaluating product claims, alternative energy sources).

COMPETENCY 005

THE TEACHER KNOWS AND UNDERSTANDS THE UNIFYING CONCEPTS AND PROCESSES THAT ARE COMMON TO ALL SCIENCES.

The beginning teacher:

A. Understands how the following concepts and processes provide a unifying explanatory framework across the science disciplines: systems, order and organization; evidence, models and explanation; change, constancy and measurements; evolution and equilibrium; and form and function.

B. Demonstrates an understanding of how patterns in observations and data can be used to make explanations and predictions.

C. Analyzes interactions and interrelationships between systems and subsystems.

D. Applies unifying concepts to explore similarities in a variety of natural phenomena.

E. Understands how properties and patterns of systems can be described in terms of space, time, energy and matter.

F. Understands how change and constancy occur in systems.

G. Understands the complementary nature of form and function in a given system.

H. Understands 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).

DOMAIN II — PHYSICAL SCIENCE

COMPETENCY 006

THE TEACHER UNDERSTANDS FORCES AND MOTION AND THEIR RELATIONSHIPS.

The beginning teacher:

A. Demonstrates an understanding of properties of universal forces (e.g., gravitational, electrical, magnetic).

B. Understands how to measure, graph and describe changes in motion using concepts of displacement, speed, velocity and acceleration.

C. Understands the vector nature of force.

D. Identifies the forces acting on an object and applies Newton's laws to describe the motion of an object.

E. Analyzes the relationship between force and motion in a variety of situations (e.g., simple machines, blood flow, geologic processes).

COMPETENCY 007

THE TEACHER UNDERSTANDS PHYSICAL PROPERTIES OF AND CHANGES IN MATTER.

The beginning teacher:

A. Describes the physical properties of substances (e.g., density, boiling point, melting point, solubility, thermal and electrical conductivity, luster, malleability).

B. Describes the physical properties and molecular structure of solids, liquids and gases.

C. Describes the relationship between the molecular structure of materials (e.g., metals, crystals, polymers) and their physical properties.

D. Relates the physical properties of an element to its placement in the periodic table, including metals, non-metals and metalloids.

E. Distinguishes between physical and chemical changes in matter.

F. Applies knowledge of physical properties of and changes in matter to processes and situations that occur in life and earth/space science.

COMPETENCY 008

THE TEACHER UNDERSTANDS CHEMICAL PROPERTIES OF AND CHANGES IN MATTER.

The beginning teacher:

A. Describes the structure and components of the atom.

B. Distinguishes among elements, compounds, mixtures and solutions and describes their properties.

C. Relates the chemical properties of an element to its placement in the periodic table.

D. Describes chemical bonds and chemical formulas.

E. Analyzes chemical reactions and their associated chemical equations.

F. Explains the importance of a variety of chemical reactions that occur in daily life (e.g., rusting, burning of fossil fuels, photosynthesis, cell respiration, chemical batteries, digestion of food).

G. Understands applications of chemical properties of matter in physical, life and earth/space science and technology (e.g., materials science, biochemistry, transportation, medicine, telecommunications).

COMPETENCY 009

THE TEACHER UNDERSTANDS ENERGY AND INTERACTIONS BETWEEN MATTER AND ENERGY.

The beginning teacher:

A. Describes concepts of work, power and potential and kinetic energy.

B. Understands the concept of heat energy and the difference between heat and temperature.

C. Understands the principles of electricity and magnetism and their applications (e.g., electric circuits, motors, audio speakers, nerve impulses, lightning).

D. Applies knowledge of properties of light (e.g., reflection, refraction, dispersion) to describe the function of optical systems and phenomena (e.g., camera, microscope, rainbow, eye).

E. Demonstrates an understanding of the properties, production and transmission of sound.

F. Applies knowledge of properties and characteristics of waves (e.g., wavelength, frequency, interference) to describe a variety of waves (e.g., water, electromagnetic, sound).

COMPETENCY 010

THE TEACHER UNDERSTANDS ENERGY TRANSFORMATIONS AND THE CONSERVATION OF MATTER AND ENERGY.

The beginning teacher:

A. Describes the processes that generate energy in the sun and other stars.

B. Applies the law of conservation of matter to analyze a variety of situations (e.g., the water cycle, food chains, decomposition, balancing chemical equations).

C. Describes sources of electrical energy and processes of energy transformation for human uses (e.g., fossil fuels, solar panels, hydroelectric plants).

D. Understands exothermic and endothermic chemical reactions and their applications (e.g., hot and cold packs, energy content of food).

E. Applies knowledge of the transfer of energy in a variety of situations (e.g., the production of heat, light, sound and magnetic effects by electrical energy; the process of photosynthesis; weather processes; food webs; food/energy pyramids).

F. Applies the law of conservation of energy to analyze a variety of physical phenomena (e.g., specific heat, nuclear reactions, efficiency of simple machines, collisions).

G. Understands applications of energy transformations and the conservation of matter and energy in life and earth/space science.

DOMAIN III — LIFE SCIENCE

COMPETENCY 011
THE TEACHER UNDERSTANDS THE STRUCTURE AND FUNCTION OF LIVING THINGS.

The beginning teacher:

A. Describes characteristics of organisms from the major taxonomic groups, including domains and kingdoms and uses these characteristics to construct a dichotomous key.

B. Analyzes how structure complements function in cells.

C. Analyzes how structure complements function in tissues, organs, organ systems and organisms including both plants and animals.

D. Identifies human body systems and describes their functions (e.g., digestive, circulatory).

E. Describes how organisms, including producers, consumers and decomposers obtain and use energy and matter.

F. Applies chemical principles to describe the structure and function of the basic chemical components (e.g., proteins, carbohydrates, lipids, nucleic acids) of living things and distinguishes between organic and inorganic compounds.

COMPETENCY 012
THE TEACHER UNDERSTANDS REPRODUCTION AND THE MECHANISMS OF HEREDITY.

The beginning teacher:

A. Compares and contrasts sexual and asexual reproduction.

B. Understands the organization of hereditary material (e.g., DNA, genes, chromosomes).

C. Describes how an inherited trait can be determined by one or many genes and how more than one trait can be influenced by a single gene.

D. Distinguishes between dominant and recessive traits and predicts the probable outcomes of genetic combinations.

E. Evaluates the influence of environmental and genetic factors on the traits of an organism.

F. Describes current applications of genetic research (e.g., related to cloning, reproduction, health, industry, agriculture).

COMPETENCY 013

THE TEACHER UNDERSTANDS ADAPTATIONS OF ORGANISMS AND THE THEORY OF EVOLUTION.

The beginning teacher:

A. Describes similarities and differences among various types of organisms and methods of classifying organisms (e.g., presence of a nucleus determines if a cell is prokaryotic and eukaryotic).

B. Describes traits in a population or species that enhance its survival and reproductive success.

C. Describes how populations and species change through time.

D. Applies knowledge of the mechanisms and processes of biological evolution (e.g., variation, mutation, environmental factors, natural selection).

E. Describes evidence that supports the theory of evolution of life on Earth.

COMPETENCY 014

THE TEACHER UNDERSTANDS REGULATORY MECHANISMS AND BEHAVIOR.

The beginning teacher:

A. Describes how organisms respond to internal and external stimuli.

B. Applies knowledge of structures and physiological processes that maintain stable internal conditions.

C. Demonstrates an understanding of feedback mechanisms that allow organisms to maintain stable internal conditions.

D. Understands how evolutionary history affects behavior.

COMPETENCY 015

THE TEACHER UNDERSTANDS THE RELATIONSHIPS BETWEEN ORGANISMS AND THE ENVIRONMENT.

The beginning teacher:

A. Understands the levels of organization within an ecosystem (organism, population, community) and identifies the abiotic and biotic components of an ecosystem.

B. Analyzes the interrelationships (food chains, food webs) among producers, consumers and decomposers in an ecosystem.

C. Identifies factors that influence the size and growth of populations in an ecosystem.

D. Analyzes adaptive characteristics that result in a population's or species' unique niche in an ecosystem.

E. Describes and analyzes energy flow through various types of ecosystems.

F. Knows how populations and species modify and affect ecosystems (e.g., succession), and how biodiversity affects the sustainability of ecosystems.

DOMAIN IV — EARTH AND SPACE SCIENCE

COMPETENCY 016

THE TEACHER UNDERSTANDS THE STRUCTURE AND FUNCTION OF EARTH SYSTEMS.

The beginning teacher:

A. Understands the layers and surface features (landforms) of Earth and uses topographic maps and satellite imaging to analyze constructive and destructive processes that produce geologic change.

B. Understands the form and function of surface and subsurface water (e.g., watershed, aquifer).

C. Applies knowledge of the composition and structure of the atmosphere and its properties, including characteristics that allow life to exist.

D. Demonstrates an understanding of the interactions that occur among the biosphere, geosphere, hydrosphere and atmosphere.

E. Applies knowledge of how human activity and natural processes, both gradual and catastrophic, can alter earth and ocean systems.

F. Identifies the sources of energy (e.g., solar, geothermal, wind, hydroelectric, biofuels) in earth systems and describes mechanisms of energy transfer (e.g., conduction, convection, radiation).

COMPETENCY 017

THE TEACHER UNDERSTANDS CYCLES IN EARTH SYSTEMS.

The beginning teacher:

A. Understands the rock cycle and how rocks, minerals, fossil fuels and soils are formed.

B. Understands the water cycle and its relationship to weather processes; how the sun and the ocean interact in the water cycle.

C. Understands the nutrient (e.g., carbon, nitrogen) cycle and its relationship to earth systems.

D. Applies knowledge of how human and natural processes affect earth systems.

E. Understands the dynamic interactions that occur among the various cycles in the biosphere, geosphere, hydrosphere and atmosphere.

COMPETENCY 018

THE TEACHER UNDERSTANDS THE ROLE OF ENERGY IN WEATHER AND CLIMATE.

The beginning teacher:

A. Understands the elements of weather (e.g., humidity, wind speed, pressure, temperature) and how they are measured.

B. Compares and contrasts weather and climate.

C. Analyzes weather charts and data to make weather predictions based on local and global patterns.

D. Applies knowledge of how transfers of energy among earth systems affect weather and climate.

E. Analyzes how Earth's position, orientation and surface features affect weather and climate.

COMPETENCY 019

THE TEACHER UNDERSTANDS THE CHARACTERISTICS OF THE SOLAR SYSTEM AND THE UNIVERSE.

The beginning teacher:

A. Understands the properties and characteristics of celestial objects.

B. Applies knowledge of the earth-moon-sun system and the interactions among them (e.g., seasons, lunar phases, eclipses).

C. Identifies properties of the components of the solar system, including systems that allow life to exist.

D. Recognizes characteristics of stars, nebulae and galaxies and their distribution in the universe.

E. Demonstrates an understanding of scientific theories of the origin of the universe.

COMPETENCY 020

THE TEACHER UNDERSTANDS THE HISTORY OF THE EARTH SYSTEM.

The beginning teacher:

A. Understands the scope of the geologic time scale and its relationship to geologic processes.

B. Demonstrates an understanding of theories about the earth's origin and geologic history.

C. Demonstrates an understanding of how tectonic forces have shaped landforms over time.

D. Understands the formation of fossils and the importance of the fossil record in explaining the earth's history.

DOMAIN V — SCIENCE LEARNING, INSTRUCTION AND ASSESSMENT

COMPETENCY 021

THE TEACHER HAS THEORETICAL AND PRACTICAL KNOWLEDGE ABOUT TEACHING SCIENCE AND ABOUT HOW STUDENTS LEARN SCIENCE.

The beginning teacher:

A. Understands how the developmental characteristics, prior knowledge and experience and attitudes of students influence science learning.

B. Selects and adapts science curricula, content, instructional materials and activities to meet the interests, knowledge, understanding, abilities, experiences and needs of all students, including English-language learners.

C. Understands how to use situations from students' daily lives to develop instructional materials that investigate how science can be used to make informed decisions.

D. Understands common misconceptions in science and effective ways to address these misconceptions.

E. Understands the rationale for the use of active learning and inquiry processes for students.

F. Understands questioning strategies designed to elicit higher-level thinking and how to use them to move students from concrete to more abstract understanding.

G. Understands the importance of planning activities that are inclusive and accommodate the needs of all students.

H. Understands how to sequence learning activities in a way that allows students to build upon their prior knowledge and challenges them to expand their understanding of science.

COMPETENCY 022

THE TEACHER UNDERSTANDS THE PROCESS OF SCIENTIFIC INQUIRY AND ITS ROLE IN SCIENCE INSTRUCTION.

The beginning teacher:

A. Plans and implements instruction that provides opportunities for all students to engage in nonexperimental and experimental inquiry investigations.

B. Focuses inquiry-based instruction on questions and issues relevant to students and uses strategies to assist students with generating, refining and focusing scientific questions and hypotheses.

C. Instructs students in the safe and proper use of a variety of grade-appropriate tools, equipment, resources, technology and techniques to access, gather, store, retrieve, organize and analyze data.

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

E. Knows how to promote the use of critical-thinking skills, logical reasoning and scientific problem solving to reach conclusions based on evidence.

F. Knows how to teach students to develop, analyze and evaluate different explanations for a given scientific result.

G. Knows how to teach students to demonstrate an understanding of potential sources of error in inquiry-based investigation.

H. Knows how to teach students to demonstrate an understanding of how to communicate and defend the results of an inquiry-based investigation.

COMPETENCY 023

THE TEACHER KNOWS THE VARIED AND APPROPRIATE ASSESSMENTS AND ASSESSMENT PRACTICES TO MONITOR SCIENCE LEARNING IN LABORATORY, FIELD AND CLASSROOM SETTINGS.

The beginning teacher:

A. Understands the relationships among science curriculum, assessment and instruction and bases instruction on information gathered through assessment of students' strengths and needs.

B. Understands the importance of monitoring and assessing students' understanding of science concepts and skills on an ongoing basis.

C. Understands the importance of carefully selecting or designing formative and summative assessments for the specific decisions they are intended to inform.

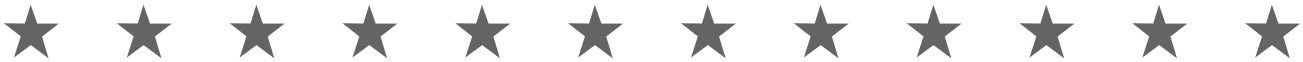
D. Selects or designs and administers a variety of appropriate assessment methods (e.g., performance assessment, self-assessment, formal/informal, formative/summative) to monitor student understanding and progress.

E. Uses formal and informal assessments of student performance and products (e.g., projects, lab journals, rubrics, portfolios, student profiles, checklists) to evaluate student participation in and understanding of the inquiry process.

F. Understands the importance of 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 4–8 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 4–8 test is designed to include a total of 90 multiple-choice questions, out of which 80 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.

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

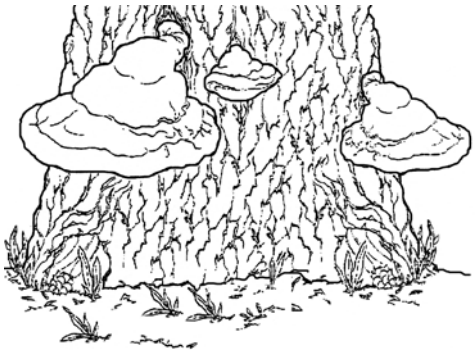
On the following pages, you will find descriptions of these commonly used question formats, along with suggested approaches for responding to each type of question. In the actual testing situation, if you are taking the paper-based version of the test, you may mark the test questions and/or write in 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 4–8 Competency 011: *The teacher understands the structure and function of living things.*

EXAMPLE

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 the 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

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.

As you read this question, it should be clear from the diagram that the shelf-like structures are fungi. Think about the characteristics that distinguish fungi from other organisms. One important difference is how fungi obtain energy and nutrients. Unlike plants, fungi lack chlorophyll and do not photosynthesize, obtaining all their energy and nutrients from the absorption of organic matter.

Now look at the response options. **The correct response is option D.** All other options refer to some part of the photosynthetic cycle and therefore do not pertain to fungi.

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 diagrams, tables and passages. In such cases, you will generally be given information followed by questions related to that information.

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.

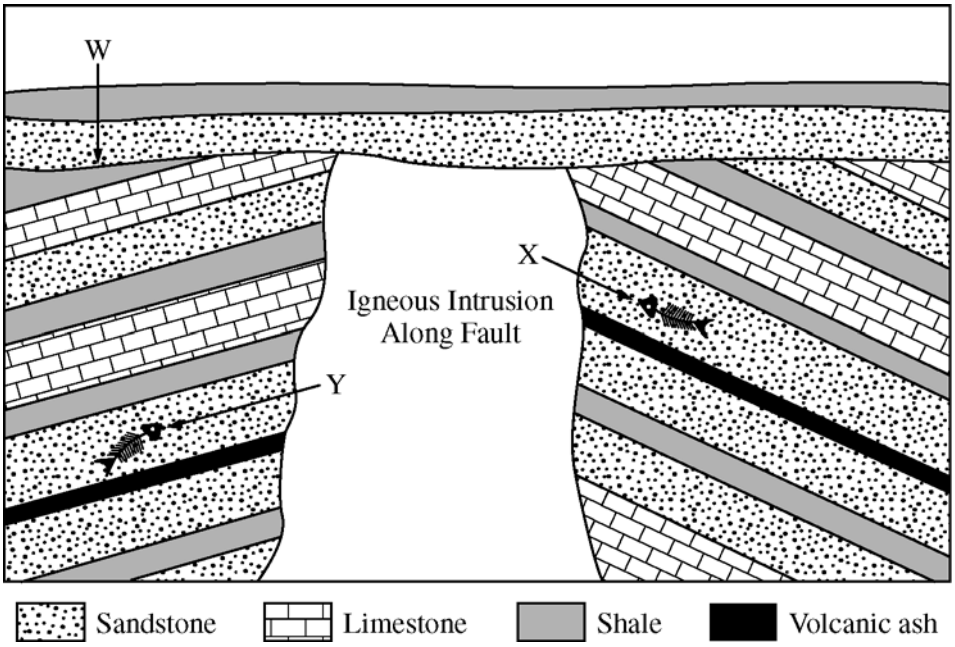
Whether you read the stimulus before or after you read the question, you should read it carefully and critically. If you are taking the paper-based version of the test, you may want to underline its important parts to help you answer the question.

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

First read the stimulus (a diagram of a stratigraphic section of rock).

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



Now you are prepared to address the first of the two questions associated with this stimulus. The first question measures Competency 020: *The teacher understands the history of the earth system.*

1. The igneous intrusion in the illustration has been dated to be 13 million years old, and the volcanic ash layer has been dated to be 24 million years old. Which of the following statements about the ages of fossil X and fossil Y is most accurate?

   A. Fossil X is younger than fossil Y, and both fossils are older than 24 million years old

   B. Fossil X and fossil Y are both between 13 million and 24 million years old

   C. Fossil X is older than fossil Y, and both fossils are younger than 13 million years old

   D. Fossil X is younger than 13 million years old, and fossil Y is older than 13 million years old

SUGGESTED APPROACH

First examine the figure in the stimulus, noting the positions of the rock layers and the fossils labeled X and Y. You should be able to create a combined stratigraphy for the entire section by matching up the pattern of layers on either side of the igneous intrusion. Locate the fossils labeled X and Y and consider their relationship in the combined stratigraphy. It is clear that the two fossils are found in the same stratigraphic layer located above the 24-million-year-old volcanic ash. Since they are above the volcanic ash layer, they must be younger than 24 million years old. Since the igneous intrusion cut through the layer in which the fossils were located 13 million years ago, both fossils must be at least that old. Options A, C and D all state that one fossil is older than the other. Therefore, **the correct response is option B**.

Now you are ready to answer the next question. The second question also measures Competency 020: *The teacher understands the history of the earth system.*

2. The discontinuity represented by the line labeled W in the illustration is most likely to be

   A. a thrust fault.

   B. an igneous intrusion.

   C. a transverse fault.

   D. an erosion surface.

SUGGESTED APPROACH

The second question requires you to recognize the characteristics of an unconformity in a stratigraphic section. Note that the unconformity in the diagram cuts across several stratigraphic layers and the igneous intrusion and that these are missing above the unconformity. Options A, B and C all refer to faults or intrusions. Faults result in the displacement of layers relative to other layers, while intrusions are characterized by the insertion of igneous rock through or between layers. In this case, the relationship of the layers to one another and to the sandstone above the unconformity indicates that the unconformity is an erosion surface and that **option D is the correct response**.

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

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)

COMPETENCY 001

1. A student will be using an alcohol lamp to heat a test tube containing a liquid. Using a test tube holder, it would be safest for the student to position the test tube

   A. directly above the flame, shaking it gently and keeping it loosely corked at all times during heating.

   B. in an upright position, while moving it slowly in a circular motion around the flame.

   C. at about a 45° angle with its mouth pointed away from people, while moving it slowly back and forth through the flame.

   D. in a vertical position, keeping the bottom of the tube in the blue part of the flame at all times.

COMPETENCY 002

2. Laboratory instructions for measuring the mass of a dry chemical on a balance, as shown below, are as follows.

Instructions:

(1) Remove any mass from the balance.

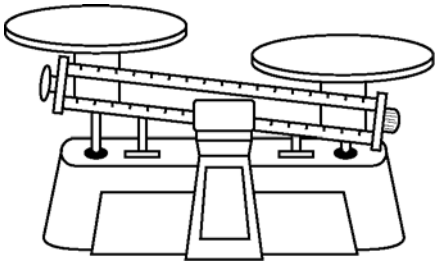
(2) Move the riders to zero.

(3) If the pointer does not read zero, rotate the adjustment knob until it does.

(4) _____ .

(5) _____ .

(6) _____ .



Which of the following should be steps 4, 5 and 6 in these instructions?

A. (4) Place the dry chemical on the balance
(5) Add counterweights until the pointer reads zero
(6) Read the mass of the chemical from the measurement bar

B. (4) Measure the mass of a watch glass
(5) Place the dry chemical on the watch glass and measure the combined mass
(6) Subtract the mass of the watch glass from the combined mass to find the mass of the chemical

C. (4) Place the dry chemical on the balance
(5) Rotate the adjustment knob until the pointer reads zero
(6) Read the mass of the chemical from the measurement bar

D. (4) Place a watch glass on the balance
(5) Move the riders to balance the beam
(6) Place the dry chemical on the watch glass and re-adjust the riders until the beam is again balanced

COMPETENCY 002

3. The table below lists measurement tasks included in laboratory activities conducted by students in a middle school science class. Which line of the table matches a measurement activity with the correct measurement tools?

Line	Measurement Activity	Tools Provided
1	Add 5 g of salt to 250 mL of water and stir.	triple-beam balance, 25 mL capacity beaker marked in 1 mL intervals
2	Add 15 mL of rubbing alcohol to 50 mL of water.	250 mL capacity Erlenmeyer flask marked in 50 mL intervals
3	Add 2 mL of peppermint oil to 8 g of powdered sugar.	5 mL capacity pipette marked in 1 mL intervals, pan balance with masses, petri dish
4	Add 20 g of sugar to 10 mL of water and heat until the sugar dissolves.	100 mL capacity graduated cylinder marked in 25 mL intervals, spring scale, mortar

A. Line 1

B. Line 2

C. Line 3

D. Line 4

COMPETENCY 004

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

At the beginning of the year, students in a middle school science class are given the following form, outlining a problem analysis procedure.

Problem Analysis Form

1. What is the problem? _____

_____

2. What are the causes of this problem? _____

_____

3. What are the effects of this problem? _____

_____

4. How could this problem be solved? _____

_____

After students have become familiar with the problem analysis procedure, they work in small groups to use the procedure to explore information in several research papers on global warming. Each paper presents a different perspective on the problem, its causes, its effects and possible solutions. Groups then share and discuss what they have discovered and are surprised to find that the papers present so many different perspectives. This activity is best for helping students recognize that

A. science has few absolute answers to the world's problems.

B. making new scientific discoveries requires interaction among many different scientific disciplines.

C. new scientific theories must be tested before they are accepted.

D. scientists cannot draw conclusions about a phenomenon until they have observed it many times.

COMPETENCY 005

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

Earth Science	Biology	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.	A person who travels rapidly from low altitude to altitudes above 10,000 feet often hyperventilates in an attempt to compensate for the reduced amount of oxygen in the air. If this response does not provide enough oxygen to the body, muscle fatigue, light-headedness, nausea, and irritability can occur.	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 the Earth's magnetic field to cause intensified displays of the *aurora borealis.*

Which of the following unifying concepts in science is 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

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

More than half of the world's population cooks and heats with biomass fuels: wood, dung or crop wastes. Such fuels are inexpensive and available in remote rural locations, but they produce smoke containing large amounts of soot and cancer-causing agents. Research in the United States and Zimbabwe suggests that people could improve their health and their cooking efficiency by using roots and gourds as fuels instead of other types of biomass. The roots and gourds, which are native to and grow well in arid climates, ignite more easily than other biomass fuels and give off virtually no smoke. This cleaner burning is a result of more thorough and efficient combustion. More efficient burning means people burn fewer roots and gourds than they do other fuels.

COMPETENCY 003

6. Scientists could best test the hypothesis of improved health by

   A. comparing a population that uses roots and gourds with a similar population that uses other biomass fuels.

   B. developing a computer simulation to compare the burning processes of roots and gourds with those of other biomass fuels.

   C. analyzing the chemical structure of roots and gourds to determine what features cause them to burn more cleanly.

   D. analyzing the efficiency of roots and gourds as a fuel by comparing their masses before and after burning.

COMPETENCY 016

7. Based on current theories about the effects of human activities on the environment, and assuming the research results described in the passage are correct, it is most likely that a worldwide switch from traditional biomass fuels to the roots and gourds in the study would

   A. slow global warming due to reduced emission of greenhouse gases.

   B. rebuild the ozone layer by reducing hydrocarbon emissions.

   C. increase water pollution due to increased fertilization of farm land.

   D. worsen acid rain problems by increasing reliance on biomass fuels.

COMPETENCY 007

8. **Use the passage below to answer the question that follows.**

Scientists long thought that the element carbon existed in only two pure forms, graphite and diamond. Graphite, the soft, black substance used in pencils, is formed of loosely linked chains of carbon atoms. Diamonds are very hard crystals of closely packed carbon atoms. Recently, however, scientists discovered a new form of pure carbon they dubbed *buckminsterfullerenes*, or *buckyballs*. Buckyballs are hollow, spherical cages of carbon atoms that have very different properties than either graphite or diamond.

This passage best illustrates the relationship between the

A. number of isotopes of an element and the ways in which that element can be used.

B. length of the atomic bonds in a substance and the strength of those bonds.

C. the arrangement of atoms in different forms of a pure element and the properties of those forms.

D. abundance of an element in nature and the number of compounds that can be formed by that element.

COMPETENCY 008

9. Which of the following lines correctly matches a type of chemical bond with a description of some of its characteristics?

Line	Bond Type	Bond Characteristics
1	Hydrogen	a strong bond in which two atoms of hydrogen share a single electron
2	Ionic	a weak bond in which atoms become charged by the loss or gain of protons in their nuclei
3	Covalent	a strong bond in which atoms share paired electrons
4	Metallic	a weak bond in which atoms of metals are held together by the mutual attraction of their nuclei

A. Line 1

B. Line 2

C. Line 3

D. Line 4

COMPETENCY 008

10. Which of the following equations is balanced?

A. $CaBr_2 + Na_2CO_3 \rightarrow 2\ CaCO_3 + NaBr$

B. $CaBr_2 + Na_2CO_3 \rightarrow CaCO_3 + 2\ NaBr$

C. $CaBr_2 + Na_2CO_3 \rightarrow 2\ CaCO_3 + 2\ NaBr$

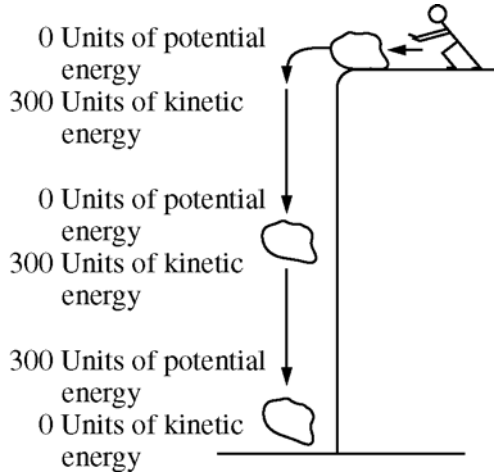
D. $CaBr_2 + Na_2CO_3 \rightarrow CaCO_3 + NaBr$

COMPETENCY 009

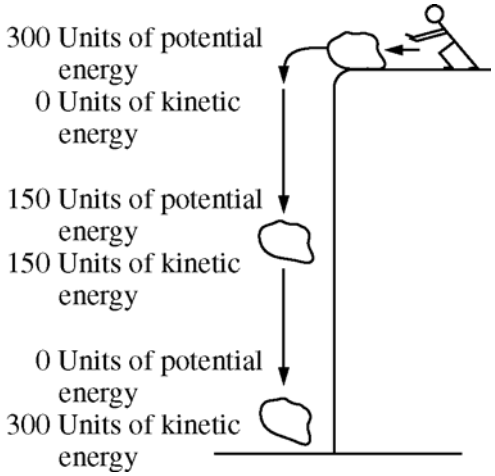
11. A boulder at the top of a cliff has 300 units of energy. A person pushes the boulder over the edge. Which of the following diagrams correctly shows how much total kinetic and potential energy the boulder has

- at the top of the cliff just before it goes over the edge,
- halfway to the bottom, and
- just before hitting the ground?

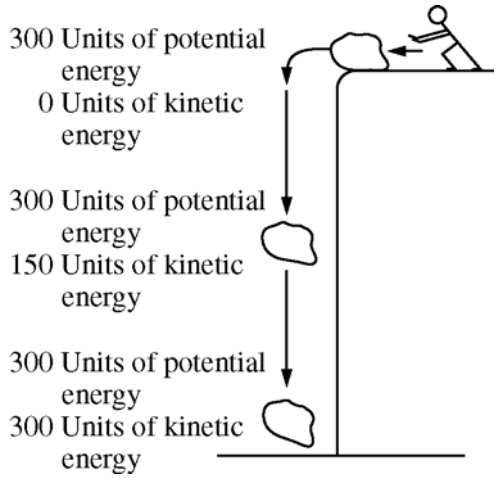
A.



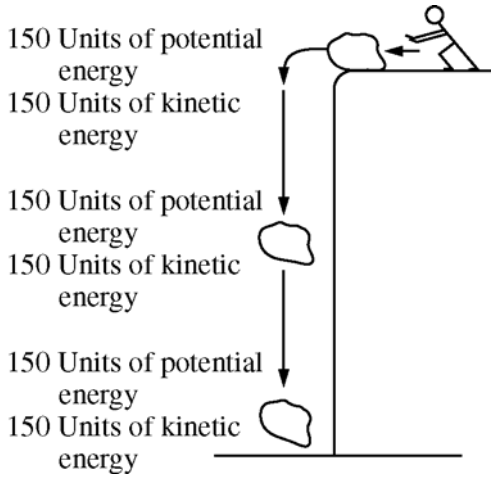
C.



B.



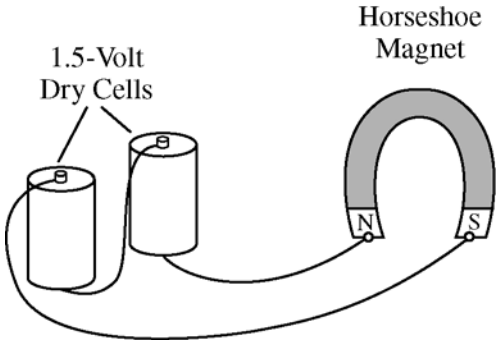
D.



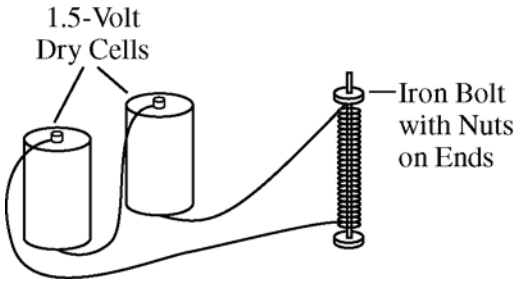
COMPETENCY 009

12. Which of the following shows a correct method for using shielded copper wire to construct an electromagnet?

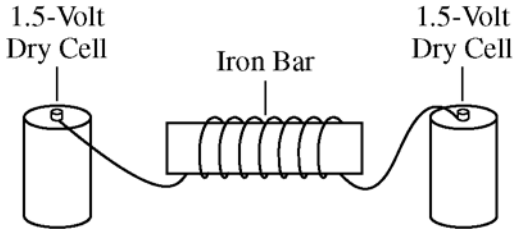
A.



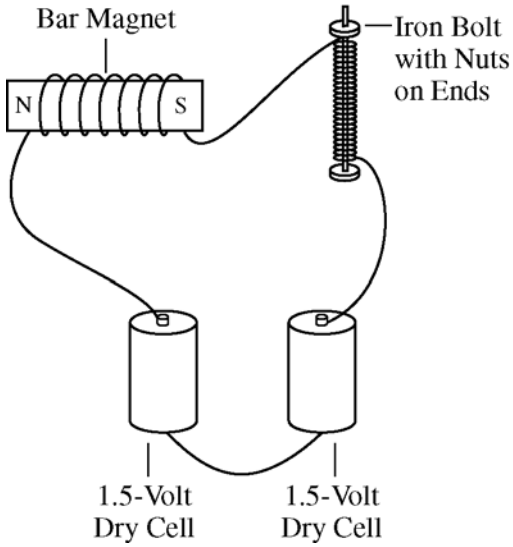
B.



C.

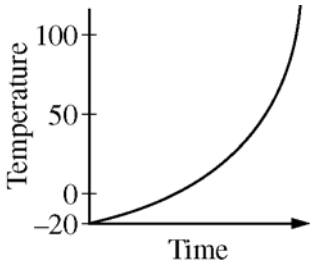


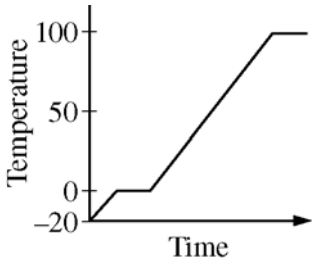
D.

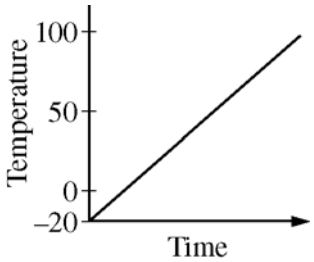


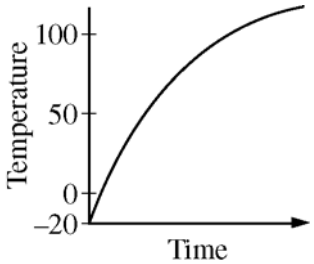
COMPETENCY 010

13. A student fills a beaker with ice and places it on a hot plate. As the ice melts, the temperature (degrees Celsius) of the ice water mixture is recorded at fifteen-second intervals. The temperature is then graphed with respect to time. Which of the following graphs is most likely to result from this experiment?

A.


B.


C.


D.


COMPETENCY 010

14. A bottle of juice is submerged in a lake. The temperature of the lake water is a few degrees warmer than that of the bottle of juice. According to the second law of thermodynamics, which of the following statements is true?

A. Heat will flow from the bottle of juice to the lake until the two are at the same temperature

B. Heat will flow from the bottle of juice to the lake until the bottle is cooler than the lake

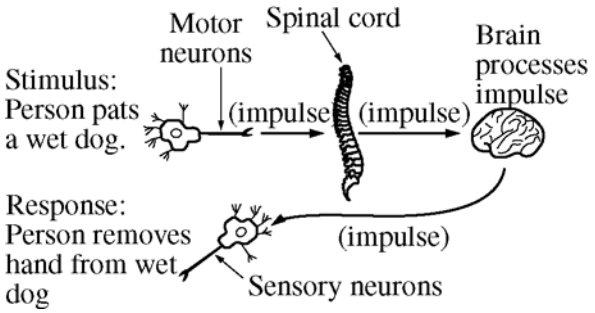
C. Heat will flow from the lake to the bottle of juice until the two are at the same temperature

D. Heat will flow from the lake to the bottle of juice until the bottle is warmer than the lake

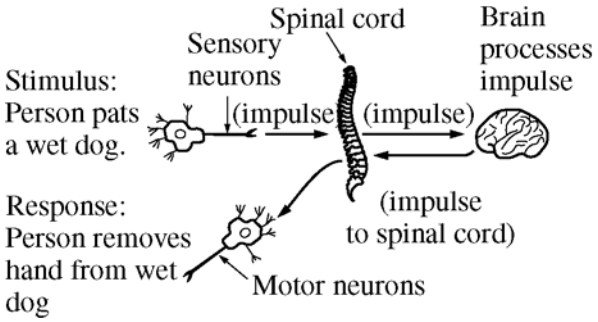
COMPETENCY 011

15. A teacher wants to prepare a model to illustrate the operation of the human nervous system. Which of the following models is most accurate?

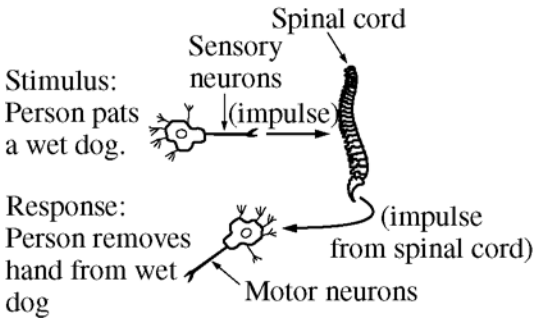
A.



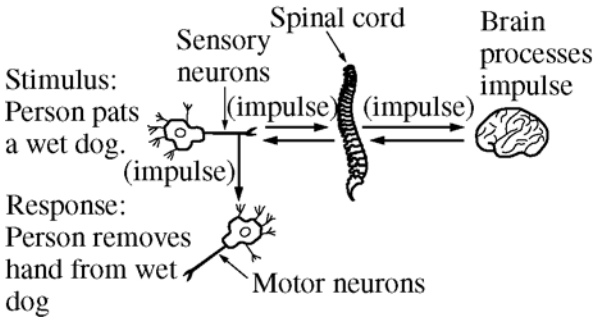
B.



C.



D.



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

Students in a science class cross-pollinate potato plant A with potato plant B. The resulting seeds are collected and planted as plot I. The class also cuts several eyes from potatoes harvested from potato plant A and plants them as plot II.

COMPETENCY 012

16. Which of the following statements best describes the type of reproduction used to produce offspring in plot I and plot II?

    A. Potato plants in plot I are produced by sexual reproduction, and potato plants in plot II are produced by asexual reproduction

    B. Potato plants in plot I are produced by asexual reproduction, and potato plants in plot II are produced by sexual reproduction

    C. The potato plants in both plot I and plot II are produced by asexual reproduction

    D. The potato plants in both plot I and plot II are produced by sexual reproduction

COMPETENCY 012

17. Which of the following statements about the genetic makeup of the potato plants grown by the class is most accurate?

    A. All potato plants grown from seeds (plot I) will be genetically identical to each other but different from both potato plant A and potato plant B

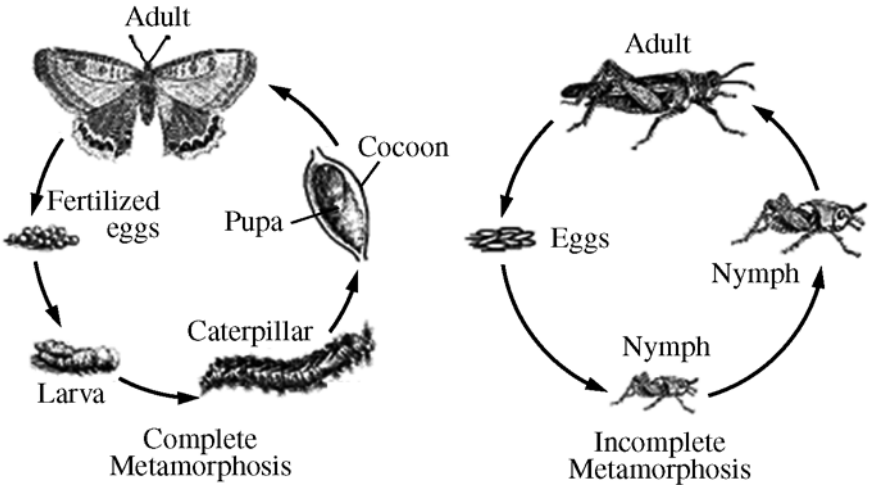
    B. All potato plants grown from seeds (plot I) will have half as many chromosomes as do the potato plants grown from potato pieces (plot II)

    C. All potato plants grown from potato pieces (plot II) will be genetically identical to potato plant A

    D. All potato plants grown from potato pieces (plot II) will have half as many chromosomes as do the potato plants grown from seeds (plot I)

COMPETENCY 013

18. **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

COMPETENCY 013

19. 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 014

20. When a person is confronted with a dangerous situation, the adrenal medulla secretes epinephrine (adrenaline), which triggers a "fight or flight" response. Which line in the table below most accurately summarizes some of the physiological changes characteristic of this response?

Line	Physiological Changes
1	*Increases*: heart rate; force of contraction of heart; blood flow to muscles, heart, brain, and viscera *Decreases*: respiratory rate; blood sugar level; rate of digestion
2	*Increases*: heart rate; respiratory rate; force of contraction of heart; blood flow to muscles *Decreases*: blood flow to heart, viscera, and brain; blood sugar level; rate of digestion
3	*Increases*: blood flow to muscles and viscera; rate of digestion; blood sugar level *Decreases*: heart rate; respiratory rate; force of contraction of heart; blood flow to heart and brain
4	*Increases*: heart rate; respiratory rate; force of contraction of heart; blood flow to muscles, heart, and brain; blood sugar level *Decreases*: blood flow to viscera; rate of digestion

A. Line 1

B. Line 2

C. Line 3

D. Line 4

COMPETENCY 014

21. A middle school science teacher presents the following model to students.

> As you probably know, escalators are moving stairs. Imagine a person walking up an escalator that is going down. If the person walks up at the same speed as the escalator is moving down, she will remain in one spot. If she walks faster than the escalator, she moves up. If she walks slower, the escalator carries her down.

This model would be most appropriate for helping students discover which of the following science concepts?

A. Newton's law relating gravity to mass and distance

B. The process of erosion due to flowing water

C. The process of maintaining homeostasis in the human body

D. The energy changes that occur during photosynthesis

COMPETENCY 015

22. 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 trees 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 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 seeds of hardwoods in abandoned fields. The slow influx of hardwood seeds eventually allows these species to overtake the pines.

COMPETENCY 015

23. Which of the following changes in an ecosystem would most likely lead to an increase in the population of a given plant species?

    A. An increase in herbivory of that species

    B. An increase in intraspecific competition for space

    C. A decrease in the population of a species occupying a similar niche

    D. A decrease in the population of a major insect pollinator

COMPETENCY 016

24. Which of the following is the most significant cause of the spread of deserts in arid regions of the Earth?

    A. Construction of large hydroelectric projects to generate electricity

    B. Diversion of underground water sources to supply cities and towns

    C. Use of surface water to provide intensive irrigation for agriculture

    D. Removal of native vegetation due to overgrazing and farming

COMPETENCY 017

25. **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 017

26. As part of its plan for reducing greenhouse gases in the atmosphere, the U.S. government has called for the planting of millions of fast-growing trees. The primary goal of this program is to reduce atmospheric carbon dioxide. Based on current understanding of the Earth's oxygen-carbon dioxide cycle, which of the following is the best analysis of the likely long-term effectiveness of this program?

    A. The trees will remove carbon from the soil during growth, which will permanently increase the soil's ability to absorb atmospheric carbon dioxide

    B. The trees will remove carbon dioxide from the air during photosynthesis, but some of that carbon dioxide will later be returned to the atmosphere after the trees die and decompose

    C. The trees will remove some carbon dioxide from the air during photosynthesis, but will release more carbon dioxide during transpiration

    D. The trees will remove both carbon dioxide and oxygen from the air, so the ratio of these two gases will remain constant

COMPETENCY 018

27. Under which of the following conditions are thunderstorms most likely to form?

    A. Two fronts meet and prevent each other from moving

    B. Heavy, moist air overtakes light, dry air, causing the lighter air to sink rapidly toward the ground

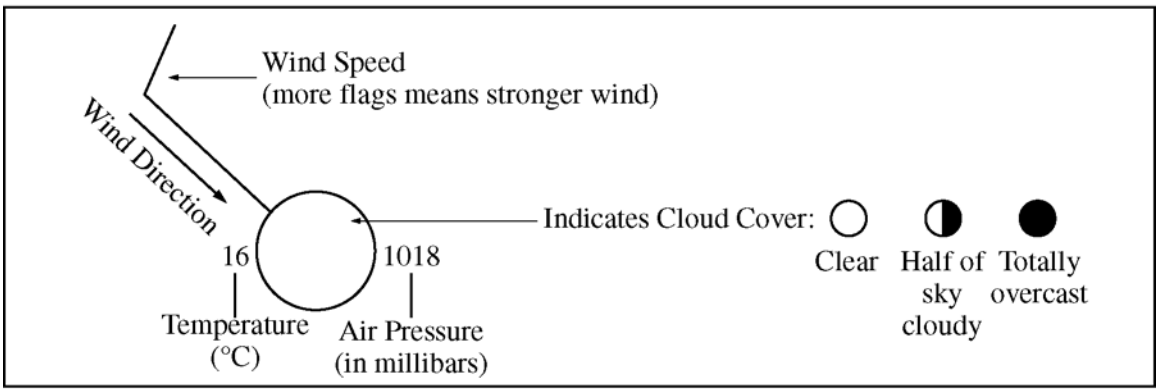
    C. Warm air meets a stationary front and causes it to begin rapidly advancing

    D. A fast-moving cold front enters an area in which there is a warm, humid air mass

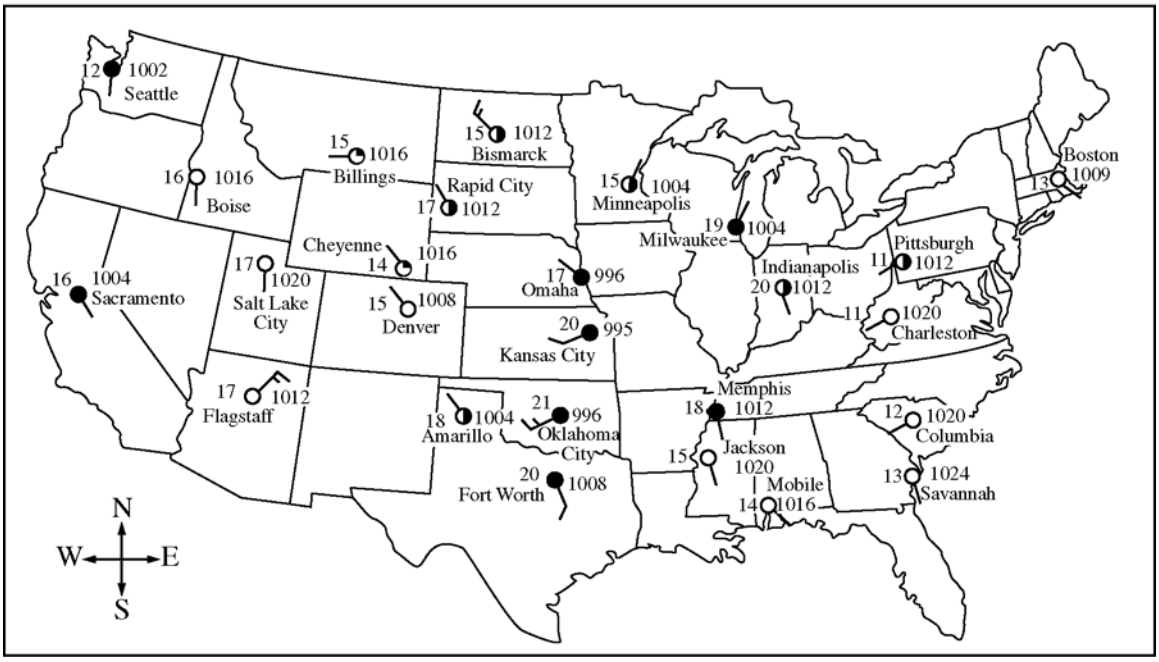
COMPETENCY 018

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

Weather Symbol Chart



Weather Conditions Map



Based on the information in the map, which of the following weather conditions is most likely to exist at the locations specified?

A. Denver, Colorado, is having showers and light winds out of the southeast

B. Kansas City, Kansas, is having periods of rain with a breeze out of the southwest

C. Columbia, South Carolina, is having heavy rain and very strong winds

D. Fort Worth, Texas, is having an overcast and hot day, with strong winds out of the northwest

COMPETENCY 019

29. 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 021

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

In a unit on the solar system, a science teacher uses a beach ball to represent the Sun while the students brainstorm everyday objects that are the right relative sizes to represent the planets. Next, the class determines how many meters are required in their model to represent accurately the relative distance between each planet and the Sun, based on actual distances in the solar system. Finally, the class sets up its model in the area around the school by measuring distances and placing the beach ball and the objects representing the planets around the school grounds in the correct relative positions.

The activities described in the passage are effective for communicating information about the solar system primarily because they provide students with

A. an opportunity to re-create the process by which Kepler derived the laws of planetary motion.

B. a conceptual model of the effects that the movement of other planets has on the motion of the Earth.

C. a framework for understanding processes involved in the formation and evolution of the solar system.

D. a concrete way of visualizing abstract ideas about the relationships among the planets in the solar system.

COMPETENCY 021

31. A science teacher wants to build students' ability to use scientific reasoning and procedures in classifying living things. Of the following, the best activity for achieving this goal is to

    A. discuss mechanisms of evolution and how the evolutionary process leads to adaptation of species to their environments.

    B. dissect preserved specimens of two closely related insect species and discuss morphological differences between them.

    C. compare the similarities and differences of living and fossil specimens of related insect species.

    D. examine a wide variety of living things and organize them into groups according to criteria established by the class.

COMPETENCY 022

32. 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 could the teacher use to help students understand the concept of developing a scientific hypothesis?

    A. Have students brainstorm possible reasons for why the pond no longer supports a fish population

    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 see if a trend emerges

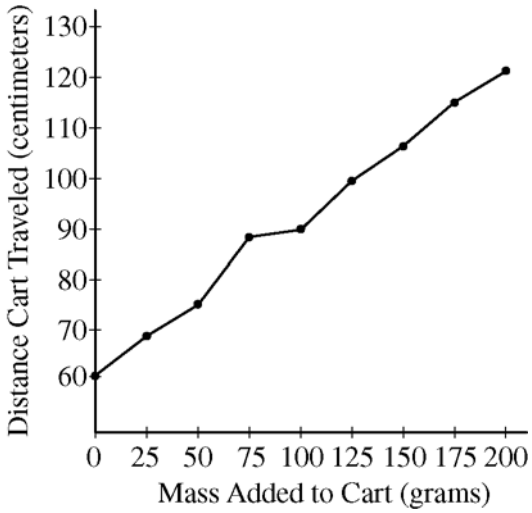
    D. Ask students to use the Internet to find a method for measuring the oxygen content of the water in the pond

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

A group of fifth-grade students wishes to test the hypothesis that adding mass to a cart rolled down a ramp will increase the distance the cart will travel along the floor. To do this, they design and carry out the following experiment using a toy cart with a mass of 200 grams, a small ramp and a supply of 25 gram masses.

1. Make a line across the ramp near the top.
2. Line up the front wheels of the cart with the line.
3. Let go of the cart without pushing it.
4. When the cart stops, measure the distance from the bottom of the ramp to the place where the front wheels stopped. Write down this distance.
5. Add a 25 gram mass to the cart.
6. Repeat until a total of 200 grams has been added to the cart.

To see more clearly the relationship between the amount of mass added to the cart and the distance the cart travels, the students graph their results. Their graph is shown below.



COMPETENCY 003

33. The students are concerned about the measurement they obtained when 75 grams were added to the cart because it did not seem to fit into the pattern created by the other results. They would like to repeat the investigation to determine whether this distance is correct. To improve their investigative design and to obtain more reliable results, the students should

    A. measure the total distance the cart traveled from the top of the ramp to where it stopped.

    B. have two students measure independently the distance the cart traveled.

    C. change the height on the ramp at which the cart is released.

    D. release the cart several times with each mass and use the average distance traveled at each mass.

COMPETENCY 006

34. The results of this experiment best illustrate which of the following physical principles?

    A. An object with more mass has a greater force of friction acting on it than one with less mass

    B. A moving object with more mass has greater momentum than one with less mass

    C. An object with less mass requires less force to start it moving than one with more mass

    D. An object with less mass exerts less downward force on a level surface than an object with more mass

COMPETENCY 022

35. The teacher wants to help her students understand the role of variables in scientific experiments. Which of the following would be the most effective way to introduce this topic in the context of this experiment?

    A. Ask the students to describe as precisely as they can how the movement of the cart changed as more mass was added to it

    B. Ask the students to identify what factors stayed the same during the experiment, what factors changed and what results the changes produced

    C. Ask the students to predict what their results would have been if they had changed the slope of the ramp instead of the mass of the cart with each trial

    D. Ask the students to suggest other experimental designs that could be used to demonstrate the same principle that was discovered in this experiment

COMPETENCY 023

36. An appropriate way to assess the students' ability to draw conclusions based on these experimental data would be to have the students

    A. predict the distance the cart would travel if 250 grams were added.

    B. determine how much farther the cart traveled with 200 grams than with 100 grams.

    C. use a graphing calculator to determine the linear regression line that best fits the data.

    D. describe what the graph would look like if the divisions on the vertical axis were spaced farther apart.

COMPETENCY 023

37. **Use the student expectation below from the Texas Essential Knowledge and Skills (TEKS) 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

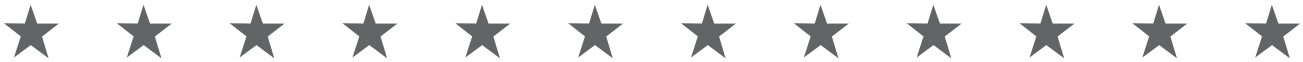
D. A performance assessment, in which students use tools to measure the attributes of various objects at measurement stations located throughout the classroom

ANSWER KEY

Question Number	Correct Answer	Competency
1	C	001
2	B	002
3	C	002
4	A	004
5	B	005
6	A	003
7	A	016
8	C	007
9	C	008
10	B	008
11	C	009
12	B	009
13	B	010
14	C	010
15	B	011
16	A	012
17	C	012
18	D	013
19	A	013
20	D	014
21	C	014
22	B	015
23	C	015
24	D	016
25	B	017
26	B	017
27	D	018
28	B	018
29	C	019
30	D	021
31	D	021
32	A	022
33	D	003
34	B	006
35	B	022
36	A	023
37	D	023

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

Science and Children, National Science Teachers Association.

Science Scope, National Science Teachers Association.

The Science Teacher, National Science Teachers Association.

Texas Science Teacher, Science Teachers Association of Texas.

OTHER RESOURCES

Arons, A. B. (1997). *Teaching Introductory Physics*. Wiley.

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Center for Science, Mathematics, and Engineering Education, National Research Council. (2000). *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning.* Washington, District of Columbia: National Academy Press.

Chang, R. (2010). *Chemistry*, Tenth Edition. McGraw-Hill.

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Joyce, B. R., Weil, M., and Calhoun, E. (2003). *Models of Teaching*, Seventh Edition. Allyn & Bacon.

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Serway, R. A., Vuille, C., and Faughn, J. S. (2009). *College Physics*, Eighth Edition. Brooks Cole.

Starr, C., Taggart, R., and Evers, C. (2009). *Biology: The Unity and Diversity of Life*, Twelfth Edition. Brooks Cole.

Tarbuck, E. J., Lutgens, F. K., and Tasa, D. (2007). *Earth: An Introduction to Physical Geology*, Ninth Edition. Prentice-Hall.

Texas Education Agency. (2010). *Texas Essential Knowledge and Skills (TEKS)*.

Texas Education Agency. (2010). *Texas Safety Standards: Kindergarten through Grade 12*, Fourth Edition.

Thompson, G., and Turk, J. (2009). *Earth Science and the Environment*, Fourth Edition. Brooks Cole.

Whitten, K. W., Davis, R. E., Peck, L., and Stanley, G. G. (2006). *General Chemistry*, Eighth Edition. Brooks Cole.

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

86315-86315 • S211E.1 • Printed in U.S.A.
760117