STATE BOARD FOR EDUCATOR CERTIFICATION/TEXAS EDUCATION AGENCY

TEXAS EDUCATOR CERTIFICATION

TExES/ExCET | TOPT | TExMaT | TASC/TASC-ASL

TExMaT | Texas Examinations for Master Teachers

Preparation Manual

091 Master Science Teacher 4–8

PREFACE

The Texas Examinations for Master Teachers® (TExMaT®) program has its origins in legislation passed in 1999 (House Bill 2307) that required the creation of the Master Reading Teacher (MRT) Certificate, the development of standards for the certificate, and the development of a Master Reading Teacher examination. In 2001, the Texas legislature passed legislation creating two additional categories of Master Teacher Certificates, the Master Mathematics Teacher (three certificates: Early Childhood–Grade 4, Grades 4–8, and Grades 8–12) and Master Technology Teacher (Early Childhood–Grade 12).

The Master Science Teacher (MST) Certificate originated with the Texas Science Initiative, which calls for the development of a cadre of science experts in Texas public schools who can teach science and mentor other teachers in best practices for science instruction. The MST Certificate was created by the Texas legislature in 2003 as part of the state's new focus on improving student achievement in the core area of science. Three levels of Master Science Teacher Certificates were established: Early Childhood–Grade 4, Grades 4–8, and Grades 8–12.

A Master Science Teacher Certificate may be obtained by individuals who:

- hold a teaching certificate,
- have at least three years of teaching experience,
- complete an SBEC-approved Master Science Teacher preparation program, AND
- pass the TExMaT Master Science Teacher EC–4, 4–8, *or* 8–12 certification examination.

The development of the educator standards for the Master Science Teacher Certificates was completed in August 2004. The first SBEC-approved Master Science Teacher preparation programs became available in early 2005. The TExMaT Master Science Teacher certification examinations are scheduled to be implemented in Spring 2006.

This manual is designed to help examinees prepare for the new Master Science Teacher 4–8 test. Its purpose is to familiarize examinees with the competencies to be tested, test item formats, and pertinent study resources. Educator preparation program staff may also find this information useful as they help examinees prepare for careers as Texas Master Teachers.

More information about the new TExMaT tests and the educator standards can be found at http://www.sbec.state.tx.us.

KEY FEATURES OF THE MANUAL

List of competencies that will be tested

Strategies for answering test questions

Sample test items and answer key

TABLE OF CONTENTS

SECTION I

THE NEW TExMaT TESTS FOR MASTER TEACHERS

Successful performance on the TExMaT examination is required for the issuance of a Texas Master Teacher certificate. Each TExMaT test is a criterion-referenced examination designed to measure the knowledge and skills delineated in the corresponding TExMaT test framework. Each test framework is based on standards that were developed by Texas educators and other education stakeholders.

Each newly developed TExMaT test is designed to measure the requisite knowledge and skills that an initially-certified Texas Master Teacher in this field in Texas public schools must possess. This test includes both individual, or stand-alone, test items (questions) and a case study assignment for which candidates will construct a written response.

Development of the New TExMaT Tests

Committees of Texas educators and interested citizens guide the development of the new TExMaT tests by participating in each stage of the test development process. These working committees are comprised of Texas educators from public and charter schools, faculty from educator preparation programs, 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 TExMaT tests are described below.

1. **Develop Standards.** Committees are convened to recommend what an initially-certified Master Teacher in this field should know and be able to do. To ensure vertical alignment of standards across the range of instructional levels, individuals with expertise in early childhood, elementary, middle, or high school education meet jointly to articulate the critical knowledge and skills for a particular content area. Participants begin their dialogue using a "clean slate" approach with the Texas Essential Knowledge and Skills (TEKS) as the focal point. Draft standards are written to incorporate the TEKS and to expand upon that content to ensure that an initially-certified Master Teacher in this field possesses the appropriate level of both knowledge and skills to instruct successfully.
2. **Review Standards.** Committees review and revise the draft standards. The revised draft standards are then placed on the SBEC Web site 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.
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 TExMaT tests. The TExMaT competencies represent the critical components of the standards that can be measured with either a paper-and-pencil-based or a computer-based examination, as appropriate. 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 a Master Teacher 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 Items.** The test contractor develops draft items (multiple-choice items and case study assignments) that are designed to measure the competencies described in the test framework. Committees review the newly developed test items that have been written to reflect the competencies in the new test frameworks. Committee members scrutinize the draft items 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 Items.** All of the newly developed test items that have been deemed acceptable by the item 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 items are valid, reliable, and free from bias.
8. **Administer New TExMaT Tests.** New TExMaT 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 TExMaT test and to recommend a final passing standard for that test. The SBEC considers this recommendation as it establishes a passing score on the test.

Taking the TExMaT Master Science Teacher Test and Receiving Scores

Please refer to the current TExMaT registration bulletin for information on test dates, sites, fees, registration procedures, and policies.

You will be mailed a score report approximately four weeks after each test you take. 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 items answered correctly and is not determined by averaging the number of questions answered correctly in each domain.
  - — For all TExMaT 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 a Master Teacher in this field in Texas public schools.
- a holistic score for your response to the case study assignment.
- 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.
- information to help you understand the score scale and interpret your results.

You will <u>not</u> receive a score report if you are absent or choose to cancel your score.

Additionally, unofficial score report information will be posted on the Internet on the score report date for each test administration. Information about receiving unofficial scores on the Internet, the score scale, and other score report topics may be found on the SBEC Web site at www.sbec.state.tx.us.

Educator Standards

Complete, approved educator standards are posted on the SBEC Web site at www.sbec.state.tx.us.

SECTION II

USING THE TEST FRAMEWORK

The Texas Examinations for Master Teachers (TExMaT) test measures the content and professional knowledge required of an initially-certified Master Teacher in this 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.

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 items that are included in this manual. These test questions represent only a *sample* of items. Thus, your test preparation should focus on the complete content eligible for testing, as specified in the competencies and descriptive statements.

Organization of the TExMaT 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 initially-certified Master Teacher in this field 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 8. These are then 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 on the next page.

Sample Competency and Descriptive Statements

Master Science Teacher 4–8

Competency:

The Master Science Teacher 4–8 understands the historical perspectives of science and how science interacts with and influences personal and societal decisions.

Descriptive Statements:

The Master Science Teacher:

- Demonstrates an understanding of the historical development of science and scientific knowledge.
- Analyzes the significance of key scientific and technological advances.
- Recognizes the contributions that diverse cultures and individuals have made to scientific knowledge and designs science instruction that is inclusive and accounts for these contributions.
- Analyzes how personal or societal needs and priorities can affect the direction, support, and applications of scientific research.
- Demonstrates an understanding of the role science can play in helping cause and/or resolve personal, societal, and global challenges.
- Knows how to apply scientific principles, the theory of probability, and the principles of risk-benefit analysis to analyze the advantages, disadvantages, or alternatives to a given decision or course of action.
- Recognizes how learning science enables students to function in an increasingly complex society.

Studying for the TExMaT Test

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

1. Identify the information the test will cover by reading through the test competencies (see the following pages in this section). *Within each domain* of this TExMaT 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 for possible resources to consult. Also, compile key materials from your preparation coursework that are aligned with the competencies.

4. Study this manual for approaches to taking the TExMaT test.

5. When using resources, concentrate on the key ideas and important concepts that are discussed in the competencies and descriptive statements.

NOTE: This preparation manual is the only TExMaT test study material endorsed by the SBEC for this field. Other preparation materials may not accurately reflect the content of the test or the policies and procedures of the TExMaT program.

Domain I ***Physical Science (approximately 18% of the test)***

Standards Assessed:

Master Science Teacher Standard I:
Content: The Master Science Teacher knows and understands and is able to mentor the teaching of the Texas Essential Knowledge and Skills (TEKS) in science.

Master Science Teacher Standard III:
Scientific Inquiry: The Master Science Teacher understands, applies knowledge of, and guides others to understand processes of scientific inquiry and the role of inquiry in science learning and teaching.

Master Science Teacher Standard V:
Safety: The Master Science Teacher understands, implements, models, and advocates: safe classroom, field, and laboratory experiences; safe use of equipment and technology; and ethical use of organisms and specimens and guides others to do the same.

Master Science Teacher Standard VI:
Inclusive Instruction: The Master Science Teacher uses and guides others to use a variety of instructional strategies and resources to meet the diverse needs of all learners.

Domain II ***Life Science (approximately 18% of the test)***

Standards Assessed:

Master Science Teacher Standard I:
Content: The Master Science Teacher knows and understands and is able to mentor the teaching of the Texas Essential Knowledge and Skills (TEKS) in science.

Master Science Teacher Standard III:
Scientific Inquiry: The Master Science Teacher understands, applies knowledge of, and guides others to understand processes of scientific inquiry and the role of inquiry in science learning and teaching.

Master Science Teacher Standard V:
Safety: The Master Science Teacher understands, implements, models, and advocates: safe classroom, field, and laboratory experiences; safe use of equipment and technology; and ethical use of organisms and specimens and guides others to do the same.

Master Science Teacher Standard VI:
Inclusive Instruction: The Master Science Teacher uses and guides others to use a variety of instructional strategies and resources to meet the diverse needs of all learners.

Domain III ***Earth and Space Science (approximately 18% of the test)***

Standards Assessed:

Master Science Teacher Standard I:
Content: The Master Science Teacher knows and understands and is able to mentor the teaching of the Texas Essential Knowledge and Skills (TEKS) in science.

Master Science Teacher Standard III:
Scientific Inquiry: The Master Science Teacher understands, applies knowledge of, and guides others to understand processes of scientific inquiry and the role of inquiry in science learning and teaching.

Master Science Teacher Standard V:
Safety: The Master Science Teacher understands, implements, models, and advocates: safe classroom, field, and laboratory experiences; safe use of equipment and technology; and ethical use of organisms and specimens and guides others to do the same.

Master Science Teacher Standard VI:
Inclusive Instruction: The Master Science Teacher uses and guides others to use a variety of instructional strategies and resources to meet the diverse needs of all learners.

Domain IV ***The History, Nature, and Context of Science; Scientific Inquiry; and Safety (approximately 18% of the test)***

Standards Assessed:

Master Science Teacher Standard I:
Content: The Master Science Teacher knows and understands and is able to mentor the teaching of the Texas Essential Knowledge and Skills (TEKS) in science.

Master Science Teacher Standard II:
History, Nature, and Context of Science: The Master Science Teacher understands, applies knowledge of, and guides others to understand the historical perspectives of science, the nature of science, and how science interacts with and influences personal and societal decisions.

Master Science Teacher Standard III:
Scientific Inquiry: The Master Science Teacher understands, applies knowledge of, and guides others to understand processes of scientific inquiry and the role of inquiry in science learning and teaching.

Master Science Teacher Standard V:
Safety: The Master Science Teacher understands, implements, models, and advocates: safe classroom, field, and laboratory experiences; safe use of equipment and technology; and ethical use of organisms and specimens and guides others to do the same.

Domain V ***Alignment and Integration, Instruction, and Assessment (approximately 14% of the test)***

Standards Assessed:

Master Science Teacher Standard IV:
Alignment and Integration: The Master Science Teacher understands, applies knowledge of, and guides others to understand the Texas Essential Knowledge and Skills (TEKS) and the national science standards and knows the importance of vertical alignment of the TEKS and integration of the science disciplines with one another and with other disciplines.

Master Science Teacher Standard VI:
Inclusive Instruction: The Master Science Teacher uses and guides others to use a variety of instructional strategies and resources to meet the diverse needs of all learners.

Master Science Teacher Standard VIII:
Student Assessment: The Master Science Teacher collaborates to select, construct, and administer aligned assessments, analyzes the results to modify instruction to improve student achievement, and develops those skills in others.

Domain VI ***The Learning and Teaching Environment, Mentoring, and Shared Leadership (approximately 14% of the test)***

Standards Assessed:

Master Science Teacher Standard VII:
Learning and Teaching Environment: The Master Science Teacher demonstrates and promotes a positive attitude, high expectations, passion, and enthusiasm for science learning and teaching.

Master Science Teacher Standard IX:
Mentoring and Shared Leadership: The Master Science Teacher facilitates standards-based science instruction by: communicating and collaborating with educational stakeholders; exhibiting leadership, mentoring, coaching, and consulting with colleagues; facilitating professional development; and making decisions based on research.

DOMAIN I—PHYSICAL SCIENCE

Competency 001 (Properties of Matter) Standard I

The Master Science Teacher 4–8 understands the physical and chemical properties of matter.

The Master Science Teacher:

- Analyzes physical and chemical changes, including changes in state, and factors that affect chemical reactions.
- Recognizes characteristics and applications of various types of reactions (e.g., oxidation-reduction, acid-base).
- Understands the characteristics of and differences between elements, compounds, mixtures, and solutions.
- Applies the law of conservation of matter to analyze a variety of situations.
- Understands the behavior of gases.
- Understands atomic and molecular structures and relates them to the organization of the periodic table and the behavior of different elements.
- Analyzes the role of different kinds of chemical bonds and intermolecular forces in forming compounds and determining the properties of substances.
- Interprets chemical formulas and equations.

Competency 002 (Force and Motion) Standard I

The Master Science Teacher 4–8 understands the concepts of and relationship between force and motion.

The Master Science Teacher:

- Understands Newton's laws and the law of universal gravitation.
- Analyzes changes in the position and motion of objects subjected to an unbalanced force.
- Applies knowledge of the relationship between force and motion to analyze common objects, simple machines, and everyday situations.
- Recognizes factors affecting the motion of an object (e.g., friction, velocity, acceleration, inertial mass, momentum).
- Interprets changes in position of an object depicted graphically.

Competency 003 (Energy and Energy Transformations) Standard I

The Master Science Teacher 4–8 understands forms of energy and energy transformations.

The Master Science Teacher:

- Analyzes the transfer of energy in a variety of situations and devices (e.g., production of heat, light, sound, and magnetic effects by electrical energy; the process of photosynthesis; weather processes).
- Applies the law of conservation of energy to analyze a variety of phenomena (e.g., specific heat, chemical and nuclear reactions, efficiency of simple machines).
- Understands the principles of electricity and magnetism.
- Applies properties and characteristics of waves to analyze sound, light, and other wave phenomena.
- Understands the characteristics of the electromagnetic spectrum.

Competency 004 (Strategies, Resources, and Equipment) Standards III, V, and VI

The Master Science Teacher 4–8 understands and uses a variety of strategies, resources, and scientific equipment for teaching developmentally appropriate physical science concepts.

The Master Science Teacher:

- Applies knowledge of appropriate techniques, procedures, tools, and technologies to observe and record phenomena associated with physical science.
- Knows how to select and safely adapt everyday materials for physical science activities and effectively uses a variety of instructional resources associated with physical science.
- Recognizes and assesses students' preconceptions and misconceptions about phenomena related to physical science.
- Plans, implements, and evaluates lessons that assist students in understanding concepts and making generalizations associated with physical science.

DOMAIN II—LIFE SCIENCE

Competency 005 (Characteristics and Needs of Organisms) Standard I

The Master Science Teacher 4–8 understands the basic characteristics and needs of organisms.

The Master Science Teacher:

- Identifies characteristics of living and nonliving components of the environment.
- Explains how structure and function are related in organisms.
- Recognizes levels of organization (e.g., cells, tissues, organs, organ systems) in organisms, including humans, and the functions of types of cells, tissues, organs, and organ systems.
- Identifies stages in the life cycles of common plants and animals and analyzes the growth and developmental processes of a variety of organisms, including humans.
- Recognizes the role of internal and external stimuli in the behavior of organisms and identifies feedback mechanisms that allow organisms to maintain stable internal conditions.

Competency 006 (Reproduction, Heredity, and Evolution) Standard I

The Master Science Teacher 4–8 understands reproduction, the principles of heredity, and the evolution of life.

The Master Science Teacher:

- Understands the processes by which plants and animals reproduce and explains how hereditary information is passed from one generation to the next, including predicting the probable outcomes of genetic combinations involving dominant and recessive traits.
- Analyzes how interactions with the physical environment can result in changes in gene frequency.
- Analyzes the role of natural selection in species variation, diversity, speciation, phylogeny, adaptation, behavior, and extinction.
- Demonstrates understanding of the principles of and evidence for the theory of evolution, including how adaptations influence the survival of populations or species.
- Understands how organisms are classified.

Competency 007 (Organisms within Ecosystems) Standard I

The Master Science Teacher 4–8 understands relationships among organisms, ecosystems, and the environment.

The Master Science Teacher:

- Analyzes ways living organisms, including humans, depend on one another and their environment for basic needs.
- Recognizes characteristics of major ecosystems and biomes and understands the consequences of species loss or introduction in a particular ecosystem.
- Understands the flow of energy and matter among organisms and in ecosystems (e.g., interrelationships among producers, consumers, and decomposers; characteristics of biogeochemical cycles).
- Demonstrates understanding of the concept of ecological niche and understands its relationship to characteristics of species in an ecosystem.
- Analyzes types of interactions among species (e.g., commensalism, symbiosis, parasitism, competition) in an ecosystem.
- Understands ecological succession and analyzes the response of ecosystems to changes in the environment.

Competency 008 (Strategies, Resources, and Equipment) Standards III, V, and VI

The Master Science Teacher 4–8 understands and uses a variety of strategies, resources, and scientific equipment for teaching developmentally appropriate life science concepts.

The Master Science Teacher:

- Applies knowledge of appropriate techniques, procedures, tools, and technologies to observe and record phenomena associated with life science.
- Knows how to select and safely adapt everyday materials for life science activities and effectively uses a variety of instructional resources associated with life science.
- Recognizes and assesses students' preconceptions and misconceptions about phenomena related to life science.
- Plans, implements, and evaluates lessons that assist students in developing concepts and making generalizations associated with life science.

DOMAIN III—EARTH AND SPACE SCIENCE

Competency 009 (Earth Materials and Processes) Standard I

The Master Science Teacher 4–8 understands the properties of Earth materials and the structure, function, and history of Earth systems.

The Master Science Teacher:

- Describes properties and uses of minerals, fossils, rocks, soils, water, atmospheric gases, and other Earth materials, including renewable, nonrenewable, and inexhaustible resources.
- Describes theories and evidence regarding the formation and history of Earth.
- Analyzes and describes how human activity and natural processes, both gradual and catastrophic, can alter Earth systems, including the extinction of species.
- Analyzes a variety of Earth cycles (e.g., rock cycle, water cycle, carbon cycle, nitrogen cycle).
- Analyzes the evolution and characteristics of different landforms and the forces and processes that shape them (e.g., faulting, folding, plate movements, earthquakes, volcanic activity, weathering, erosion).

Competency 010 (Hydrosphere and Atmosphere) Standard I

The Master Science Teacher 4–8 understands the structure and function of the hydrosphere and characteristics of Earth's climate, weather, and atmosphere.

The Master Science Teacher:

- Recognizes the impact of the hydrosphere on land formation (e.g., erosion, weathering, coastal processes), organisms, and ecosystems.
- Identifies components of the water cycle and their relationship to weather and climate.
- Analyzes the effect of the sun on Earth systems (e.g., atmospheric circulation, ecosystems) and how Earth's position, orientation, and surface features affect seasons, weather, and climate.
- Identifies chemical and physical components of the atmosphere and understands changes in climate and weather caused by natural events and human activities.
- Identifies the physical and chemical characteristics of oceans and ocean circulation.
- Identifies the relationship between groundwater and surface water in a watershed.

Competency 011 (Solar System and Universe) Standard I

The Master Science Teacher 4–8 understands components and characteristics of the solar system and the universe.

The Master Science Teacher:

- Understands the origin, history, and properties of the solar system and its scale in space and time.
- Understands theories of the origin of the universe, including the processes that form stars and the characteristic stages in the life cycle of a star.
- Identifies methods of exploring the solar system and universe.
- Identifies, orders, and describes components of the solar system (e.g., physical characteristics of planets, moons, asteroids, comets) and their relationship to the sun and to each other.
- Relates the movements and orientations of the moon, Earth, and the sun to tides, phases, seasons, and day and night.

Competency 012 (Strategies, Resources, and Equipment) Standards III, V, and VI

The Master Science Teacher 4–8 understands and uses a variety of strategies, resources, and scientific equipment for teaching developmentally appropriate earth and space science concepts.

The Master Science Teacher:

- Applies knowledge of appropriate techniques, procedures, tools, and technologies to observe and record phenomena associated with earth and space science.
- Knows how to select and safely adapt everyday materials for earth and space science activities and effectively uses a variety of instructional resources associated with earth and space science.
- Demonstrates knowledge of the use of the senses and basic tools for monitoring changes in the weather and making weather measurements.
- Recognizes and assesses students' preconceptions and misconceptions about phenomena related to earth and space science.
- Plans, implements, and evaluates lessons that assist students in developing concepts and making generalizations associated with earth and space science.

DOMAIN IV—THE HISTORY, NATURE, AND CONTEXT OF SCIENCE; SCIENTIFIC INQUIRY; AND SAFETY

Competency 013 (Historical, Personal, and Societal Contexts) Standard II

The Master Science Teacher 4–8 understands the historical perspectives of science and how science interacts with and influences personal and societal decisions.

The Master Science Teacher:

- Demonstrates an understanding of the historical development of science and scientific knowledge.
- Analyzes the significance of key scientific and technological advances (e.g., Copernican revolution, relativity, atomic theory, germ theory, industrial revolution).
- Recognizes the contributions that diverse cultures and individuals have made to scientific knowledge.
- Designs science instruction that is inclusive and accounts for the contributions to science of diverse cultures and individuals.
- Analyzes how personal or societal needs and priorities can affect the direction, support, and applications of scientific research.
- Demonstrates an understanding of the role science can play in helping cause and/or resolve personal, societal, and global challenges.
- Applies scientific principles to analyze the advantages, disadvantages, or alternatives to a given decision or course of action.
- Understands how learning science enables students to function in an increasingly complex society.

Competency 014 (Nature of Science and Unifying Themes) Standards I and II

The Master Science Teacher 4–8 understands the nature of scientific thought and how unifying themes form a conceptual framework to organize science and technology.

The Master Science Teacher:

- Demonstrates an understanding of the organizational, explanatory, and predictive power of scientific theories and models and recognizes the limitations to the kinds of questions that can be answered through scientific means.
- Knows that all scientific ideas are subject to refinement as new information challenges prevailing theories and as new theories cause previous observations to be interpreted in new ways.
- Recognizes the role of logical reasoning in developing, evaluating, and validating scientific explanations and is able to analyze, review, and critique hypotheses and theories using scientific evidence and information.
- Knows the roles of sharing research results and peer review in developing and validating scientific knowledge.
- Demonstrates an understanding of the principles of scientific ethics in conducting research and reporting results.
- Uses physical, conceptual, and mathematical models to describe and make predictions about natural phenomena and evaluates the strengths and limitations of various types of models.
- Demonstrates an understanding of how certain concepts and processes (i.e., systems, order, and organization; evidence, models, and explanation; change, constancy, and measurements; evolution and equilibrium; form and function; properties and patterns) form a unifying framework for science, mathematics, and technology and are applied to the various science disciplines.
- Analyzes systems in terms of cycles, structure, processes, properties, patterns, and the interactions that occur among the components of a given system or subsystem.

Competency 015 (Scientific Inquiry) Standard III

The Master Science Teacher 4–8 understands the processes of scientific inquiry and applies these processes in science learning and teaching and guides others to do so.

The Master Science Teacher:

- Understands the processes, tenets, and assumptions of multiple methods of inquiry leading to scientific knowledge.
- Demonstrates an understanding of the characteristics, applications, and design of scientific investigations using appropriate methods for experimental and nonexperimental research (e.g., controlled experiments, descriptive studies, comparative data analysis).
- Identifies potential sources of error in a given inquiry-based investigation.
- Recognizes patterns in collected data and observations of natural phenomena and develops, analyzes, and evaluates different explanations for the results of scientific investigations.
- Interprets data and applies methods of statistical analysis and measures (e.g., mean, median, mode, correlation).
- Plans and implements instruction that provides opportunities for all students to engage in scientific inquiry and to use higher-order thinking skills, logical reasoning, and problem solving to reach conclusions based on evidence.
- Assists students in identifying, refining, and focusing scientific ideas and questions that form the basis for an inquiry activity.
- Guides students in making systematic observations and measurements, analyzing data, and recording and reporting results.
- Demonstrates the use of a variety of tools, technologies, and techniques to access, gather, store, retrieve, organize, and analyze data.
- Manages groups of students in laboratory and field settings to optimize scientific inquiry.
- Designs and uses criteria for assessing student participation in and understanding of the inquiry process.

Competency 016 (Safety) Standard V

The Master Science Teacher 4–8 understands, implements, models, and advocates for safe science learning environments, safe use of equipment and technology, and the ethical use and care of organisms and guides others to do so.

The Master Science Teacher:

- Knows sources of information about laboratory safety and interprets and appropriately applies safety regulations and guidelines.
- Knows procedures for responding to accidents or emergencies in the classroom, field, or laboratory.
- Works with the district and school to create, implement, and enforce policies, rules, and safety procedures to promote and maintain a safe learning environment during laboratory and field activities.
- Knows strategies and resources for maintaining current safety training and promoting safety training for others.
- Knows how to create a safe, learner-centered environment that is flexible and supportive of scientific inquiry and that provides adequate laboratory space and equipment for all students, including those with special needs.
- Knows how to use and guide others to use safe practices in designing, planning, and implementing instructional activities in the laboratory, field, and classroom.
- Applies procedures to inventory, maintain, and optimize quick and safe access to safety equipment (e.g., eyewash station, sink, safety shower, fire blanket, extinguisher).
- Demonstrates an understanding of appropriate procedures for storing, ordering, inventorying, performing safety checks on, handling, using, disposing of, caring for, and maintaining chemicals, materials, specimens, and equipment.

DOMAIN V—ALIGNMENT AND INTEGRATION, INSTRUCTION, AND ASSESSMENT

Competency 017 (Vertical Alignment and Integration) Standard IV

The Master Science Teacher 4–8 understands the Texas Essential Knowledge and Skills (TEKS) for Science and other science education initiatives, recognizes the importance of the vertical alignment of the TEKS, and applies strategies for integrating the science disciplines with one another and with other disciplines.

The Master Science Teacher:

- Knows the purpose, content, and organization of the Texas Essential Knowledge and Skills (TEKS) for Science and uses them to plan and implement grade-appropriate instruction that is vertically aligned with the overall science curriculum.
- Demonstrates familiarity with the national science standards and other science education initiatives and applies information from related publications (e.g., *National Science Education Standards*, *Science for All Americans*, *Benchmarks for Science Literacy*) to science curriculum, instruction, and assessment.
- Knows how students build scientific knowledge and skills and the relationship between students' cognitive development and vertical alignment of the Texas Essential Knowledge and Skills (TEKS) and uses this knowledge to sequence learning activities.
- Recognizes how learning in one science discipline can support and enhance learning in other science disciplines and knows how to make connections among the science disciplines.
- Demonstrates an understanding of how science fits into the overall curriculum and is able to integrate content, materials, skills, and processes between science and other disciplines in the school curriculum in a meaningful way.
- Recognizes connections between science and daily life and uses common examples from students' daily lives to help explain or illustrate scientific processes, concepts, and principles.
- Knows how to evaluate and select instructional materials based on alignment with the Texas Essential Knowledge and Skills (TEKS), sound scientific principles, and learner-centered pedagogy.
- Knows how to provide guidance to other teachers regarding proper alignment and effective integration of science content.

Competency 018 (Science Instruction) Standard VI

The Master Science Teacher 4–8 plans and implements effective science instruction using a variety of strategies and resources to meet the diverse needs of all learners and guides others to do so.

The Master Science Teacher:

- Knows established theories and research on how all students learn science and develop scientific understanding and how the developmental characteristics of students influence science learning.
- Determines, designs, and uses instructional approaches and activities supported by research evidence as being effective for developing important science content knowledge, concepts, process skills, problem-solving strategies, and critical- and analytical-thinking capacities.
- Recognizes how common preconceptions and misconceptions that students have about scientific phenomena influence learning.
- Applies effective instructional strategies that build on students' prior knowledge and address misconceptions.
- Knows how to motivate students and actively engage them in the learning process by using a variety of research-based instructional formats that are effective with a range of students, including students who are at risk, English language learners, and students from traditionally underrepresented groups in the sciences.
- Recognizes the importance of taking into account the full diversity of the student population and cultural and gender biases in designing effective science instruction and selecting materials.
- Recognizes assistive technologies and instructional modifications that enable students with disabilities and special needs to participate fully in science activities.
- Applies strategies that use instructional time and resources effectively.
- Knows techniques for identifying students' strengths and needs in science and for modifying, differentiating, and integrating instruction based on those strengths and needs.
- Uses and translates among multiple representations (e.g., verbal, concrete, tabular, graphic, pictorial, mathematical, symbolic) of science content.
- Works collaboratively to ensure access for all students to facilities, equipment, and laboratory- and field-based investigations.
- Knows how to provide guidance and feedback to other teachers regarding lesson plans, instructional materials, and teaching strategies to help them develop their knowledge and skills in science instruction for all students.

Competency 019 (Student Assessment) Standard VIII

The Master Science Teacher 4–8 selects, constructs, and administers aligned student assessments; analyzes results to modify instruction; and develops these skills in others.

The Master Science Teacher:

- Recognizes the relationships among curriculum, student assessment, and instruction.
- Demonstrates an understanding of technical issues associated with testing (e.g., reliability, validity, absence of bias, clarity of language, appropriateness of level) and applies this knowledge to the evaluation, selection, design, and administration of student assessment materials and procedures.
- Selects, designs, and administers a variety of appropriate assessment instruments and/or methods (e.g., formal/informal, formative/summative) to monitor student understanding and progress in science.
- Uses ongoing formal and informal assessments of students' science understanding to guide and improve instructional practice.
- Knows the importance of sharing assessment criteria with students and stating the criteria clearly so that students can understand and derive meaning from them.
- Recognizes the role of student assessments as learning experiences and strategies for engaging students in meaningful self-assessments.
- Communicates effectively with other teachers about the development and use of student assessment techniques and the interpretation of results to guide instruction.
- Knows how to communicate assessment results to parents/guardians.
- Establishes criteria consistent with current ethical and legal principles regarding sharing of assessment results with students, parents/ guardians, and appropriate school personnel.

DOMAIN VI—THE LEARNING AND TEACHING ENVIRONMENT, MENTORING, AND SHARED LEADERSHIP

Competency 020 (Learning and Teaching Environment) Standard VII

The Master Science Teacher 4–8 understands the importance of and strategies for creating an environment that fosters positive attitudes, high expectations, passion, and enthusiasm for the learning and teaching of science.

The Master Science Teacher:

- Understands that the attitudes and expectations of teachers and students and the environment inside and outside the school affect the learning of science.
- Ensures high expectations and equity in science instruction for all students by reflecting on one's own behaviors and attitudes and encouraging others to do so.
- Applies the results from research to promote and create a positive learning environment with respect to linguistic, cultural, socioeconomic, and developmental diversity.
- Designs and manages the time, space, and resources needed to create a positive teaching and learning environment.
- Identifies and uses community resources to supplement the school science program in order to create a positive learning and teaching environment.
- Uses a variety of strategies to establish a collaborative scientific community among students and teachers that supports actively engaged learning (e.g., listening to and respecting students' ideas, modeling effective learning processes, conveying a sense of passion and enthusiasm about science).
- Knows how to advocate for students and science education in the school and community.
- Promotes careers in science and science education.
- Recognizes the importance of keeping up-to-date on current and emerging science topics and technology and uses effective strategies and resources for doing so.
- Recognizes the importance of empowering teachers and students with the courage to promote and embrace change.
- Knows how to promote academic integrity in the learning environment.

Competency 021 (Leadership, Communication, and Collaboration) Standard IX
The Master Science Teacher 4–8 uses leadership skills and knows how to communicate and collaborate with educational stakeholders to facilitate implementation of standards-based science instruction.

The Master Science Teacher:

- Knows the dual role of the Master Science Teacher as teacher and mentor in the school community.
- Demonstrates an understanding of leadership, communication, and facilitation skills and strategies.
- Applies principles, guidelines, and professional ethical standards regarding collegial and professional collaborations, including issues related to confidentiality.
- Understands the importance of collaborating with administrators, colleagues, parents/guardians, and other members of the school community to establish and implement the roles of the Master Science Teacher and ensure effective ongoing communication.
- Knows strategies for building trust and a spirit of collaboration with other members of the school community to effect positive change in the school science program and science instruction.
- Uses leadership skills to ensure the effectiveness and ongoing improvement of the school science program, encourage support for the program, and engage others in improving the program.
- Collaborates with administrators to address the specific needs and concerns of novice teachers of science that contribute to attrition.
- Applies learning processes and procedures that facilitate peer learning and self-learning and uses positive, constructive techniques for providing feedback to other teachers.
- Cultivates shared leadership among teachers and students in the school system and community at large.
- Advocates for scientific literacy in the community by discussing science-related issues with students, colleagues, administrators, parents/guardians, and the community.

Competency 022 (Mentoring, Coaching, Consultation, and Professional Development)

Standard IX

The Master Science Teacher 4–8 knows how to provide professional development through mentoring, coaching, and consultation with colleagues, and makes instructional decisions based on research about science and science learning.

The Master Science Teacher:

- Knows and applies research-based skills and strategies for mentoring, coaching, and consulting in the development, implementation, and evaluation of an effective standards-based science program.
- Encourages others to reflect on teaching behaviors and attitudes that ensure high expectations and equity in science instruction for all students.
- Maintains the role of mentor via collaborative consultation and avoids the roles of evaluation and supervision.
- Knows and applies learning processes and procedures for facilitating adult learning.
- Knows models and features of effective professional development programs that promote sustained application in classroom practice (e.g., demonstration, modeling, guided practice, feedback, coaching, follow-up).
- Knows how to use mentoring, coaching, and consultation to facilitate team building for identifying strengths and needs related to science instruction, developing strategies for addressing particular needs, and promoting science learning.
- Uses consultation to work effectively with colleagues who have varying levels of skill and experience and/or different philosophical approaches to instruction to develop, implement, and monitor science programs based on the Texas Essential Knowledge and Skills (TEKS).
- Knows how to select and use strategies to maximize effectiveness as a Master Science Teacher, such as applying principles of time management and engaging in continuous self-assessment.
- Knows how to collaborate with teachers, administrators, and others to identify professional development needs, generate support for professional development programs, and ensure provision of effective, ongoing, data-based professional development opportunities.
- Advocates the importance of active participation in professional science education organizations.
- Knows sources for locating information about research, including emerging research, on science and science learning and understands methods and criteria for reviewing research on science learning and selecting research for educational applications.

SECTION III

MULTIPLE-CHOICE ITEMS

The purpose of this section is to describe multiple-choice item formats that you will see on the TExMaT Master Science Teacher (MST) test and to suggest possible ways to approach thinking about and answering the multiple-choice items. In addition to the introduction to multiple-choice item formats and approaches, you will find sample multiple-choice items, explanations for the correct and incorrect responses for a select number of multiple-choice items, and an answer key.

The Master Science Teacher 4–8 test is designed to include 80 scorable multiple-choice items and approximately 10 nonscorable items. Your final scaled score will be based only on scorable items. The nonscorable multiple-choice items are pilot tested by including them in the test in order to collect information about how these questions will perform under actual testing conditions. Nonscorable test items are not considered in calculating your score, and they are not identified on the test.

All multiple-choice items on this test are designed to assess your knowledge of the content described in the test framework. The multiple-choice items assess your ability to recall factual information **and** to think critically about the information, analyze it, consider it carefully, compare it with other knowledge you have, or make a judgment about it.

When you are ready to answer a multiple-choice item, you must choose one of four *answer choices* labeled A, B, C, and D. Then you must mark your choice on a separate answer sheet.

In addition to the multiple-choice items, the MST test will include one case study assignment. Please see Section IV: Case Study Assignment.

Periodic Table of the Elements

A periodic table of the elements will be provided in your test booklet. A copy of this periodic table is also provided on page 29 of this preparation manual. For the MST 4–8 test, it is not necessary to memorize the names of the elements in the periodic table.

For the MST 4–8 test, it is not necessary to memorize the names of the elements in the periodic table.

PERIODIC TABLE OF THE ELEMENTS

1 IA																	18 VIIIA
1 **H** 1.01	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 23.0	12 **Mg** 24.3	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 39.9
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** 98.9	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57–71	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89–103	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (264)	108 **Hs** (265)	109 **Mt** (268)	110	111	112	113	114	115	116	117	118

Lanthanide Series	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
Actinide Series	89 **Ac** (227)	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	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)

Some of the elements 110 and above have been reported but not fully authenticated and named.

Multiple-Choice Item Formats

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

— Single items
— Items with stimulus material

You may have two or more items related to a single stimulus. When you have at least two items related to a single stimulus, the group of items is called a cluster. After the last item of a clustered item set containing two or more items, you will see the graphic illustrated below.

◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆

This graphic is used to separate these clustered items related to specific stimulus material from other items that follow.

SINGLE ITEMS

In the single item format, a problem is presented as a direct question or an incomplete statement, and four answer choices appear below the item. Read each item carefully and critically. Think about what it is asking and the situation it is describing. Eliminate any obviously wrong answer choices, select the correct answer, and mark it on your answer sheet.

ITEMS WITH STIMULUS MATERIAL

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

One or more items may be related to a single stimulus. You can use several different approaches to answer these types of items. Some commonly used approaches are listed below.

Strategy 1 Skim the stimulus material to understand its purpose, its arrangement, and/or its content, then read the item and refer again to the stimulus material to verify the correct answer.

Strategy 2 Read the item *before* considering the stimulus material. The content of the item will help you identify the purpose of the stimulus material and locate the information you need to respond to the item.

Strategy 3 Use a combination of both strategies; apply the "read the stimulus first" strategy with shorter, more familiar stimuli and the "read the item first" strategy with longer, more complex, or less familiar stimuli. You can experiment with the sample items 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 item, you should read it carefully and critically. You may want to underline its important points to help you respond to the item.

As you consider items set in educational contexts, try to use the identified teacher's point of view to respond to the items that accompany the stimulus. Be sure to consider the items in terms of only the information provided in the stimulus—not in terms of specific situations or individuals you may have encountered.

On the following pages, you will find samples of these commonly used item formats, along with explanations of the correct and incorrect responses. In the actual testing situation, you may mark the test items and/or write in the margins of your test booklet, **but your final response must be indicated on the answer sheet provided.**

Sample Multiple-Choice Items and Explanations

As part of your preparation for the test, sample multiple-choice items have been provided for you to review. To demonstrate how each competency may be assessed, each sample item is accompanied by the competency number that it measures. While studying, you may wish to read the competency before and after you consider each sample item. Please note that the competency numbers will not appear on the actual test form.

An explanation of the correct and incorrect responses is also provided. Each explanation offers one of perhaps many perspectives on why a given response is correct or incorrect in the context; there may be other explanations as well. Keep in mind when reviewing items and response options that there is one best response to each item.

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

Competency 001

During the formation of potassium chloride (KCl), electrons are transferred from the highest energy level of one of the atoms to the highest energy level of the other atom. The formation of KCl that results from this kind of electron transfer is an example of which of the following types of chemical bonding?

A. ionic

B. metallic

C. covalent

D. nonpolar

Option A is correct because the difference in electronegativity of potassium and chlorine atoms is large. As a result, high energy level electrons are transferred from potassium atoms to chlorine atoms, resulting in the formation of oppositely charged ions that are attracted to each other electrostatically.

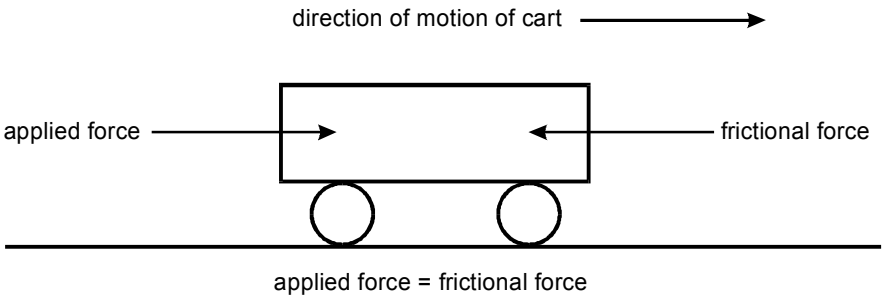
Option B is incorrect because atoms in a sample of a metal have similar electronegativities. As a result, high energy level electrons delocalize as they move freely from one metal atom to another.

Option C is incorrect because covalent bonds commonly occur between elements with a relatively large number of valence electrons and a relatively high electronegativity. As a result, electrons are shared as they move back and forth between atoms.

Option D is incorrect because it describes a covalent, molecular structure in which there is little difference in electronegativity and electrons are shared equally between atoms. It also describes a molecular structure consisting of polar covalent bonds arranged symmetrically.

Competency 002

Use the diagram below to answer the question that follows.



A cart moves in a straight line along a level surface as shown in the diagram above. All forces acting on the cart are balanced. Which of the following best describes the motion of the cart over time?

A. The velocity of the cart will remain constant.

B. The acceleration of the cart will steadily increase.

C. The momentum of the cart will steadily decrease.

D. The inertia of the cart will steadily increase.

Option A is correct because, according to Newton's law of inertia, an object cannot change its speed or direction unless acted upon by an unbalanced force.

Option B is incorrect because the rate of acceleration of an object of a given mass is directly proportional to the magnitude of the unbalanced force acting on the object.

Option C is incorrect because the momentum of an object is the product of its mass and velocity. There are no unbalanced forces causing the cart to change its velocity as the mass of the cart remains constant.

Option D is incorrect because the inertia of an object is a measure of the resistance of that object to any change in velocity that results from the action of an unbalanced force and is proportional to the mass of the cart, which, in this situation, remains constant.

Competency 003

A pendulum is composed of a mass suspended by a string. Once the pendulum is started, each successive swing becomes lower and lower in height until the mass returns to rest. In which of the following ways does energy leave this system?

A. During the swinging of the pendulum, thermal energy is produced by friction.

B. Tension in the string absorbs energy as the mass of the pendulum is set in motion.

C. As the pendulum moves downward, some energy is absorbed by the earth's gravitational field.

D. The kinetic energy of the mass at the base of the pendulum increases as it comes to rest.

Option A is correct because as the pendulum swings, the kinetic energy of the system is converted to thermal energy as a result of friction between the moving parts of the pendulum and between the surrounding air molecules and the swinging pendulum mass and string.

Option B is incorrect because the tension in the string is a function of the gravitational force acting on the pendulum mass and the changes in the angle of displacement from the pendulum's equilibrium position.

Option C is incorrect because the earth's gravitational field is a force rather than a form of energy and acts only to convert the gravitational potential energy of the pendulum into kinetic energy.

Option D is incorrect because the kinetic energy of an object decreases as its velocity decreases.

Competency 004

Which of the following procedures should be carried out before using a pH meter to measure the pH of a liquid at room temperature?

A. Dilute the liquid to be measured to the pH range recommended for the particular pH meter.

B. Calibrate the pH meter with liquids of known pH.

C. Leave the liquid out for a period of several hours to allow volatile gases to evaporate.

D. Adjust the pH meter based on the electrical conductivity of the liquid.

Option B is correct because all scientific measurements are based on a comparison of an unknown quantity or dimension with a commonly accepted standard unit of measurement.

Option A is incorrect because diluting the solution would change the pH of the solution.

Option C is incorrect because the exchange of gases and the evaporation of water could alter the pH of the solution.

Option D is incorrect because a measurement of the overall electrical conductivity of a solution does not directly correlate with a measurement of the pH of a solution.

Competency 005

A cell containing a 5% saline solution is placed into a 3% saline solution. Which of the following statements accurately describes the effect on the cell?

A. The net movement of dissolved particles will be out of the cell, causing the cell to shrink.

B. The net movement of dissolved particles will be into the cell, causing the cell to swell.

C. The net movement of water will be out of the cell, causing the cell to shrink.

D. The net movement of water will be into the cell, causing the cell to swell.

Option D is correct because, during osmosis, water molecules enter the cell through the cell membrane by diffusion until the percent salinity inside the cell is the same as outside the cell, thus increasing the amount of water inside of the cell.

Option A is incorrect because reducing the concentration of dissolved ions inside the cell would occur during the active transport of ions out of the cell through the cell membrane, which requires energy.

Option B is incorrect because the active transport of dissolved ions into the cell would increase the difference in the percent salinity rather than equalize the percent salinity.

Option C is incorrect because passive transport of water out of the cell would increase the difference in the percent salinity rather than equalize the percent salinity.

Competency 006

The environment most directly affects the evolutionary adaptation of species or populations by influencing:

A. the reproductive success of individuals.

B. the growth and development of individuals.

C. the social behaviors that support group success.

D. the carrying capacity of a particular habitat.

Option A is correct because individuals best adapted to the specific conditions in the environment will be more likely to survive and reproduce than other less well-adapted individuals in the population.

Option B is incorrect because environmental influences on the growth and development of individuals do not alter the genes of an individual.

Option C is incorrect because social behaviors that support group success do not necessarily result in adaptations unless they affect the reproductive success of individuals in the group.

Option D is incorrect because the carrying capacity of a habitat influences the size of the population and does not necessarily determine which individuals in a population survive to reproduce.

Competency 007

The remora is a fish that attaches itself to a shark by means of a suction disk in order to be able to eat the remnants of the shark's food that float past. While this relationship directly benefits the remora, it has neither a harmful nor beneficial effect on the host shark. This type of relationship between these two different species is typically referred to as:

A. commensalism.

B. competition.

C. mutualism.

D. parasitism.

Option A is correct because it describes a symbiotic relationship in which one organism benefits from the relationship without influencing the behavior or survival of the other organism.

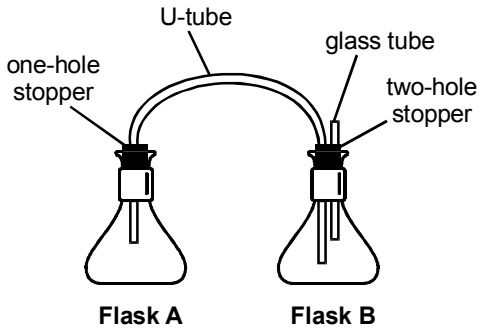
Option B is incorrect because the shark provides access to a food supply to another organism without a reduction in its own food supply.

Option C is incorrect because the shark and the remora do not have a mutually beneficial relationship with each other.

Option D is incorrect because neither organism is harmed to any extent in the relationship.

Competency 008

Use the diagram below to answer the question that follows.



The diagram above shows the apparatus for an experiment in which students fill Flask A with yeast, sugar, and water. Flask B is filled with bromthymol blue, which changes color when exposed to carbon dioxide. This experiment would best demonstrate which of the following processes to students?

A. distillation

B. neutralization

C. fermentation

D. carbonization

Option C is correct because carbon dioxide is one product of the chemical reaction that occurs during the fermentation of sugar.

Option A is incorrect because distillation is the process of separating components of a mixture based on differences in physical properties.

Option B is incorrect because neutralization is the process of an acid reacting with a base to produce an end point pH.

Option D is incorrect because carbonization is the process converting a chemical compound containing carbon into a residue consisting principally of carbon.

Competency 009

Which of the following best describes the primary mechanism driving the movement of tectonic plates?

A. the gravitational pull of the sun and the moon on Earth

B. the centripetal force produced by the rotation of Earth on its axis

C. the convection currents in Earth's mantle

D. the spinning of Earth's inner core

Option C is correct because the unequal heating of magma beneath Earth's lithosphere causes some of the magma to expand and rise toward Earth's surface while cooling magma in other locations becomes more dense and sinks into Earth's interior. These motions create convection currents that are believed to drive tectonic plate movements.

Option A is incorrect because the influence of the gravitational pull of the sun and the moon on Earth's tectonic plates is insignificant.

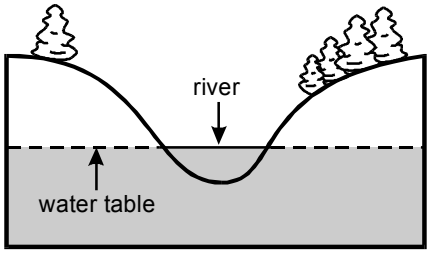
Option B is incorrect because centripetal force is a center-directed force that causes an object to follow a curved path, such as Earth's gravitational pull, and is not a primary cause of the movement of tectonic plates.

Option D is incorrect because the rotational motion of Earth's inner core is not transferred directly to Earth's tectonic plates and would not account for the variety of directions of tectonic plate movements.

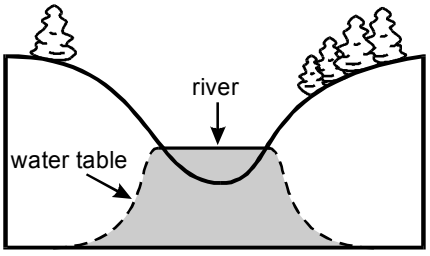
Competency 010

A river flows through a valley with homogeneous sandy soils. If the climate is moderately wet, which of the following cross sections best represents the relationship between the water table and the river in this watershed?

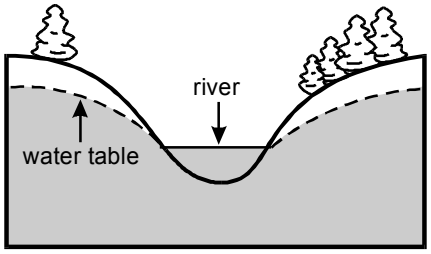
A.



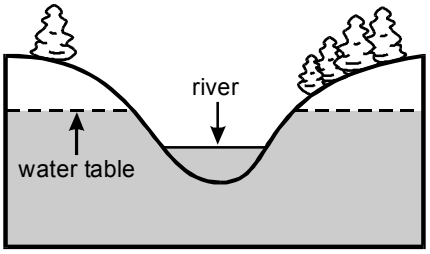
B.



C.



D.



Option C is correct because in a moderately wet climate the water table in a sandy soil follows the surface contours as water from precipitation percolates into the soil.

Option A is incorrect because it does not account for the contribution from precipitation percolating through the overlying sandy soils.

Option B is incorrect because the depicted water table profile does not account for the percolation of precipitation through soils in a moderately wet climate and there is no suggested cause for the dropoff in the water table away from the river.

Option D is incorrect because in a homogeneous sandy soil there would be no reason for a sudden drop in water table in the immediate vicinity of the river.

Competency 011

Which of the following best explains why one side of the moon always faces toward Earth, while the other side always faces away from Earth?

A. The moon revolves around Earth at the same speed as Earth revolves around the sun.

B. Earth completes a rotation once every 24 hours, while the moon's rotation takes approximately a year.

C. The moon rotates once on its axis each time it completes a single orbit of Earth.

D. Earth and the moon each rotate about their axes at the same speed but in opposite directions.

Option C is correct because it describes the only relationship between the moon's period of rotation and its orbital period that would result in the far side of the moon always facing away from Earth.

Option A is incorrect because the description does not refer to the moon's period of rotation, which is a factor in determining the view of the moon's surface from Earth.

Option B is incorrect because Earth's daily rotation would cause an observer to see the moon from a slightly different angle each time Earth revolved on its axis if the moon took a full year to orbit Earth.

Option D is incorrect because it does not refer to the moon's orbital period, which is a factor in determining the view of the moon's surface from Earth.

Competency 012

Students using a sling psychrometer record the temperatures of the dry bulb and wet bulb thermometers. Which of the following information would most likely be recorded on a very humid day?

A. a dry bulb temperature lower than the actual air temperature

B. a wet bulb temperature lower than the actual air temperature

C. large differences in dry bulb and wet bulb temperatures

D. small differences in dry bulb and wet bulb temperatures

Option D is correct because the rate of evaporation of water from the wet cloth on the surface of the wet bulb thermometer would be relatively slow on a humid day, when the atmosphere contains a high percentage of water vapor. Therefore, very little thermal energy, required for the evaporation process, would be absorbed from the surface of the wet bulb thermometer.

Option A is incorrect because the dry bulb temperature reflects the actual air temperature.

Option B is incorrect because the evaporation of water from the surface of a wet bulb thermometer absorbs rather than releases thermal energy.

Option C is incorrect because on a humid day very little evaporation would occur from the cloth surface of the wet bulb thermometer. In order for there to be a larger difference in the dry and wet bulb temperature readings, a high rate of evaporation of water from the surface of the wet bulb thermometer would have to occur.

Competency 013

Which of the following subsequent scientific developments helped improve the agreement between Copernicus's model of the solar system and the observed behavior of the planets?

A. Newton's laws of motion

B. Einstein's theory of relativity

C. Kepler's theory of elliptical orbits

D. Halley's prediction of comet orbits

Option C is correct because Kepler's determination of the mathematical characteristics of planetary orbits was based on the decades of planetary data collected by Tycho Brahe. Even though it was Copernicus who proposed the theory first, it was Kepler who demonstrated how a heliocentric model based on elliptical planetary orbits corresponded with observations made by Tycho Brahe.

Option A is incorrect because Newton's determination of the amount of gravitational force that keeps an object in orbit applies to geocentric systems as well as heliocentric systems and would not have by itself helped resolve the inconsistencies between Copernicus's heliocentric model and Tycho Brahe's careful observations.

Option B is incorrect because Einstein's development of theories of relativity served to resolve conflicts between electromagnetic theory and Newtonian mechanics rather than conflicts between geocentric and heliocentric models of the solar system.

Option D is incorrect because Halley's work focused on the orbits of comets that potentially could orbit around Earth and did not focus on planetary motion.

Competency 014

Use the information below to answer the question that follows.

A mammal lives in a cold environment. Receptors in its skin send temperature information to the brain. The brain sends a signal to muscles which alternately contract and relax, causing the animal to shiver. The shivering produces heat. Receptors in the skin send temperature information to the brain indicating that enough heat has been produced by the shivering. The animal stops shivering.

Which of the following terms best describes this process by which a system's output is monitored and then altered as necessary?

A. feedback loop

B. inhibitory response

C. remote sensing

D. neural integration

Option A is correct because a feedback loop accurately describes the mechanism by which the warming response initiated by the brain is inhibited once the brain receives signals that sufficient warming has occurred. In this way, sensory information feeds back into the system to regulate the mammal's body temperature.

Option B is incorrect because it describes a process by which a response of a system in an organism is suppressed.

Option C is incorrect because it describes a method by which an impulse is received and interpreted.

Option D is incorrect because it describes the process of neurons' receiving both inhibitory and excitatory responses from other neurons.

Competency 015

A sixth-grade student reads in a book that no two snowflakes are exactly alike, but she does not believe it. She tells her teacher that she can prove that the book is wrong. A second student remarks that the first student will never find two identical snowflakes because scientists have already studied the question and have been unable to find two identical snowflakes. This discussion demonstrates that the students are having difficulty understanding which of the following assumptions underlying the practice of science?

A. Intuition is an effective starting point for investigating the plausibility of a hypothesis.

B. Negative evidence neither proves nor disproves a theory or hypothesis.

C. Observation of nature may reveal the underlying cause of a particular phenomenon.

D. Science requires experimental evidence to verify a hypothesis.

Option B is correct because data that are collected to disprove a theory or revise a hypothesis is only a sampling of all of the potential data that may exist. Therefore, negative evidence cannot be used to disprove a theory or revise a hypothesis.

Option A is incorrect because the student's intuitive sense that there may be identical snowflakes that have not yet been discovered is a legitimate motivation for scientific inquiry.

Option C is incorrect because, although observation may reveal important information about snowflake shape that has not yet been revealed, both students accept that observation is central to answering the question.

Option D is incorrect because both students accept that some sort of evidence would be necessary to support or revise the hypothesis that no two snowflakes are alike. One student believes adequate evidence has already been assembled to demonstrate the hypothesis, while the other is skeptical and believes further evidence could be found to prove her point.

Competency 015

A seventh-grade student has submitted the research question, "What is the effect of agricultural and urban runoff on Galveston Bay?" Her teacher asks her to refine her research question. Which of the following questions would allow the student to design and conduct a more focused investigation?

A. How has the water chemistry in Galveston Bay changed as the area has been developed?

B. Which causes more damage to organisms living in Galveston Bay: urban or agricultural runoff?

C. How do increased nitrate levels affect plant growth in Galveston Bay and other estuaries?

D. What will be the long-term affects of not controlling agricultural and urban runoff in Galveston Bay?

Option C is correct because the question, "How do increased nitrate levels affect plant growth in Galveston Bay and other estuaries?" suggests a focus principally on the influences of a specific contaminate on the growth of plants in estuaries. This limits the student's research to a specific testable question.

Option A is incorrect because the question posed suggests that the scope of the research will include all of the changes in the chemistry of Galveston Bay, an unrealistic task for a seventh-grade research project.

Option B is incorrect because the question posed suggests that the research will include the study of both urban and agricultural influences on the chemistry of Galveston Bay. Distinguishing the various influences of these two different pollution sources would be very difficult and is an unreasonable task for a seventh-grade research project.

Option D is incorrect because the question posed suggests that the student will model future influences of both urban and agricultural runoff in Galveston Bay. Modeling future trends of contaminant runoff into Galveston Bay and identifying its potential effects present a project beyond the scope of a seventh-grade research project.

Competency 016

Bacterial colonies were grown on plated media as part of an experiment. What disposal strategy would be most appropriate for the used plates?

A. Apply antibiotics to the plates before disposing of them.

B. Sterilize the plates before disposing of them.

C. Wash the plates with soap and water before disposing of them.

D. Dispose of the plates immediately in a separate waste bag.

Option B is correct because sterilization of the plates is the only procedure that would effectively destroy the bacterial colonies.

Option A is incorrect because there may be some strains of bacteria that are resistant to the applied antibiotics and the use of antibiotics for such a purpose could stimulate the development of resistant strains. Legal and financial considerations would also make this impractical.

Option C is incorrect because soap and water may not remove all the bacteria on the material of the culture media and washing the plates would release bacteria into the wastewater system.

Option D is incorrect because the waste bag may provide an environment in which the bacterial colonies can grow.

Competency 021

Several weeks into the school year, a novice teacher is assigned to a class after the original teacher had to take an unplanned leave of absence due to illness. When the Master Science Teacher arrives at the teacher's classroom to meet her, he observes that the students are noisy and seem to be off-task. In this situation, which of the following would be the most appropriate action for the Master Science Teacher to take?

A. advising the teacher on how to gain control of her class

B. introducing himself to the teacher and asking if she would like his assistance

C. reprimanding the students for their poor behavior

D. reporting the situation to the administrator in charge of discipline for the school

---

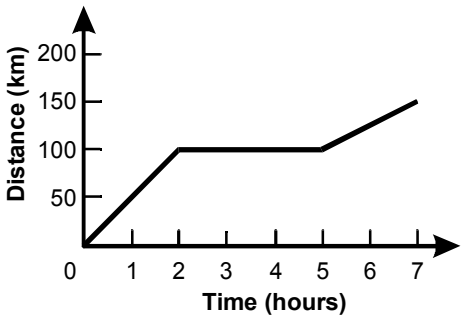
Option B is correct because it encourages communication between the teacher and the Master Science Teacher that can result in a constructive relationship and promote the role of the Master Science Teacher as a mentor and not as a supervisor.

Option A is incorrect because it suggests that the teacher will be instructed rather than be given an opportunity to be more fully involved in an assessment and discussion of classroom dynamics and teaching strategies.

Option C is incorrect because reprimanding the students without consulting with the teacher potentially undermines the teacher's authority in the classroom, while placing the Master Science Teacher in the role of supervisor instead of mentor.

Option D is incorrect because by reporting the situation to an administrator, the Master Science Teacher is not establishing an interactive relationship with the teacher and is not helping foster a more positive relationship between the teacher and her students.

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



The time-distance graph above plots the distance a vehicle travels over a certain amount of time.

Competency 020

Which of the following scenarios would best fit the pattern displayed in the time-distance graph?

A. The vehicle travels at 25 km/h, then stops while the driver has lunch, and then continues the trip at 50 km/h.

B. The vehicle travels at 50 km/h, then stops while the driver has lunch, and then continues the trip at 25 km/h.

C. The vehicle travels at 25 km/h, then stops while the driver has lunch, and then continues on at 25 km/h.

D. The vehicle travels at 50 km/h, continues at 50 km/h, and then stops while the driver has lunch.

Option B is correct because the vehicle travels 100 kilometers during the first two hours of the trip, remains stationary for the next three hours, and travels 50 kilometers during the final two hours of the trip.

Option A is incorrect because it describes a situation in which the speed during the first two hours of the trip is less than the speed during the final two hours of the trip.

Option C is incorrect because it describes a situation in which the speed during the first two hours of the trip is the same as the speed during the last two hours of the trip.

Option D is incorrect because it describes a situation in which the vehicle maintains a speed of 50 km/h during the first two portions of the trip and is not moving during the third portion of the trip.

Competency 020

During which of the following time intervals shown on the time-distance graph does the vehicle reach its highest speed?

A. 0–1 hours

B. 2–3 hours

C. 4–5 hours

D. 6–7 hours

Option A is correct because the maximum speed of the vehicle is maintained during the described time period.

Options B and C are incorrect because they represent time periods during which the vehicle is not moving.

Option D is incorrect because it represents a time period when the vehicle is traveling at less than its maximum speed.

Additional Sample Multiple-Choice Items and Answer Key

This section presents additional sample multiple-choice items for you to review in preparation for the test. The competency number that each item measures is also listed in order to demonstrate how each competency may be assessed. You may wish to read the competency before and after you consider each sample item. Please note that the competency numbers will not appear on the actual test form.

An answer key is also provided and follows the additional multiple-choice items. The answer key lists the correct answer for each sample test item. Please note that the answer key also lists the competency assessed by each item and that the sample items are not necessarily presented in competency order.

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

Competency 001

1. All of the elements in a particular group in the periodic table of elements have similar physical and chemical properties. Which of the following best explains why this is true?

   A. All of the elements in a group have the same number of protons.

   B. All of the elements in a group have the same number of neutrons.

   C. All of the elements in a group have the same number of valence electrons.

   D. All of the elements in a group have the same number of valence neutrons.

Competency 002

2. A person is sitting on the edge of a merry-go-round that is turning at a constant speed. In this situation, the centripetal force:

   A. is constant in both magnitude and direction.

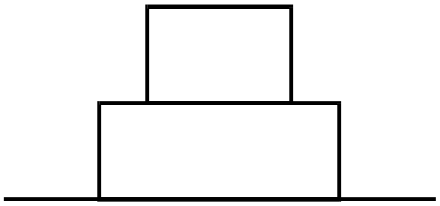
   B. changes magnitude but is constant in direction.

   C. is constant in magnitude but changes direction.

   D. changes both magnitude and direction.

Competency 002

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



The diagram above represents two blocks with different masses stacked on a table. Either block may have the greater mass. Which of the following is a true statement about the upward force on each block?

A. The upward force on the upper block is less than the upward force on the lower block.

B. The block in the upper position has the greater upward force.

C. The upward force on the upper block is equal to the upward force on the lower block.

D. The block with the greater mass has the greater upward force.

Competency 003

4. Two graphite-coated spheres located 20 cm apart are electrostatically charged. If the distance between the two charged spheres is reduced to 10 cm, the repulsive force between the two spheres will:

A. stay the same.

B. double.

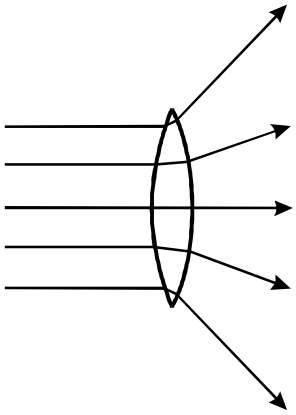
C. triple.

D. quadruple.

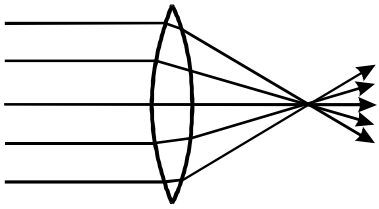
Competency 003

5. Which of the following diagrams correctly illustrates the passage of light rays through a converging lens?

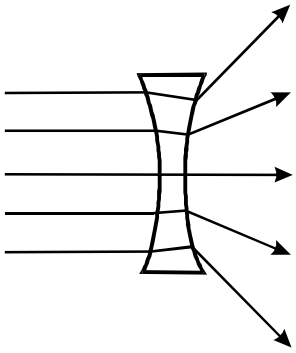
A.



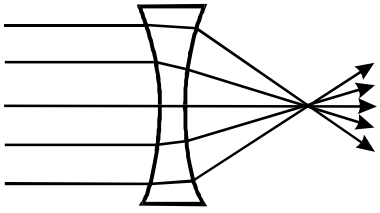
B.



C.

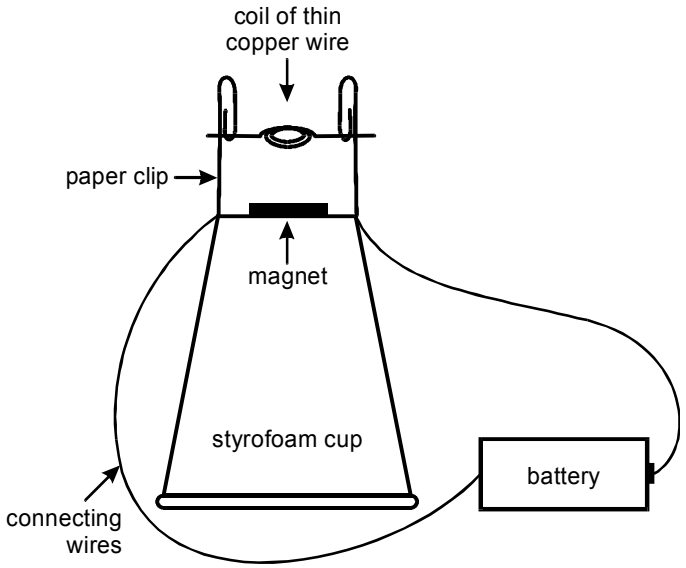


D.



Competency 004

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



The device shown in the diagram above includes paper clips that are bent and taped to an upside-down styrofoam cup. Each paper clip is connected to a battery with a length of wire. A coil of copper wire with two long ends sits in the curve created by the bent paper clips. Under this coil sits a magnet. Which of the following could be most effectively demonstrated with this device?

A. the principle of electromagnetic induction

B. the relationship between electricity and magnetism

C. the first and second laws of thermodynamics

D. the difference between potential and kinetic energy

Competency 004

7. As part of an introductory class on physical science, a teacher wants to use a demonstration to help students understand chemical compounds. Which of the following demonstrations is the most appropriate activity for helping students understand chemical compounds?

   A. combustion of gasoline vapors

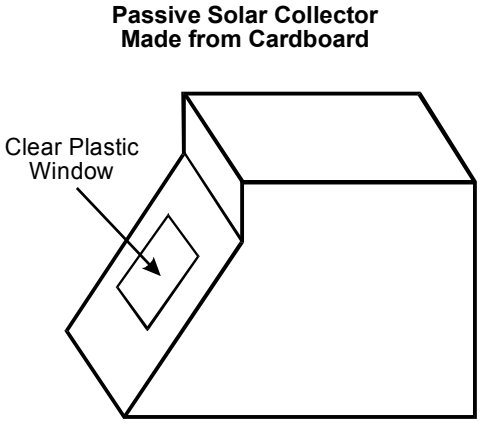
   B. flame test for metallic ions

   C. distillation of alcohol from juice

   D. electrolysis of saltwater solution

Competency 004

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



Students have designed and constructed the passive solar collector shown above by modifying the shape of a cardboard box and by adding a window made from clear plastic wrap. Students must now change the design of their solar collector to demonstrate the movement of energy by convection. Which of the following design changes would most effectively achieve this goal?

A. Add insulation to the roof and walls of the box.

B. Create additional covered openings in the side of the box.

C. Add two uncovered openings to the top of the box.

D. Cover the walls and roof of the box with aluminum foil.

Competency 005

9. Which of the following describes how atmospheric nitrogen is converted into nitrogen compounds that can be used by plants?

   A. Leaf cells absorb elemental nitrogen, changing it into usable nitrates during the process of photosynthesis.

   B. Bacteria and fungi growing in soils and in association with the roots of some plants take up nitrogen, changing it into usable nitrates.

   C. Plants absorb elemental nitrogen through roots hairs, combining it with oxygen to produce usable nitrates.

   D. Fungi on the leaves and stems of certain plants consume elemental nitrogen from the air, producing usable nitrates as a waste product.

Competency 005

10. Which of the following best explains how the structure of the DNA double helix relates to its function?

   A. Complementary strands of nucleic acids in the double helix of the DNA molecule provide a template for reproducing the genetic code.

   B. The two strands of the DNA double helix provide duplicates of the genetic code to reduce mutations.

   C. Proteins produced by the DNA molecule during cell replication use a double helix as a structural template for folding.

   D. The double helix structure of the DNA molecule creates a tunnel structure in which amino acid chains are assembled.

Competency 006

11. Which of the following sets of characteristics are most often used to distinguish one animal phylum from another?

   A. source of energy, mobility, developmental characteristics

   B. body form, type of nervous system, habitat

   C. body symmetry, developmental characteristics, body form

   D. habitat, type of skeletal system, body symmetry

Competency 006

12. A student is creating a chart in an attempt to predict the outcome of a cross between two pea plants with different-colored flowers. One pea plant has two dominant alleles for red flowers, denoted *RR*. The other pea plant has recessive alleles for white flowers, denoted *rr*. Which of the following best describes what the flower color of their offspring will be?

   A. All the offspring will have hybrid red flowers.

   B. Half the offspring will have white flowers and half will have red flowers.

   C. All the flowers will have hybrid white flowers.

   D. Three quarters of the offspring will have red flowers and one quarter will have white flowers.

Competency 007

13. In which of the following parts of the tropical rainforest ecosystem is the majority of carbon stored?

    A. hydrosphere

    B. animal waste

    C. soil deposits

    D. plant biomass

Competency 007

14. A critical step in the nitrogen cycle is the transformation of atmospheric nitrogen (N_2) into a form usable by plants. Which of the following best explains this process?

    A. The stable N_2 bond is split by solar radiation.

    B. N_2 is modified by bacteria in the soil and roots.

    C. The acidic N_2 is neutralized by bases in groundwater.

    D. N_2 is broken down in leaf cells after being taken in through stomata.

Competency 008

15. A group of students is preparing to conduct a study on the effect of dissolved-oxygen levels on the fish in two ponds. Which of the following characteristics of the pond water would it be most important for the students to measure as part of this study?

    A. pH level

    B. concentration of heavy metals

    C. water temperature

    D. conductivity

Competency 008

16. Students working in pairs take turns observing the behaviors and interactions of a pair of mice kept in a cage in the classroom. The teacher has placed the cage in a quiet corner of the classroom behind a blind made from a large piece of cardboard that has several small holes through which students make their observations. This setup best demonstrates an understanding by the teacher of which of the following procedures related to studying animal behavior?

    A. Steps need to be taken to minimize the influence of the observers' presence or actions on the natural behavior of animals.

    B. The most accurate conclusions about animal behavior can be drawn when the animals are calm and relaxed.

    C. Observations of behavior need to be carefully controlled so that they are consistent from one observation period to the next.

    D. Placing a physical barrier between the observers and the animals makes it easier for the observers to remain objective.

Competency 009

17. An increase in sediments carried in major rivers has been noted in a number of tropical countries where development pressures have decreased forest cover. The most likely cause for this increase in the sediment load of major rivers is:

    A. increased runoff of precipitation into affected rivers.

    B. change in precipitation patterns in watersheds surrounding affected rivers.

    C. decrease in the flow volume of affected rivers.

    D. change in chemical weathering rates of soils and rocks surrounding affected rivers.

Competency 010

18. A monsoon-like flow develops in the southwestern United States during middle to late summer, bringing an increase in moist southerly winds and related afternoon thunderstorms. Which of the following leads to the development of this moist flow of air during the middle to late summer?

    A. a semi-stable difference in the air pressure over the land and sea

    B. an increase in the temperature of the Pacific Ocean

    C. a change in the flow of the subtropical jet stream

    D. an increase in the upwelling of warm water in the Gulf of Mexico

Competency 010

19. Methane, carbon dioxide, and water vapor act to warm the lower layers of the atmosphere by:

    A. absorbing visible light energy from the sun and storing it as thermal energy.

    B. preventing infrared energy from radiating from the earth's surface into space.

    C. converting visible light and ultraviolet energy from the sun into infrared energy.

    D. reacting chemically and releasing heat when struck by ultraviolet energy from the sun.

Competency 011

20. Interstellar dust clouds are believed to coalesce into planetary systems with a central star as a result of the:

    A. compressive force of dark energy found in space.

    B. quantum forces exerted by subatomic particles.

    C. magnetic attraction of metallic ions in interplanetary debris.

    D. universal gravitational attraction between masses.

Competency 011

21. There is evidence found in fossil corals that indicates that Earth is rotating at a slower rate today than in the past. This slowing of Earth's rate of rotation is primarily caused by:

    A. frictional drag of the atmosphere.

    B. solidification of Earth's interior.

    C. shifting of the tectonic plates.

    D. gravitational effects of the moon.

Competency 012

22. A student is interested in identifying an unknown mineral sample. She suspects that the mineral is calcite. Which of the following everyday materials would be most useful in conducting a test for the mineral calcite?

    A. detergent

    B. ammonia

    C. vinegar

    D. water

Competency 013

23. Which of the following key geological concepts of the nineteenth century was developed by James Hutton and Charles Lyell and was important in convincing scientists of the reality of evolutionary change?

    A. Continents that are now separated by oceans were at one time grouped together in one huge supercontinent.

    B. Radioactive elements decay at a regular rate, and this decay can be used to measure the age of a deposit.

    C. Processes that shaped the earth in the geologic past are essentially the same as those that operate today.

    D. Worldwide catastrophes have regularly wiped out almost all life and changed the earth's surface.

Competency 015

24. Students perform a lab on weathering and erosion in which clean water and marble chips are shaken in a container. After several minutes of shaking, the water is carefully poured off and the mass of the marble chips is measured. Clean water is reintroduced and the process is repeated several times. Some students record an increase in the mass of the marble chips after the experiment. Which of the following sources of error would best explain the students' recorded increase in the mass of the marble chips?

    A. The container was not shaken long enough.

    B. The container was not shaken forcefully enough.

    C. The water was not completely poured off.

    D. Rocks fell out when the water was poured off.

Competency 015

25. Which of the following inquiry abilities is most effectively developed as students meet to compare the results of their individual investigations of the same topic?

    A. recognizing and analyzing alternative explanations

    B. communicating and defending a scientific hypothesis

    C. formulating and revising scientific theories

    D. identifying questions and concepts that guide scientific research

Competency 016

26. A science teacher is planning a laboratory activity that will require a student to wear protective eyewear. According to Texas safety regulations, students who wear corrective glasses:

    A. are required to remove their glasses and wear the regular protective eyewear.

    B. must wear additional protective eyewear over their glasses.

    C. must be supplied with special protective eyewear that corrects their vision.

    D. are not required to wear additional protective eyewear.

Competency 017

27. An elementary school teacher is preparing a unit on the phase changes of water and would like to use an example from students' daily lives to explain that energy is required for water to evaporate. Which of the following would be the best example for the teacher to use to illustrate this concept?

    A. Rain puddles disappear slowly on humid days.

    B. Fog forms more often at night than during the day.

    C. Water takes a long time to heat up on a kitchen stove.

    D. Sweating helps cool skin and lower body temperature.

Competency 018

28. In a science unit on magnetism, students are asked to design an activity that would help them understand how magnetic force varies with distance. An important advantage of having the students create their own activities rather than being assigned previously developed activities is that activities developed by students:

    A. are more likely to be at an appropriate cognitive level.

    B. often result in an increase in motivation.

    C. are more likely to have real-world applications.

    D. often result in greater content knowledge.

Competency 019

29. When analyzing a student's score on the science section of a standardized achievement test, it is important for the Master Science Teacher to consider the confidence interval because it:

    A. allows the teacher to determine whether the test is a valid measure of the student's knowledge.

    B. indicates whether the test provides a reliable measure of the student's knowledge.

    C. allows the teacher to examine the range of test scores that might include the student's true score.

    D. indicates how the raw score translates into the percentile score for the test.

Competency 020

30. Science teachers at a school have been asked to adopt a new curriculum that administrators believe will better reflect the Texas Essential Knowledge and Skills (TEKS) for Science. At a meeting with the Master Science Teacher, several teachers express concern about their ability to implement the changes successfully. Which of the following would be the most effective way for the Master Science Teacher to respond to these teachers' concerns?

    A. Suggest that the teachers meet to discuss ways of using the new curriculum to improve science instruction at the school.

    B. Reassure the teachers about their ability to meet the challenge of implementing the new curriculum effectively.

    C. Suggest that the teachers meet with the administrators to discuss their misgivings and request a delay in adopting the new curriculum.

    D. Collaborate with the teachers to identify the type of assistance and support needed to implement the new curriculum.

Answer Key		
Item Number	**Correct Answer**	**Competency**
1	**C**	001
2	**C**	002
3	**A**	002
4	**D**	003
5	**B**	003
6	**B**	004
7	**D**	004
8	**C**	004
9	**B**	005
10	**A**	005
11	**C**	006
12	**A**	006
13	**D**	007
14	**B**	007
15	**C**	008
16	**A**	008
17	**A**	009
18	**A**	010
19	**B**	010
20	**D**	011
21	**D**	011
22	**C**	012
23	**C**	013
24	**C**	015
25	**A**	015
26	**B**	016
27	**D**	017
28	**B**	018
29	**C**	019
30	**D**	020

SECTION IV

CASE STUDY ASSIGNMENT

In addition to the multiple-choice section, the Master Science Teacher (MST) test will include one case study assignment that requires a written response. The written-response score will be combined with the multiple-choice score to produce a total test scaled score.

Included in this section is a description of the case study assignment, an explanation of how case study assignment responses will be scored, one sample case study assignment, and examples of a strong and a weak response to the assignment.

On the actual test, candidates will be given a different case study assignment from the sample provided in this preparation manual.

How Case Study Assignment Responses Are Scored

Responses will be scored on a four-point scale (see next page). Each point on the scale represents the degree to which the performance characteristics (see below) are demonstrated in the response.

The score point descriptions reflect typical responses at each score point. Although the score assigned corresponds to one of the score points, individual responses may include attributes of more than one score point.

PERFORMANCE CHARACTERISTICS

PURPOSE	The extent to which the candidate responds to the components of the assignment in relation to relevant competencies in the Master Science Teacher 4–8 test framework.
APPLICATION OF KNOWLEDGE	Accuracy and effectiveness in the application of knowledge as described in relevant competencies in the Master Science Teacher 4–8 test framework.
SUPPORT	Quality and relevance of supporting details in relation to relevant competencies in the Master Science Teacher 4–8 test framework.
RATIONALE	Soundness of reasoning and depth of understanding of the assigned task in relation to relevant competencies in the Master Science Teacher 4–8 test framework.
SYNTHESIS	The extent to which the candidate is able to synthesize the knowledge and skills required to perform the multifaceted role of the Master Science Teacher 4–8 in an applied context.

SCORE SCALE

Score	Score Point Description
4	**The "4" response reflects thorough knowledge and understanding of relevant competencies in the Master Science Teacher 4–8 test framework.** • The response addresses all components of the assignment and fully completes the assigned task. • The response demonstrates an accurate and very effective application of relevant knowledge. • The response provides strong supporting evidence with specific and relevant examples. • The response demonstrates clear, logical reasoning and a comprehensive understanding of the assigned task. • The response demonstrates strong ability to synthesize the knowledge and skills required to perform the multifaceted role of the Master Science Teacher 4–8.
3	**The "3" response reflects sufficient knowledge and understanding of relevant competencies in the Master Science Teacher 4–8 test framework.** • The response addresses most or all components of the assignment and sufficiently completes the assigned task. • The response demonstrates a generally accurate and effective application of relevant knowledge; minor problems in accuracy or effectiveness may be evident. • The response provides sufficient supporting evidence with mostly specific and relevant examples. • The response demonstrates sufficient reasoning and an overall understanding of the assigned task. • The response demonstrates sufficient ability to synthesize the knowledge and skills required to perform the multifaceted role of the Master Science Teacher 4–8.
2	**The "2" response reflects partial knowledge and understanding of relevant competencies in the Master Science Teacher 4–8 test framework.** • The response addresses at least some components of the assignment and/or partially completes the assigned task. • The response demonstrates a partial and/or ineffective application of relevant knowledge; significant inaccuracies may be evident. • The response provides minimal supporting evidence with few relevant examples; some extraneous or unrelated information may be evident. • The response demonstrates limited reasoning and understanding of the assigned task. • The response demonstrates partial ability to synthesize the knowledge and skills required to perform the multifaceted role of the Master Science Teacher 4–8.
1	**The "1" response reflects little or no knowledge or understanding of relevant competencies in the Master Science Teacher 4–8 test framework.** • The response addresses few components of the assignment and/or fails to complete the assigned task. • The response demonstrates a largely inaccurate and/or ineffective application of relevant knowledge. • The response provides little or no supporting evidence, few or no relevant examples, or many examples of extraneous or unrelated information. • The response demonstrates little or no reasoning or understanding of the assigned task. • The response demonstrates little or no ability to synthesize the knowledge and skills required to perform the multifaceted role of the Master Science Teacher 4–8.
U	The "U" (Unscorable) will be assigned to responses that are off topic/off task, illegible, primarily in a language other than English, or are too short or do not contain a sufficient amount of original work to score.
B	The "B" (Blank) will be assigned to written response booklets that are completely blank.

Scoring Process

Case study assignment responses are scored on a scale of 1 to 4. Typically, each response is scored by two or more qualified readers. All scorers have successfully completed standardized orientation and are calibrated to the scoring criteria throughout the scoring session. If two scores assigned are discrepant, additional scoring will determine the final score.

Analytic Notation

Examinees who do not pass the test and do not perform satisfactorily on the case study assignment will receive information concerning specific aspects of the written response that show a need for improvement. This information will be provided for examinees to use in preparing to retake the test.

If you do not pass the test or perform satisfactorily on the case study assignment, your score report will indicate one or more of the following areas for improvement in your written response. These areas are based on the performance characteristics in the score scale.

- Purpose
- Application of Knowledge
- Support
- Rationale
- Synthesis

Preparing for the Case Study Assignment

Following is one sample case study assignment that represents the type of question you will see on the MST test.

In preparing for the case study assignment component of the test, you may wish to draft a response to the question by reading the case study and planning, writing, and revising your essay. Although you can choose how much time to spend during the test session to respond to the case study assignment, the assignment has been created so that an acceptable response could be written within 90 minutes. Also, since no reference materials will be available during the test, it is recommended that you refrain from using a dictionary, a thesaurus, or textbooks while writing your practice response.

After you have written your practice response, review your response in light of the score point descriptions. You may also wish to review your response and the score scale with staff in your MST preparation program.

General Directions for Responding to the Case Study Assignment

DIRECTIONS FOR CASE STUDY ASSIGNMENT
Master Science Teacher 4–8

General Directions:

This section of the test consists of one case study assignment. For this assignment, you are to prepare a written response and record it in the area provided in the written response booklet.

Read the case study assignment carefully before you begin to write. Think about how you will organize what you plan to write. You may use any blank space provided in this test booklet to make notes, create an outline, or otherwise prepare your response. ***Your final response, however, must be written in the written response booklet.***

Evaluation Criteria:

Your written response will be evaluated based on the extent to which it demonstrates the knowledge and skills required to perform the roles of the Master Science Teacher 4–8. You may draw from research and your professional experience. (Citing specific research is not required.)

Read the assignment carefully to ensure that you address all components. Your response to the assignment will be evaluated based on the following criteria:

- **PURPOSE:** The extent to which you respond to the components of the assignment in relation to relevant competencies in the Master Science Teacher 4–8 test framework.
- **APPLICATION OF KNOWLEDGE:** Accuracy and effectiveness in the application of knowledge as described in relevant competencies in the Master Science Teacher 4–8 test framework.
- **SUPPORT:** Quality and relevance of supporting details in relation to relevant competencies in the Master Science Teacher 4–8 test framework.
- **RATIONALE:** Soundness of reasoning and depth of understanding of the assigned task in relation to relevant competencies in the Master Science Teacher 4–8 test framework.
- **SYNTHESIS:** The extent to which you are able to synthesize the knowledge and skills required to perform the multifaceted role of the Master Science Teacher 4–8 in an applied context.

The assignment is intended to assess knowledge and skills required to perform the roles of the Master Science Teacher 4–8, not writing ability. Your response, however, must be communicated clearly enough to permit a valid judgment about your knowledge and skills. Your response should be written for an audience of educators knowledgeable about the roles of the Master Science Teacher 4–8.

The final version of your response should conform to the conventions of edited American English. Your response should be your original work, written in your own words, and not copied or paraphrased from other work. You may, however, use citations when appropriate.

Sample Case Study Assignment

Classroom Context: This case study focuses on a seventh-grade teacher, Ms. Burke, who is teaching a lesson on joint and muscle action in the human body. The class, which meets for 50 minutes a day, is composed of students who achieve at various levels.

Master Science Teacher Task: Ms. Burke has asked the Master Science Teacher (MST) to observe her class during a lesson on joint and muscle action in the human body and to provide her with feedback. The MST has agreed to observe her class. Ms. Burke shows the MST information about the lesson she plans to teach. On the following pages, you will find:

- information from Ms. Burke regarding previous instruction for this class;
- information about the lesson;
- an assignment given by Ms. Burke to her class;
- excerpts of notes taken by the MST while observing Ms. Burke's class; and
- representative samples of student work from her class.

Using these materials, write a response in which you demonstrate your knowledge of science, science instruction, and mentoring by analyzing this case study.

Your response should include the following information:

1. An analysis of one significant strength and two significant weaknesses in the effectiveness of the lesson. Cite evidence from the case study to support your observations.

2. A full description of two instructional strategies that would be effective for Ms. Burke to use to address the two weaknesses you have identified. Be sure to describe one strategy for each of the weaknesses you have identified.

3. An explanation of why each of the strategies you have described would be effective in improving Ms. Burke's instruction.

4. A full description of a plan of action you would develop as a mentor-teacher specifically to guide Ms. Burke in implementing the strategies you have described.

Information from Ms. Burke regarding previous instruction: The students in this class have described the structure and functions of the human skeleton and the process of muscular contraction. Earlier in the school year, students had studied energy changes that occur as work is done with simple machines. Ms. Burke thinks that students are prepared to analyze the structure and function of the human forearm. Students have been provided with a description of the procedures for the lesson's activity.

INFORMATION ABOUT THE LESSON

Objectives:

- **Collect, analyze, and record information to explain a phenomenon.**
- **Relate forces to basic processes in living organisms.**
- **Identify the systems of the human organism and describe their functions.**

Introduction

- Discuss the types of bones and muscular actions that are required to perform simple tasks.
- Have students identify the components of a lever.
- Have students describe the purpose of a lever.

Materials per group

- spring scale
- safety goggles (per student)
- two metersticks
- fulcrum
- string
- object to be lifted

Activity

1. Use a spring scale to record the weight of an object to be lifted.
2. Put one end of the meterstick on the fulcrum.
3. Use string to attach the object to be lifted to the other end of the meterstick.
4. Attach one end of a piece of string to the 50 cm mark of the meterstick. Attach the spring scale to the other end of that piece of string.
5. Hold the spring scale and pull up on the lever to practice lifting the object a small distance off the table. A lab partner will also need to practice preventing the end of the meterstick from slipping off the fulcrum.
6. Record the force required to lift the object 10 cm off the table.
7. Use a meterstick to measure the distance your hand moves as you lift the object 10 cm off the table.
8. Move the string away from the 50 cm mark so that the lever is more similar to the structure of your forearm. Repeat steps 6 and 7.
9. Move the string so that the least amount of force is required to lift the object. Repeat steps 6 and 7.

Discussion Compare and contrast the motion of the forearm with the motion of the lower leg.

Assignment Complete the assignment "The Human Machine."*

*A copy of the assignment follows this description of the lesson.

ASSIGNMENT

The Human Machine

Complete the table below with data from the class activity.

	Weight of Object	Distance Object Is Lifted	Distance the Hand Moves	Force Needed to Lift the Object
Trial 1				
Trial 2				
Trial 3				

1. How is step 1 of the procedure an example of Newton's first law of motion?

2. What kind of energy changes occurred as the object was lifted by the lever?

3. What is a disadvantage of the structure of the human forearm?

4. What is an advantage of the structure of the human forearm?

5. Besides the forearm, what is another example of a simple machine in the human body?

SELECTED EXCERPTS FROM THE MST'S OBSERVATION NOTES

- As class begins, Ms. Burke moves a model of a lever to the center of her demonstration table and says, "If you recall, we studied simple machines earlier this year. What I have constructed for you here is a third-class lever. Would anyone like to describe how a third-class lever works?"
  - — A student says, "The fulcrum is at one end and the object to be lifted is at the other end." Ms. B replies, "Where is a lifting force applied?" The student answers, "Somewhere between the fulcrum and the object." Ms. B asks, "Why did we study simple machines like this lever?" The student says, "To understand how to make it easier to lift an object." Ms. B says, "Excellent, you have remembered a lot about our work with simple machines, no pun intended."
  - — Ms. B then asks, "How many third-class levers are in the human body?" A student answers, "We have four levers because we have two arms and two legs." Ms. B asks, "Where are the fulcrums in your arms and legs?" The student replies, "In our elbows and knees." Ms. B asks, "Are there other fulcrums in your arms and legs?"
  - — Another student says, "Our hips and shoulders seem to be fulcrums, so each arm has two levers and each leg has two levers. So, we have eight levers."
- Ms. B encourages students to think about more possibilities for levers by saying, "Wiggle your fingers in lots of different ways and observe that you have many more third-class levers in your body."
  - — A student says, "Wow, there must be at least fourteen levers in each hand. The same must be true for each foot. That means that we have a lot of third-class levers in our body."
  - — Another student asks, "Is our jaw a lever?" Ms. B says, "Yes, it is, but you still have not identified all of the levers in a human body."
- Ms. B says, "Every part of your body that moves up and down or back and forth is a lever. Your neck has dozens of third-class levers. You have hundreds of levers in your body."
  - — Another student asks, "How can our neck be an example of a third-class lever?" Ms. B answers, "The bottom of your neck is a fulcrum, and your head, which moves, is at the other end of your neck. The muscles that move your neck are attached to the vertebrae somewhere between your head and the bottom of your neck. So, that fits the definition of a third-class lever."
  - — A student says, "I thought that levers were used to lift objects." Ms. B replies, "Sometimes levers are used to move objects in other directions. Levers can also be used to squeeze things. Can anyone provide an example of a lever that does work as it squeezes an object?" A student replies, "Would scissors be an example?" Ms. B says, "Yes, it would, but what is an example of that kind of lever in our bodies?"
  - — Another student speaks up, "What about when we squeeze something in our hand? Isn't that just another use of the third-class levers that are in our hands?" Ms. B responds, "Yes, that's true. When we hold on to something, we are using our hands as a different kind of lever." A somewhat confused student asks, "How can one set of bones and muscles be two different kinds of levers?"
- Ms. B says, "That is a very good question. I want the class to think about the different ways that bones and muscles interact to create different kinds of leverage for different purposes."

SELECTED EXCERPTS FROM THE MST'S OBSERVATION NOTES *(continued)*

- Ms. B continues, "As you build a third-class lever, think of other examples in the human body where muscles and bones can be used for different kinds of tasks. Now, let's get started with our levers." Ms. B asks students to divide into groups of three that were established the previous day and to begin constructing and analyzing levers.

- As students proceed through the lesson's activity, Ms. B walks around the room and observes groups of students as they begin to measure the force required to lift an object using a lever. She observes one group having difficulty keeping one end of the meterstick on the fulcrum.

  — Ms. B asks them to use their fingers as a model of ligaments that hold the elbow joint together. She says, "If you use your fingers to prevent the end of the meterstick on the fulcrum from slipping, then you are simulating the action of your elbow as a fulcrum."

- Another group of students seems to be having difficulty deciding how to conduct the second trial of the investigation.

  — A student asks, "Which way do we move the string if we want this lever to be more similar to a forearm?" Ms. B asks, "Can you feel where the biceps are attached to the bones in the uppermost part of your forearm?" The student says, "Yes. The muscle is attached to the bone right near the elbow." Ms. B says, "Then you need to pull up on the lever closer to the fulcrum." The student then says, "But it doesn't seem like the muscles in our arm pull up." Ms. B replies, "You will learn about force vectors in high school. Then you will understand how a muscle pulling at an angle can pull in the up direction."

- After all of the groups of students have collected their force and distance data, Ms. B asks them to return to their seats for a discussion of the results of their investigation.

  — One student says, "It seems like the arm is not a great machine." Ms. B asks, "Why do you say that?" The student replies, "It takes more force to lift the object than the weight of the object."

  — Ms. B says to the class, "Even though you are working harder with your forearm, there is an advantage to putting in that extra amount of work. One of the questions you need to answer on the assignment is a question about a disadvantage of the structure of the human forearm. There is also a question about the advantage of the structure of the human forearm."

  — Another student asks, "Are there any machines in our bodies that reduce how much work we do to lift something?" Ms. B replies, "No, I really can't think of any. Anyway, an animal with a first-class or second-class lever would be a strange looking animal."

  — Ms B. then says, "There are also questions on the assignment that relate to Newton's laws and energy conversions that we studied earlier in the year. Please review your notes when you answer those questions."

- Ms. B asks the class to complete the questions on the assignment sheet. Ms. B then says, "I am also passing out the procedure for the next activity, and I'd like you to read through it for tomorrow."

STUDENT A
COMPLETED ASSIGNMENT

The Human Machine

Complete the table below with data from the class activity.

	Weight of Object	**Distance Object Is Lifted**	**Distance the Hand Moves**	**Force Needed to Lift the Object**
Trial 1	*1.0 N*	*10 cm*	*5 cm*	*2.1 N*
Trial 2	*1.0 N*	*10 cm*	*2 cm*	*5.0 N*
Trial 3	*1.0 N*	*10 cm*	*10 cm*	*1.0 N*

1. How is step 1 of the procedure an example of Newton's first law of motion?

   The object wasn't moving when we were measuring the weight of the object.

2. What kind of energy changes occurred as the object was lifted by the lever?

   The energy we used to lift the object became potential energy.

3. What is a disadvantage of the structure of the human forearm?

   It takes a lot of force to lift things, which is probably why we use machines to do more work.

4. What is an advantage of the structure of the human forearm?

   We can move objects a long distance but our muscles don't have to move as much.

5. Besides the forearm, what is another example of a simple machine in the human body?

   I think that our teeth are like wedges.

STUDENT B
COMPLETED ASSIGNMENT

The Human Machine

Complete the table below with data from the class activity.

	Weight of Object	Distance Object Is Lifted	Distance the Hand Moves	Force Needed to Lift the Object
Trial 1	*1.1 N*	*10 cm*	*5 cm*	*2.3 N*
Trial 2	*1.1 N*	*10 cm*	*2.5 cm*	*4.4 N*
Trial 3	*1.1 N*	*10 cm*	*9 cm*	*1.2 N*

1. How is step 1 of the procedure an example of Newton's first law of motion?

   The force we pulled up with was staying constant and the object didn't move.

2. What kind of energy changes occurred as the object was lifted by the lever?

   A lot of our work became a little bit of work lifting the object.

3. What is a disadvantage of the structure of the human forearm?

   The same answer as the answer to question two.

4. What is an advantage of the structure of the human forearm?

   I guess that we can lift things that are away from our body.

5. Besides the forearm, what is another example of a simple machine in the human body?

   When we twist our wrists, our arm and our hand are like a wheel and axle.

Sample Case Study Responses

MST 4–8 Strong Response

In this lesson, Ms. Burke does a good job of integrating the study of simple machines with the study of movement of the human body produced by the skeletal and muscular systems working together. Students get hands-on experience with a lever and are asked to relate this to the motion of the forearm. The lesson provides a concrete, real-world experience for seventh-grade students, as they can feel the muscle action of their forearm.

One weakness of this lesson is that Ms. Burke missed an opportunity to use an inquiry-based approach to the study of levers and movement. She described and demonstrated only one type of lever. Her model was a third-class lever and the questions and examples related to only this type. Students did not have the opportunity to discover connections for themselves.

An instructional strategy that would be more effective would be to develop a more inquiry-based approach to the lesson. Ms. B should set up a model of a third-class lever and ask students to identify the type. She then should have students tell her how to change the model to first a first-class and then a second-class lever. She should have students use their forearms to lift an object and identify the type of lever that is represented. This could also be done with other parts of the body.

(continued)

Developing an inquiry-based approach to the lesson would be more effective because it would allow students to analyze the action of their forearm and form their own hypothesis as to the type of lever it represents. Students would develop analytical and observational skills and have experience in applying their knowledge of simple machines.

A second weakness of this lesson is that Ms. Burke did not clarify a student's misconception that the amount of work done to lift an object is increased or decreased as the distance between the object being lifted and the applied force is changed. When a student says, "It seems like the arm is not a great machine," Ms. B reinforces the misconception by saying, "Even though you are working harder with your forearm, there is an advantage to putting in that extra amount of work." Both student A and student B show this misconception in their answers to the third question on the assignment.

An instructional strategy to help students clarify misconceptions about work accomplished as objects are lifted with levers would be to have students compute the work done. Two additional columns could have been added to the table on the assignment. One column could be for the product of multiplying the weight of the object being lifted by the distance it was lifted. The other column could be the product of multiplying the applied force by the distance the student's hand moved. Both products would be similar and would reveal that work input and work output are similar in each trial.

(continued)

Clarifying misconceptions using this strategy would be effective because it emphasizes that the distance the hand moved decreased as the amount of force applied by the hand increased. This procedure would also reinforce the law of conservation of energy.

To help implement these strategies, I would meet with Ms. Burke immediately after the lesson and ask her to reflect on what went well and what did not. I would guide her through the students' assignments and see how she might change the lesson to have an inquiry-based approach. I would offer her sources of information about inquiry teaching in science. I would suggest that we make arrangements for her to observe my class or another experienced teacher who consistently uses inquiry-based lessons. In the debriefing, I would also be sure to encourage Ms. B to continue to develop lessons that integrate the sciences and relate to students' experiences.

To have a lesson that is more inquiry-based and to avoid misconceptions, I would encourage Ms. B to allow students to form their own hypotheses and design experiments to answer questions that arise in a lesson.

MST 4–8 Weak Response

Ms. Burke presents a very good lesson on levers in the human body. Of course there is always room for improvement and I will describe both strengths and weaknesses in the lesson. One strong point is that she spends a lot of time comparing levers to the human body. She asks the students questions and lets them participate in the discussion. By doing this, she is able to see if they understand the ideas being presented before moving on.

One weakness is that Ms. Burke does not fully explain the experiment before letting the students work on their own. Some students have trouble keeping the meterstick on the fulcrum. The teacher has to go around to the groups and explain how they could keep the stick steady with their fingers. Other groups don't know where to attach the string to the stick.

Another weakness is that some of the concepts involved in the experiment have not been covered in class. Some students ask about force vectors and Ms. Burke tells them that they will learn about that in high school. Also, in the homework assignment, it is clear that students do not understand Newton's laws and energy changes.

To overcome these weaknesses, Ms. Burke should model the experiment before letting the students try it themselves. She could show them how to secure the stick to the fulcrum and deal with any other technical problems they might run into. Modeling is always a good technique because it gives students a chance to actually see what is going to happen. If students have a clear idea of what to expect, they will do better on the experiment since they don't have to waste time figuring out the basics.

(continued)

For the second weakness, Ms. Burke should be sure to cover all the material that will be contained in the lesson. If Newton's laws will be a part of the experiment, she needs to explain that to the students. If information, like the force vectors, is too advanced for the students, she should try to present it in a simplified way rather than just say they will learn it later. By covering all the important concepts, the teacher ensures that the students will have the knowledge they need to complete the experiment. This would help them especially when they try to do the homework on their own.

As a mentor, I would guide Ms. Burke by first modeling a lesson for her. She could observe me in my classroom presenting a similar lesson on levers. After my presentation, I could point out the differences between what I did and how she presented the lesson. By discussing the differences, she would discover ways to improve her teaching. I would follow up by observing her a few more times to make sure she was comfortable with the changes.

SECTION V

PREPARATION RESOURCES

The resources listed below may help you prepare for the TExMaT 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

Teaching Pre K–8, Early Years, Inc.

The Earth Scientist, National Earth Science Teachers Association

The Elementary School Journal, University of Chicago Press

The Science Teacher, National Science Teachers Association

The Texas Science Teacher, Science Teachers Association of Texas

Young Children, Journal of the National Association for the Education of Young People

Web Sites

Teacher Toolkit; Safety; Facilities; TEXTeams; Charles A. Dana Center
www.utdanacenter.org/sciencetoolkit

Texas Regional Collaboratives for Excellence in Science Teaching
www.thetrc.org

Science Teachers Association of Texas Convention: October 27–29; Houston, TX; 2005
www.statweb.org

NCLB: A Teacher Toolkit
www.ed.gov/teachers/nclbguide/nclb-teachers-toolkit.pdf

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

National Association of Biology Teachers
www.nabt.org

American Chemical Society
www.acs.org

American Association of Physics Teachers
www.aapt.org

Texas Earth Science Teachers Association
www.statweb.org/testa/

Texas Marine Education Association
www.stateweb.org/tmea

National Earth Science Teachers Association
www.nestanet.org

Girlstart: Nonprofit program to empower girls in science, mathematics, and technology
www.girlstart.org

National Science Teachers Association Convention: Houston, TX March 31–April 3, 2005
www.nsta.org

What Works Clearinghouse
www.w-w-c.org

UTOPIA: University of Texas Web site for educators
www.utopia.utexas.edu

Southwest Educational Development Laboratory
www.sedl.org

IBM Science Resource
www.tryscience.org/

NASA's The Space Place
www.spaceplace.nasa.gov

Earth Science Week Materials; October 9–15, 2005
www.earthscienceworld.org/week

Middle School Physical Science Resource Center
www.science-house.org/middleschool

Online-Middle School Science
www.bcps.org/offices/lis/curric/middle/sci.html

MiddleWeb, Science
www.middleweb.com

Other Sources

Arny, T. T. (2002). *Explorations: An Introduction to Astronomy* (3rd ed.). New York, NY: McGraw-Hill, Inc.

Bybee, R. W. (Ed.) (2002). *Learning Science and the Science of Learning: Science Educators' Essay Collection*. Arlington, VA: National Science Teachers Association.

Carr, J. F., and Harris, D. E. (2001). *Succeeding with Standards: Linking Curriculum, Assessment, and Action Planning*. Alexandria, VA: Association for Supervision and Curriculum Development.

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, D.C.: National Academy Press.

Cunningham, W. P., and Saigo, B. W. (1999). *Environmental Science: A Global Concern* (5th ed.). New York, NY: McGraw-Hill, Inc.

Delta Education. *K–6 Delta Science Readers*. Nashua, NH: Delta Education.

Driver, R., Squires, A., Rushworth, P., and Wood-Robinson, V. (1995). *Making Sense of Secondary Science: Research into Children's Ideas*. New York, NY: Routledge.

Enger, E. D., and Ross, F. C. (2001). *Concepts in Biology* (9th ed.). New York, NY: McGraw-Hill, Inc.

Hartman, H. J,., and Glasgow, N. A. (2001). *Tips for the Science Teacher: Research-Based Strategies to Help Students Learn*. Thousand Oaks, CA: Corwin Press.

Hewett, P. G. (2004). *Conceptual Physics* (9th ed.). Boston, MA: Addison Wesley Publishing Co.

Hewett, P. G., Suchocki, J., and Hewitt, L. (2002). *Conceptual Physical Science: Explorations*. Boston, MA: Addison Wesley Publishing Co.

Joyce, B. R., Weil, M., and Calhoun, E. (2000). *Models of Teachings* (6th ed.). Boston, MA: Allyn and Bacon, Inc.

Krogh, D. (2002). *Biology: A Guide to the Natural World* (2nd ed.). Upper Saddle River, NJ: Prentice-Hall Publishing Co.

Llewellyn, D. (2001). *Inquire Within: Implementing Inquiry-Based Science Standards*. Thousand Oaks, CA: Corwin Press.

Marzano, R. J., Pickering, D., and McTighe, J. (1993). *Assessing Student Outcomes: Performance Assessment Using the Dimensions of Learning Model.* Alexandria, VA: Association for Supervision and Curriculum Development.

National Research Council. (2001). *Classroom Assessment and the National Science Education Standards*. Washington, D.C.: National Academy Press.

National Research Council. (2002). *How People Learn: Brain, Mind, Experience, and School.* Washington, D.C.: National Academy Press.

National Research Council. (2005). *How Students Learn: History, Mathematics, and Science in the Classroom*. Washington, D.C.: National Academy Press.

National Research Council. (1996). *National Science Education Standards*. Washington, D.C.: National Academy Press.

Nebel, B. J., and Wright, R. T. (2000). *Environmental Science: The Way the World Works*. Upper Saddle River, NJ: Prentice-Hall Publishing Co.

Ostlund, K. L. (1992). *Science Process Skills: Assessing Hands-On Student Performance*. Boston, MA: Addison-Wesley Publishing Company, Inc.

Perrone, V. (Ed.). (1991). *Expanding Student Assessment.* Alexandria, VA: Association for Supervision and Curriculum Development.

Posner, G. J., and Rudnitsky, A. N. (1994). *Course Design: A Guide to Curriculum Development for Teachers* (4th ed.). White Plains, NY: Longman.

Ramig, J., Bailer, J., and Ramsey, J. (1995). *Teaching Science Process Skills*. Torrence, CA: Frank Schaffer Publications, Inc.

Rezba, R., et al. (1995). *Learning and Assessing Science Process Skills*. Dubuque, IA: Kendall/Hunt Publishing Company.

Rhoton, J., and Bowers, P. (Eds.). (1997). *Issues in Science Education*. Arlington, VA: National Science Teachers Association.

Rutherford, F. J., and Ahlgren, A. (1990). *Science for All Americans*. New York, NY: Oxford University Press.

Santa, C. M., and Alverman, D. E. (Eds.). (1991). *Science Learning: Processes and Applications*. Newark, DE: International Reading Association, Inc.

Scherer, M. (Ed.) (1999). *A Better Beginning: Supporting and Mentoring New Teachers*. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

Stronge, J. H. (2002). *Qualities of Effective Teachers.* Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

Stronge, J. H., Tucker, P. D., and Hindman, J. L. (2004). *Handbook for Qualities of Effective Teachers*. Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

Sullivan, C. G. (2004). *How to Mentor in the Midst of Change* (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development (ASCD).

Tarbuck, E. J., and Lutgens, F. K. (2000). *Earth Science* (9th ed.). Upper Saddle River, NJ: Prentice-Hall Publishing Co.

Texas Education Agency. (1997). *Texas Essential Knowledge and Skills (TEKS).* Austin, TX.

Texas Education Agency. (2000). *Texas Safety Standards: Kindergarten through Grade 12* (2nd ed.). Austin, TX.