TEXAS EDUCATION AGENCY
TEXAS EDUCATOR CERTIFICATION

TExES TExMaT TASC/TASC-ASL

Texas Examinations of Educator Standards™ (TExES™) Program

Preparation Manual

Life Science 7–12 (238)

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About The Test

Test Name	Life Science 7–12
Test Code	238
Time	5 hours
Number of Questions	100 multiple-choice questions
Format	Computer-administered test (CAT)

The TExES Life Science 7–12 (238) test is designed to assess whether an examinee has the requisite knowledge and skills that an entry-level educator in this field in Texas public schools must possess. The 100 multiple-choice questions are based on the Life Science 7–12 test framework. Questions on this test range from grades 7–12. The test may contain questions that do not count toward the score.

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

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The Domains

Domain	Domain Title	Approx. Percentage of Test	Standards Assessed
I.	Scientific Inquiry and Processes	15%	Life Science 7–12 I–III, VI—VII, XI
II.	Cell Structure and Processes	20%	Life Science 7–12 IX
III.	Heredity and Evolution of Life	20%	Life Science 7–12 IX
IV.	Diversity of Life	20%	Life Science 7–12 IX
V.	Interdependence of Life and Environmental Systems	15%	Life Science 7–12 IX
VI.	Science Learning, Instruction and Assessment	10%	Life Science 7–12 IV–V

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The Standards

Life Science 7–12 Standard I
The science teacher manages classroom, field and laboratory activities to ensure the safety of all students and the ethical care and treatment of organisms and specimens.

Life Science 7–12 Standard II
The science teacher understands the correct use of tools, materials, equipment and technologies.

Life Science 7–12 Standard III
The science teacher understands the process of scientific inquiry and its role in science instruction.

Life Science 7–12 Standard IV
The science teacher has theoretical and practical knowledge about teaching science and about how students learn science.

Life Science 7–12 Standard V
The science teacher knows the varied and appropriate assessments and assessment practices to monitor science learning.

Life Science 7–12 Standard VI
The science teacher understands the history and nature of science.

Life Science 7–12 Standard VII
The science teacher understands how science affects the daily lives of students and how science interacts with and influences personal and societal decisions.

Life Science 7–12 Standard IX
The science teacher knows and understands the science content appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in life science.

Life Science 7–12 Standard XI
The science teacher knows unifying concepts and processes that are common to all sciences.

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Domains and Competencies

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:

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

Domain I — Scientific Inquiry and Processes

Competency 001: *The teacher understands how to select and manage learning activities to ensure the safety of all students and the correct use and care of organisms, natural resources, materials, equipment and technologies.*

The beginning teacher:

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

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

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

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

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

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

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

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

Competency 002: *The teacher understands the nature of science, the process of scientific inquiry and the unifying concepts that are common to all sciences.*

The beginning teacher:

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

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

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

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

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

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

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

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

I. Understands the difference between a theory and a hypothesis, how models are used to represent the natural world and how to evaluate the strengths and limitations of a variety of scientific models (e.g., physical, conceptual, mathematical).

Competency 003: *The teacher understands the history of science, how science impacts the daily lives of students and how science interacts with and influences personal and societal decisions.*

The beginning teacher:

A. Understands the historical development of science, key events in the history of science and the contributions that diverse cultures and individuals of both genders have made to scientific knowledge.
B. Knows how to use examples from the history of science to demonstrate the changing nature of scientific theories and knowledge (i.e., that scientific theories and knowledge are always subject to revision in light of new evidence).
C. Knows that science is a human endeavor influenced by societal, cultural and personal views of the world, and knows that decisions about the use and direction of science are based on factors such as ethical standards, economics and personal and societal biases and needs.
D. Understands the application of scientific ethics to the conducting, analyzing and publishing of scientific investigations.
E. Applies scientific principles to analyze factors (e.g., diet, exercise, personal behavior) that influence personal and societal choices concerning fitness and health (e.g., physiological and psychological effects and risks associated with the use of substances and substance abuse).
F. Applies scientific principles, the theory of probability and risk/benefit analysis to analyze the advantages of, disadvantages of or alternatives to a given decision or course of action.
G. Understands the role science can play in helping resolve personal, societal and global issues (e.g., recycling, population growth, disease prevention, resource use, evaluating product claims).

Domain II — Cell Structure and Processes

Competency 004: *The teacher understands the structure and function of biomolecules.*

The beginning teacher:

A. Identifies the chemical elements necessary for life and understands how these elements combine to form biologically important compounds.
B. Relates the physical and chemical properties of water and carbon to the significance of these properties in basic life processes.
C. Analyzes how a molecule's biological function is related to its shape (e.g., enzymes, tRNA, DNA, receptors, neurotransmitters, lipids).

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

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

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

Competency 005: *The teacher understands that cells are the basic structures of living things and have specialized parts that perform specific functions.*

The beginning teacher:

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

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

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

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

Competency 006: *The teacher understands how cells carry out life processes.*

The beginning teacher:

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

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

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

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

Competency 007: *The teacher understands how specialized cells, tissues, organs, organ systems and organisms grow and develop.*

The beginning teacher:

A. Understands factors (e.g., hormones, cell size) that regulate the cell cycle and the effects of unregulated cell growth (e.g., cancer).
B. Analyzes the role of cell differentiation in the development of tissues, organs, organ systems and living organisms.
C. Analyzes factors (e.g., genetics, disease, nutrition, exposure to toxic chemicals) affecting cell differentiation and the growth and development of organisms.
D. Identifies the different levels of organization in multicellular organisms and relates the parts to each other and to the whole.

Domain III — Heredity and Evolution of Life

Competency 008: *The teacher understands the structures and functions of nucleic acids in the mechanisms of genetics.*

The beginning teacher:

A. Relates the structure of DNA (e.g., bases, sugars, phosphates) to the nature, function and relationships of genes, chromatin and chromosomes.
B. Relates the structures of DNA and RNA to the processes of replication, transcription, translation and genetic regulation.
C. Compares and contrasts the organization and control of the genome in viruses, prokaryotic cells and eukaryotic cells.
D. Understands the types, biological significance and causes of mutations.
E. Identifies methods and applications of genetic identification and manipulation (e.g., production of recombinant DNA, cloning, PCR).
F. Analyzes human karyotypes to identify chromosomal disorders and sex.

Competency 009: *The teacher understands the continuity and variations of traits from one generation to the next.*

The beginning teacher:

A. Applies the laws of probability to determine genotypic and phenotypic frequencies in Mendelian inheritance (e.g., using Punnett squares, pedigree charts).
B. Compares the processes of meiosis and mitosis (in plants and animals) and describes their roles in sexual and asexual reproduction.

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

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

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

Competency 010: *The teacher understands the theory of biological evolution.*

The beginning teacher:

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

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

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

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

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

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

Competency 011: *The teacher understands evidence for evolutionary change during Earth's history.*

The beginning teacher:

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

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

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

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

Domain IV — Diversity of Life

Competency 012: *The teacher understands similarities and differences between living organisms and how taxonomic systems are used to organize and interpret the diversity of life.*

The beginning teacher:

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

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

C. Explains the uses and limitations of classification schemes.

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

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

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

Competency 013: *The teacher understands that, at all levels of nature, living systems are found within other living systems, each with its own boundaries and limits.*

The beginning teacher:

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

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

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

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

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

Competency 014: *The teacher understands the processes by which organisms maintain homeostasis.*

The beginning teacher:

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

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

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

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

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

Competency 015: *The teacher understands the relationship between biology and behavior.*

The beginning teacher:

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

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

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

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

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

Domain V — Interdependence of Life and Environmental Systems

Competency 016: *The teacher understands the relationships between abiotic and biotic factors of terrestrial and aquatic ecosystems, habitats and biomes, including the flow of matter and energy.*

The beginning teacher:

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

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

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

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

Competency 017: *The teacher understands the interdependence and interactions of living things in terrestrial and aquatic ecosystems.*

The beginning teacher:

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

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

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

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

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

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

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

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

Competency 018: *The teacher understands the relationship between carrying capacity and changes in populations and ecosystems.*

The beginning teacher:

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

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

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

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

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

Domain VI — Science Learning, Instruction and Assessment

Competency 019: *The teacher understands research-based theoretical and practical knowledge about teaching science, how students learn science and the role of scientific inquiry in science instruction.*

The beginning teacher:

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

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

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

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

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

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

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

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

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

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

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

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

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

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Competency 020: *The teacher knows how to monitor and assess science learning in laboratory, field and classroom settings.*

The beginning teacher:

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

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

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

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

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

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

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

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

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

Approaches to Answering Multiple-Choice Questions

The purpose of this section is to describe multiple-choice question formats that you will typically see on the Life Science 7–12 test and to suggest possible ways to approach thinking about and answering them. These approaches are intended to supplement and complement familiar test-taking strategies with which you may already be comfortable and that work for you. Fundamentally, the most important component in assuring your success on the test is knowing the content described in the test framework. This content has been carefully selected to align with the knowledge required to begin a career as a Life Science 7–12 teacher.

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

When you are ready to respond to a multiple-choice question, you must choose one of four answer options. Leave no questions unanswered. Questions for which you mark no answer are counted as incorrect. Your score will be determined by the number of questions for which you select the correct answer.

The Life Science 7–12 test is designed to include a total of 100 multiple-choice questions, out of which 80 are scored. The number of scored questions will not vary; however, the number of questions that are not scored may vary in the actual test. Your final scaled score will be based only on scored questions. The questions that are not scored are being pilot tested to collect information about how these questions will perform under actual testing conditions. These pilot questions are not identified on the test.

How to Approach Unfamiliar Question Formats

Some questions include introductory information such as a map, table, graph or reading passage (often called a stimulus) that provides the information the question asks for. New formats for presenting information are developed from time to time. Tests may include audio and video stimulus materials such as a movie clip or some kind of animation, instead of a map or reading passage. Other tests may allow you to zoom in on the details in a graphic or picture.

Tests may also include interactive types of questions. These questions take advantage of technology to assess knowledge and skills that go beyond what can be assessed using standard single-selection multiple-choice questions. If you see a format you are not familiar with, **read the directions carefully**. The directions always give clear instructions on how you are expected to respond.

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

For most questions, you will respond by clicking an oval to choose a single answer choice from a list of options. Other questions may ask you to respond by:

- **Typing in an entry box.** When the answer is a number, you might be asked to enter a numeric answer or, if the test has an on-screen calculator, you might need to transfer the calculated result from the calculator into the entry box. Some questions may have more than one place to enter a response.
- **Clicking check boxes.** You may be asked to click check boxes instead of an oval when more than one choice within a set of answers can be selected.
- **Clicking parts of a graphic.** In some questions, you will choose your answer by clicking on location(s) on a graphic such as a map or chart, as opposed to choosing from a list.
- **Clicking on sentences.** In questions with reading passages, you may be asked to choose your answer by clicking on a sentence or sentences within the reading passage.
- **Dragging and dropping answer choices into "targets" on the screen.** You may be asked to choose an answer from a list and drag it into the appropriate location in a table, paragraph of text or graphic.
- **Selecting options from a drop-down menu.** This type of question will ask you to select the appropriate answer or answers by selecting options from a drop-down menu (e.g., to complete a sentence).

Remember that with every question, you will get clear instructions on how to respond.

Question Formats

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

— Single Questions
— Clustered Questions

On the following pages, you will find descriptions of these commonly used question formats, along with suggested approaches for responding to each type.

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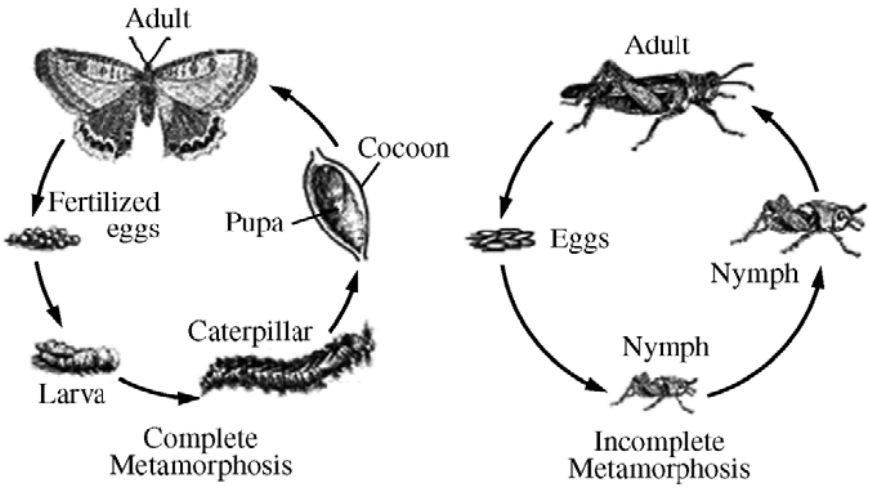
Single Questions

The single-question format presents a direct question or an incomplete statement. It can also include a reading passage, graphic, table or a combination of these. Four answer options appear below the question.

The following question is an example of the single-question format. It tests knowledge of Life Science 7–12 Competency 013: *The teacher understands that, at all levels of nature, living systems are found within other living systems, each with its own boundaries and limits.*

Example

Use the illustrations below to answer the question that follows.



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

   A. In species with complete metamorphosis, immature members of the species can avoid predators more easily
   B. In species with complete metamorphosis, growth and development occurs more rapidly and the individual reaches sexual maturity at an earlier age
   C. In species with complete metamorphosis, immature members of the species can disperse over a wider area after hatching
   D. In species with complete metamorphosis, immature and adult life stages can utilize different parts of the larger environment

Suggested Approach

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

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

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

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

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

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

Clustered Questions

Clustered questions are made up of a stimulus and two or more questions relating to the stimulus. The stimulus material can be a reading passage, description of an experiment, graphic, table or any other information necessary to answer the questions that follow.

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

Strategy 1 Skim the stimulus material to understand its purpose, its arrangement and/or its content. Then read the questions and refer again to the stimulus material to obtain the specific information you need to answer the questions.

Strategy 2 Read the questions *before* considering the stimulus material. The theory behind this strategy is that the content of the questions will help you identify the purpose of the stimulus material and locate the information you need to answer the questions.

Strategy 3 Use a combination of both strategies. Apply the "read the stimulus first" strategy with shorter, more familiar stimuli and the "read the questions first" strategy with longer, more complex or less familiar stimuli. You can experiment with the sample questions in this manual and then use the strategy with which you are most comfortable when you take the actual test.

Whether you read the stimulus before or after you read the questions, you should read it carefully and critically. You may want to note its important points to help you answer the questions.

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

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

Example

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

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

Now you are prepared to respond to the first of the two questions associated with this stimulus. The first question tests knowledge of Life Science 7–12 Competency 016: *The teacher understands the relationships between abiotic and biotic factors of terrestrial and aquatic ecosystems, habitats and biomes, including the flow of matter and energy.*

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

   A. Bacterial digestion shreds the coarse material in the heap into finer particles that can be more closely packed
   B. Bacterial respiration converts some of the carbon in the heap to carbon dioxide that is released into the atmosphere
   C. Heat produced by spontaneous combustion in the heap converts much of the original mass into energy
   D. Bacterial digestion converts the large molecules of cellulose and other carbon compounds in the heap to smaller and simpler carbon compounds

Suggested Approach

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

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

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

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

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

Now you are ready to answer the next question. The second question measures Life Science 7–12 Competency 019: *The teacher understands research-based theoretical and practical knowledge about teaching science, how students learn science and the role of scientific inquiry in science instruction.*

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

   A. The student knows that relationships exist between properties of matter and its components
   B. The student uses scientific methods during field and laboratory investigations
   C. The student knows that interdependence and interactions occur within an ecosystem
   D. The student knows the significance of plants in the environment

Suggested Approach

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

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

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

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

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

In this way, analysis of the four options should lead you to select **option C as the best response**.

Multiple-Choice Practice Questions

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

For each sample test question, there is a correct answer and a rationale for each answer option. Please note that the sample questions are not necessarily presented in competency order.

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

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

COMPETENCY 001

1. The hamster kept as a class pet had a litter of 14 babies. Once the babies were a week old, the students monitored their growth by weighing them every other day and recording their individual weights to the nearest gram. The students used calculators to also determine the average weight of all the babies each time they were weighed. Many of the students reported the average weight to hundredths of grams. Which of the following best explains why the averages should have been reported only to the nearest gram?

   A. It is simpler to graph data points that are rounded to the nearest whole number
   B. A calculation cannot appear to be more accurate than the original measurement
   C. Rounding to the nearest whole number facilitates determining which students performed the most accurate measurements
   D. The sample size was too small to justify averages in hundredths of grams

Answer and Rationale

COMPETENCY 001

2. In an effort to increase the number of students eating vegetables at lunch, school cafeteria management asked students to sample six different vegetables, each vegetable presented both raw and cooked. The cafeteria personnel recorded the number of students who said that they would eat the vegetables if presented at lunch in each of the tested forms. Which of the following types of graph will most effectively show the data for simplicity of interpretation?

   A. Scatter plot
   B. Stem-and-leaf plot
   C. Line graph
   D. Bar graph

Answer and Rationale

COMPETENCY 003

3. Prior to the 1940s and 1950s, it was generally believed that heritable genetic material was composed of protein. It was known that chromosomes contain both DNA and proteins, the latter of which appeared to provide the complexity apparently required by genetic material. Experiments performed in the 1940s and 1950s confirmed that genetic material was actually DNA by demonstrating both its heritability and its importance in dictating the phenotype of an organism. Which of the following is best demonstrated by this scenario?

   A. Hypotheses should not be proposed before knowing all the facts
   B. Experimental data obtained before the middle of the twentieth century is unreliable
   C. Scientific theories are subject to change in light of new data
   D. A theory must be absolutely supported by data prior to its publication

Answer and Rationale

COMPETENCY 004

4. A particular virus infects only particular types of cells in particular organisms. Which of the following is of greatest importance in determining which cell types are infected?

   A. The structures of a ligand on the surface of a virus and a receptor on the surface of a cell
   B. The ratio between the concentration of virus and the number of cells of a particular type
   C. The pH and temperature environment of the body around different cell types
   D. The differing availability to viruses of products produced by different cell types

Answer and Rationale

COMPETENCY 004

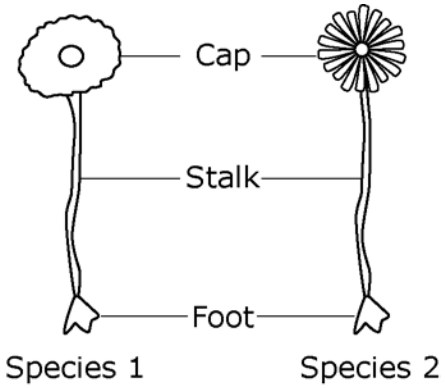
5. Which of the following properties is one that makes carbon basic to the chemistry of life?

   A. Carbon has many isotopes, two of which are stable
   B. Carbon readily reacted with other atoms in the ancient Earth atmosphere to form many complex molecules
   C. A carbon atom has four valence electrons and forms four covalent bonds with other atoms
   D. A carbon atom has an equal number of protons and electrons

Answer and Rationale

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

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



Acetabularia are single-celled marine algae that reach between 2 and 5 cm in length. A cap at one end of the cell is attached to a stalk, which is in turn attached to a foot. If the cap of a cell is removed, a new cap grows on the stalk and the detached cap degrades. Experiments have shown that if a stalk from species 2 is grafted onto a foot from species 1, a new cap grows on the end of the stalk that in a short while resembles a species 1 cap. Similarly, grafting a species 1 stalk onto a species 2 foot gives rise to a cap that in a short while resembles a species 2 cap. Regrowth of caps following removal of the new caps always results in caps of the same species type as the feet.

COMPETENCY 005

6. Which of the following best explains the experimental results?

   A. mRNAs are stored in *Acetabularia* caps
   B. A growth factor is present in the stalk of *Acetabularia*
   C. Nuclei are present in *Acetabularia* feet
   D. Chloroplasts are concentrated in *Acetabularia* feet

Answer and Rationale

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

COMPETENCY 002

7. Which of the following is the best control for the grafting procedure?

   A. Remove the stalk and cap from a foot of species 1 and observe whether the foot regrows at the base of the stalk
   B. Remove a cap and stalk from a foot of species 1 and replace the same cap and stalk and observe cap regrowth and morphology
   C. Remove the cap and stalk from a foot of species 1, replace with the stalk from a third species of *Acetabularia*, and observe cap morphology
   D. Remove the cap and stalk from a foot of species 1, replace with one stalk each of species 1 and 2, and observe cap morphology

Answer and Rationale

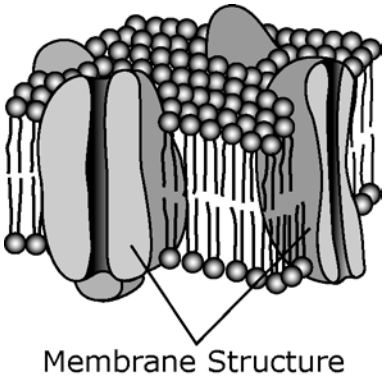
COMPETENCY 019

8. Which of the following procedures is most likely to engage and motivate the students to learn more about regulation of cell growth?

   A. Play a game in which teams of students compete to see who can correctly answer the most questions about organelle function
   B. Direct the students to Internet sites on which they can watch animations of cell processes
   C. Have the students read short biographies of scientists who are engaged in research about cell-growth regulation
   D. Have the students microscopically examine cultured cells before and after they add substances to the cells that affect cell division and morphology

Answer and Rationale

Use the diagram below to answer the question that follows.



COMPETENCY 005

9. The diagram is a model of a eukaryotic cell membrane. Which of the following is the most likely function of the indicated membrane structures?

   A. To facilitate the exchange of O_2 and CO_2 by the cell
   B. To catalyze the synthesis of molecules secreted by the cell
   C. To enable the movement of ions across the cell membrane
   D. To promote the entry of hormones into the cell

Answer and Rationale

COMPETENCY 005

10. Which of the following properties best distinguishes prokaryotic and eukaryotic cells from all viruses?

    A. Prokaryotes and eukaryotes are surrounded by a lipid bilayer, and viruses are not
    B. Prokaryotes and eukaryotes divide by mitosis, and viruses do not
    C. Prokaryotes and eukaryotes synthesize proteins on ribosomes, and viruses do not
    D. Prokaryotes and eukaryotes have genomes of DNA, and viruses have genomes of RNA

Answer and Rationale

COMPETENCY 006

11. Which of the following provides the major source of energy for cellular respiration in plants?

    A. Energy from the Sun
    B. CO_2 and water
    C. Nutrients absorbed from the soil
    D. Sugars synthesized by photosynthesis

Answer and Rationale

COMPETENCY 006

12. Which of the following is commonly produced in anaerobic respiration but not in aerobic respiration?

    A. Lactic acid
    B. ATP
    C. Pyruvic acid
    D. H_2O

Answer and Rationale

COMPETENCY 007

13. Which of the following is most likely to trigger uncontrolled cell division and tumor formation?

    A. A mutation of a cyclin protein that interferes with the binding of cyclins and cyclin-dependent kinases (Cdk)
    B. A mutation to a cell surface receptor that causes continuous signaling in the absence of ligand binding
    C. An increase in the cytosolic concentration of second messengers such as cAMP and Ca^{2+}
    D. An increase in the rate of cellular respiration and ATP production

Answer and Rationale

COMPETENCY 008

14. If a single base pair is deleted from the coding region of gene *X*, which of the following is the most likely effect on the entire sequence of protein X?

    A. Protein X will be of normal sequence because three sequential base pairs must be deleted to affect the protein sequence
    B. Protein X will be of normal sequence because one of every three base pairs is a wobble base that can be deleted without altering protein sequence
    C. Protein X will differ from the normal sequence by one amino acid coded in the region of the deletion
    D. Protein X will be significantly shorter than the normal length because a stop codon will be introduced

Answer and Rationale

COMPETENCY 008

15. For which of the following reasons is it better to clone a cDNA than genomic DNA into bacteria if the bacteria are to synthesize a eukaryotic protein of the correct sequence?

    A. There are discrepancies between the genetic codes of prokaryotes and eukaryotes
    B. The transcription factors of prokaryotes and eukaryotes differ
    C. Bacteria cannot process mRNAs to remove introns
    D. Bacteria cannot modify proteins in the same way as eukaryotes can

Answer and Rationale

COMPETENCY 009

16. In a particular species of fly, gene *R* can be found in two allelic forms, *R*, which is dominant, and *r*, which is recessive. Similarly, gene *T* can be found in two allelic forms, *T*, which is dominant, and *t*, which is recessive. A female fly of genotype *RrTt* is crossed with a male fly of genotype *rrtt*. The progeny are examined with respect to genes *R* and *T*, and their genotypes are determined. The results are shown in the following table.

Genotype	Percent of Progeny
RrTt	39%
Rrtt	11%
rrTt	13%
rrtt	37%

Which of the following is the most likely explanation for the data?

A. Genes *R* and *T* are on different chromosomes that exhibit independent assortment
B. Genes *R* and *T* are linked on a single chromosome
C. Genes *R* and *T* are both on the X chromosome
D. Genes *R* and *T* are on different chromosomes that do not assort independently

Answer and Rationale

COMPETENCY 009

17. Siamese cats are white at birth but, as they mature, they become tan with much darker extremities, including the ears, nose, legs and tail. Which of the following is the most likely explanation of the color pattern?

A. An allele of a gene required for pigment synthesis encodes a temperature-sensitive enzyme
B. An allele of a gene required for pigment synthesis is triggered by sex hormones
C. A gene required for pigment synthesis is located in mitochondrial DNA and is only expressed in cells of the extremities
D. A gene required for pigment synthesis in cells is activated by increased light exposure

Answer and Rationale

COMPETENCY 010

18. It has been observed that when two species of stickleback fish occur in a single lake, they have distinct morphologies and niches. The species differ in size and shape and in the number and length of the gill rakers that are involved in food particle retention. One species feeds in open water, and the other feeds at the lake bottom. When only one species of stickleback inhabits a lake, the species exhibits an intermediate morphology and niche. This scenario illustrates which of the following phenomena?

    A. Müllerian mimicry
    B. Character displacement
    C. Facilitation
    D. Competitive exclusion

Answer and Rationale

COMPETENCY 010

19. Which of the following scenarios best illustrates disruptive selection?

    A. Female widowbirds preferentially mate with male widowbirds with longer tails
    B. Water boatmen occur in three distinct shades of brown; when a population includes all three shades, predatory fish eat a disproportionately large number of the most common form and reduce its frequency in the population
    C. Guppies that are preyed on by fish that prefer large, mature guppies reproduce at a smaller size and younger age than more rapidly growing guppies that are preyed on by fish that prefer small, juvenile guppies
    D. Under drought conditions, a population of cactus finches includes individuals with deep bills and others with long bills but few with bills of intermediate shape, as are common with normal rainfall

Answer and Rationale

COMPETENCY 011

20. Recent evidence suggests that the segmented body plan of several protostome phyla arose independently in the phyla, rather than from a common ancestor. The evidence suggests convergent evolution of segmentation in Annelida (segmented worms), Arthropoda (arthropods) and Onychophora (velvet worms). Which of the following most likely provided the evidence?

    A. Analyses of ribosomal RNA and mitochondrial DNA sequences
    B. Studies of newly uncovered fossils from several geologic periods
    C. Comparison of interactions between cells in different segments
    D. Comparison of chromosome numbers among the three types of organisms

Answer and Rationale

COMPETENCY 011

21. Which of the following adaptations was important in the evolution of terrestriality in plants?

    A. Production of spores
    B. Development of vascular tissue
    C. Shedding of leaves during cold weather
    D. Ability to perform photosynthesis

Answer and Rationale

COMPETENCY 012

22. Which of the following adaptations best distinguishes a desert mammal from one that lives in the taiga?

    A. Ability to burrow into the ground
    B. Use of fur color as camouflage from predators
    C. Mode of obtaining and retaining water
    D. Reproducing sexually or by parthenogenesis

Answer and Rationale

COMPETENCY 012

23. Which of the following best distinguishes the structure of bacteria from that of archaea?

    A. Genomes of bacteria are located in nucleoids, and those of archaea are located in nuclei
    B. Cell walls of bacteria contain peptidoglycan, and those of archaea lack peptidoglycan
    C. Chromosomes of bacteria are circular, and those of archaea are linear
    D. Chlorophyll in bacteria is located in infoldings of the plasma membrane, and chlorophyll in archaea is located in chloroplasts

Answer and Rationale

COMPETENCY 013

24. People and animals are vaccinated to protect them from potential pathogens. Which of the following best describes the mechanism by which a vaccination provides protection?

    A. The lymphatic system carries pathogens more rapidly to lymphoid organs after preexposure to a similar vaccine
    B. The vaccine remains in the body and competes with the real pathogen for cells to infect
    C. Memory lymphocytes are produced that rapidly respond upon subsequent encounter with a pathogen that resembles a vaccine
    D. There is an increase in the number of phagocytic cells that can find and ingest pathogens that resemble a vaccine

Answer and Rationale

COMPETENCY 013

25. Mutation of a protein specific to which of the following cell types is most likely to interfere with the transport of sugars in angiosperms?

    A. Sclereids
    B. Tracheids
    C. Collenchyma cells
    D. Sieve-tube elements

Answer and Rationale

COMPETENCY 014

26. In the flipper of a dolphin, each artery is surrounded by several veins. Which of the following is the best explanation for the arrangement of blood vessels?

    A. Cool blood in the veins receives heat from arterial blood as the venous blood returns to the animal's core
    B. Oxygen-poor blood in the veins absorbs oxygen from the artery as the blood returns to the animal's core
    C. The artery is protected from trauma by the veins and surrounding musculature
    D. Flipper movement ensures that the rate of blood flow in the veins equals the rate of flow in the artery

Answer and Rationale

COMPETENCY 015

27. Which of the following best demonstrates that some behaviors involve both an innate and a learned component?

    A. A pheromone produced by a queen honeybee attracts workers to the queen in the hive and drones to the queen outside the hive
    B. The females of some cichlid species hold fertilized eggs in their mouths until the eggs hatch and the fry become free swimming
    C. Whooping cranes raised by sandhill cranes imprint on sandhill cranes and do not recognize other whooping cranes
    D. A rat that presses a lever in a box and routinely receives a food reward will continue to press the lever

Answer and Rationale

COMPETENCY 016

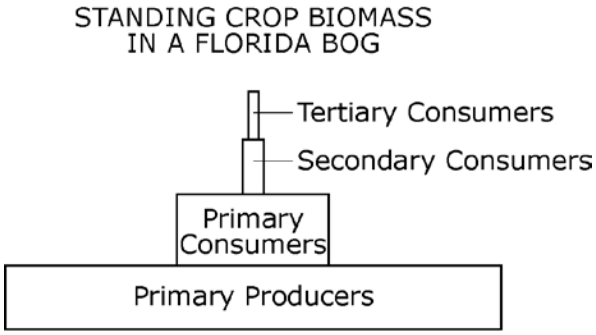
28. The productivity of coral reefs is substantially greater than the productivity of the open ocean. Which of the following best explains the high productivity of coral reefs?

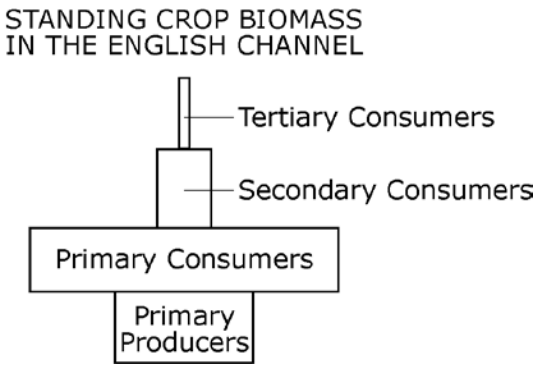
    A. Corals grow in relatively deep water with a low concentration of salt and a high concentration of dissolved CO_2
    B. Corals grow close to the shore in warm water dense with plankton and with a high concentration of nutrients from land runoff
    C. Corals grow in shallow cold water with abundant sunlight and a high concentration of dissolved O_2
    D. Corals grow in relatively shallow, nutrient-poor water easily penetrated by sunlight

Answer and Rationale

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

Shown below is a diagram of standing biomass pyramids for two ecosystems, a Florida bog and the English Channel. Use the diagram to answer the two questions that follow.





COMPETENCY 017

29. Which of the following best explains why the pyramids narrow so sharply as they reach the top level?

    A. Organisms at higher levels die more rapidly than organisms at lower levels
    B. Inefficient energy transfers between levels support fewer organisms at higher levels
    C. Organisms at higher levels produce fewer offspring than organisms at lower levels
    D. Recycling of organic matter and essential chemical elements occurs less efficiently at higher levels

Answer and Rationale

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

COMPETENCY 017

30. Which of the following best explains why primary consumers, zooplankton, outweigh primary producers, phytoplankton, in the biomass pyramid of the English Channel?

    A. Individual phytoplankton are denser than zooplankton and provide such a rich energy source that few are required per zooplankton
    B. Zooplankton are both heterotrophic and autotrophic and so are not entirely dependent on phytoplankton as an energy source
    C. Zooplankton use energy exceptionally efficiently so that many can be supported by relatively few phytoplankton
    D. Phytoplankton reproduce and are consumed so quickly by the zooplankton that they cannot develop a large standing crop

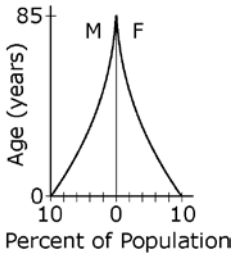
Answer and Rationale

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

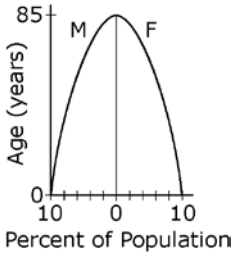
COMPETENCY 018

31. Assuming no emigration, immigration or catastrophic event, which of the following graphs best illustrates a population that is likely to decrease in size over the next 25 years?

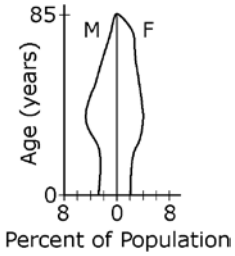
A.



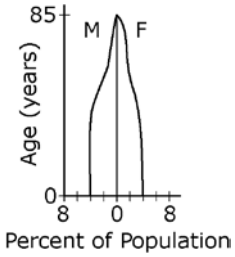
B.



C.



D.



Answer and Rationale

NOTE: After clicking on a link, right click and select "Previous View" to go back to original text.

COMPETENCY 020

32. Students perform a laboratory exercise to investigate how cell membranes regulate the movement of materials into and out of cells. They use both live cells and artificial membranes, exposing both to several treatments and monitoring the effects of the treatments. Which of the following methods will best allow the teacher to assess understanding by each student of the significance of the results?

    A. Have the students write reports on the exercise and include a discussion in which they infer from their results the mechanisms by which many different types of materials cross cell membranes
    B. Have the students work in pairs and discuss the experiments with each other as they perform the exercise
    C. After completing the exercise, select several volunteers to stand up and summarize the significance of the results to the rest of the class
    D. After completing the exercise, give the students a multiple-choice quiz with questions about the procedure and the results obtained as they performed the exercise

Answer and Rationale

Answer Key and Rationales

Question Number	Competency Number	Correct Answer	Rationales
1	001	B	**Option B is correct** because significant figures rules state that there cannot be more significant figures in a calculation than in the data used for the calculation. **Option A is incorrect** because the ability to graph is irrelevant to the calculation of averages. **Option C is incorrect** because the question asks nothing about comparing the students' results and results can be compared equally well with more figures. **Option D is incorrect** because significant figures, rather than sample size, determines the number of figures in the averages. Back to Question
2	001	D	**Option D is correct** because each form of each vegetable is a discrete variable which can be indicated on the X-axis and form the basis for a bar. The absolute number of students who positively responded to each vegetable determines the height of each bar. To determine which vegetables are most likely to be consumed, the heights of the 12 bars can be easily compared. **Option A is incorrect** because there is no absolute X-axis variable to plot. **Option B is incorrect** because a stem-and-leaf plot is used to examine the distribution of a series of numerical observations within a single data set, such as the amount of one particular vegetable eaten by individual students. **Option C is incorrect** because there is no absolute X-axis variable to plot and so no points to connect into a line. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
3	003	C	**Option C is correct** because the experiments to determine what molecule contained genetic material took place over many years and continuously built on prior experiments. As technology improved and as more data was generated, the theory changed. This is a relatively common occurrence. **Option A is incorrect** because hypotheses are based on logical analysis of available data and then are further tested, to be eventually accepted, discarded or modified. **Option B is incorrect** because much experimental data obtained early in the twentieth century has proven to be very reliable. In many cases, further experimentation with more modern techniques has upheld previous data and conclusions. **Option D is incorrect** because theories based on experiments that have received peer-reviews are deemed to be logical and worthy of further investigation, and are published with supporting data in scientific journals. This allows the theories to be tested further by the same or many other investigators. Back to Question
4	004	A	**Option A is correct** because the specificity of interaction between the amino acids of the ligand on the surface of a virus and the amino acids and carbohydrates of a receptor molecule on the surface of a cell determines both host range and tissue-type specificity of virus binding. **Option B is incorrect** because the ratio of virus to cell number might influence the number of cells infected, but it will not determine which cells are infected. **Option C is incorrect** because pH and temperature should be relatively constant in the body, and they are not likely to alter viral specificity. **Option D is incorrect** because molecules produced by the cells might possibly alter the rate of new virus production, but they will not affect viral specificity. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
5	004	C	**Option C is correct** because the atom's ability to make four covalent bonds allows it to form large, complex molecules. **Option A is incorrect** because the number of isotopes does not influence carbon's role in the chemistry of life. **Option B is incorrect** because carbon is thought to have combined to form only a few simple molecules. **Option D is incorrect** because, while a true statement, the number of protons is typically identical to the number of electrons in any uncharged atom. Back to Question
6	005	C	**Option C is correct** because nuclei contain the genetic material with directions for protein production in the cell. The fact that it apparently takes a short while for the cap to assume an appearance parallel with the strain of the foot implies that older mRNAs and proteins in the cell degrade and new ones are synthesized based on genetic material in the foot. Because genetic material is in nuclei, then the feet must contain nuclei. **Option A is incorrect** because the caps are removed in the experiments described so nothing can be concluded about mRNA storage in the caps. **Option B is incorrect** because a growth factor, particularly one in the grafted stalk, should not influence the type of cap produced and make it match the foot species. **Option D is incorrect** because chloroplasts do contain some genetic material but that material is used for chloroplast function only. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
7	002	B	**Option B is correct** because it demonstrates whether a cap and stalk can be removed from *Acetabularia* and replaced without any loss of viability or change to the morphology. **Option A is incorrect** because it involves no grafting and additionally tests the regrowth of the foot rather than of the stalk and cap. **Option C is incorrect** because it introduces the variable of an additional species. **Option D is incorrect** because it introduces the variable of two species' stalks grafted onto a single foot. Back to Question
8	019	D	**Option D is correct** because the students will become more engaged when they get to manipulate cells by themselves and observe the effects of their manipulations. **Option A is incorrect** because such a game does not directly address regulation of cell growth or stimulate curiosity. **Option B is incorrect** because watching animations is a passive form of learning, and it may not generate interest in cell-growth regulation. **Option C is incorrect** because it is passive learning and does not directly address regulation of cell growth. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
9	005	C	**Option C is correct** because the labeled structures appear to be integral membrane proteins with channels running through them. Ions in solution are hydrated by water and are too large to pass between membrane lipids. They require channel proteins, with different proteins specific to each type of ion. **Option A is incorrect** because O_2 and CO_2 can pass between membrane lipids. **Option B is incorrect** because molecules secreted by a eukaryotic cell are synthesized by cellular organelles rather than by channel proteins. **Option D is incorrect** because most protein hormones bind to cell membrane receptors without entering the cells and lipid hormones pass between the membrane lipids. Back to Question
10	005	C	**Option C is correct** because viruses contain no ribosomes and are dependent on the ribosomes of the prokaryotic or eukaryotic cells they infect for synthesis of viral proteins. **Option A is incorrect** because many viruses that infect eukaryotic cells are released by budding out of the cells and so acquire an envelope derived from the cell's plasma membrane. **Option B is incorrect** because only eukaryotes divide by mitosis. **Option D is incorrect** because many viruses have genomes of DNA; the viruses that infect bacteria all have DNA genomes. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
11	006	D	**Option D is correct** because plants synthesize sugars by photosynthesis, and the sugars can be converted to glucose. The energy stored in glucose is then released by glycolysis, and the Krebs/citric acid cycle in the cytosol and mitochondria of the plant cells, respectively. **Option A is incorrect** because the Sun provides energy for photosynthesis but not for cellular respiration. **Option B is incorrect** because CO_2 and water are not energy sources. CO_2 is released during cellular respiration and fixed in photosynthesis; H_2O is produced during cellular respiration and provides a source of electrons for noncyclic photo-phosphorylation in photosynthesis. **Option C is incorrect** because no nutrients are absorbed from the soil that provide energy for cellular respiration. Back to Question
12	006	A	**Option A is correct** because lactic acid is a product of fermentation, which is a common form of anaerobic respiration. **Option B is incorrect** because ATP is produced in both anaerobic and aerobic respiration. **Option C is incorrect** because pyruvic acid is the final breakdown product of glucose in glycolysis, the initial metabolic pathway of both anaerobic and aerobic respiration. **Option D is incorrect** because H_20 is released when oxygen is reduced during oxidative phosphorylation of aerobic respiration. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
13	007	B	**Option B is correct** because binding of a ligand such as a cellular growth factor to a cell surface receptor is the normal way by which intracellular signaling is triggered. Mutations to such receptors often induce conformational changes to the receptors that cause the receptors to initiate signaling in the absence of ligand binding. **Option A is incorrect** because blocking interaction between cyclins and cyclin-dependent kinases blocks cell cycle progression and cell division. **Option C is incorrect** because cAMP and Ca^{2+} are ubiquitous second messengers, so increasing their concentrations is likely to cause so many metabolic problems in a cell that the cell will die. **Option D is incorrect** because increased cellular respiration and ATP production are likely to be a consequence of, rather than a cause of, increased cell division. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
14	008	D	**Option D is correct** because each codon specifying an amino acid is three bases, so loss of a single base pair in the DNA will alter the entire amino acid coding sequence past the deletion, i.e., will alter the translation reading frame. Because three codons of the genetic code are translation stop codons rather than amino acid-dictating codons, it is likely that one of the altered codons will be a stop codon, causing a shorter protein to be produced. **Option A is incorrect** because deletion of one base pair alters the translation reading frame. **Option B is incorrect** because only the third base of many codons is a wobble base whose alteration does not alter the amino acid encoded, and the question does not indicate that the third base is the one that is deleted. Additionally, the third base of some codons is not a wobble base so changing the third base of such codons does alter which amino acid is encoded. **Option C is incorrect** because deletion of one base pair alters the entire translation reading frame and not just a single amino acid. Back to Question
15	008	C	**Option C is correct** because cDNA, a double-stranded DNA copy of an mRNA, does not contain introns, but genomic DNA does. Bacteria do not have the molecules necessary to process pre-mRNAs and remove the introns prior to translation. The only way to translate a protein of correct amino acid sequence is to clone a cDNA that lacks the introns. **Option A is incorrect** because the genetic codes of prokaryotes and eukaryotes are essentially identical. **Option B is incorrect** because transcription factors are irrelevant to pre-mRNA processing. **Option D is incorrect** because it refers to protein modifications, but the difference between a cDNA and genomic DNA is the lack or presence, respectively, of introns. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
16	009	B	**Option B is correct** because the expected data, if genes *R* and *T* are completely unlinked, should show 25% of each genotype of progeny. The genotype of the gamete from the male fly can only be *rt* and, if the genes are unlinked, there is a 25% chance of gametes with each of the following genotypes being produced by the female fly: *RT*, *Rt*, *rT*, *rt*. The data suggest that (1) the female fly, with genotype *RrTt*, is the result of a pairing between *RT* and *rt* gametes and (2) the *R* and *T* or *r* and *t* alleles are close enough on the chromosome that relatively little crossing-over occurred between them during formation of gametes by the female fly. **Option A is incorrect** because 25% of each genotype of progeny is expected if the genes are on different chromosomes and assorting independently. **Option C is incorrect** because there is no information to suggest that male and female progeny differ in their expression of the genes, as would be the case with X-linkage. **Option D is incorrect** because different chromosomes do assort independently of each other. Back to Question
17	009	A	**Option A is correct** because extremities of a cat are cooler than the core and if an enzyme that is required for pigment synthesis or deposition has a different conformation and exhibits greater activity at a lower temperature, then only the extremities will be dark. **Option B is incorrect** because it is highly improbable that sex hormones will activate a gene associated with pigment deposition only in cells of the extremities. **Option C is incorrect** because most mitochondrial genes encode products required for mitochondrial function and are not expected to differentially affect pigment production or deposition. **Option D is incorrect** because other parts of the animal are exposed to light to the same degree as the extremities. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
18	010	B	**Option B is correct** because character displacement refers to the tendency for traits to be more divergent in sympatric populations of two species than in allopatric populations of the same species. **Option A is incorrect** because Müllerian mimicry refers to a resemblance between two or more unpalatable species that generally have a common predator, but the stickleback fish described differ in appearance and occupy different niches that probably have different predators. **Option C is incorrect** because facilitation refers to the positive effect of one species on the survival and reproduction of another species, but the two stickleback species have separate niches. **Option D is incorrect** because competitive exclusion refers to the greater success of one species when two species compete for the same resources, but the two stickleback species have separate niches and do not compete. Back to Question
19	010	D	**Option D is correct** because disruptive selection is a form of natural selection in which individuals with extreme phenotypes survive and reproduce with greater success than do individuals with intermediate phenotypes. **Option A is incorrect** because the scenario illustrates sexual selection. **Option B is incorrect** because the scenario illustrates frequency-dependent selection in which the frequency of different phenotypes is maintained at approximately equal levels by reduction of the most common phenotype, in this instance because of the greater likelihood of being eaten. **Option C is incorrect** because the scenario illustrates directional selection in which there is a shift, under certain predator conditions, toward more rapidly maturing guppies that can reproduce prior to being eaten. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
20	011	A	**Option A is correct** because comparing the similarities or dissimilarities of rRNA and mitochondrial DNA sequences in different organisms has been shown to be a reliable way of analyzing possible relationships. Such technologies were not available in the early days of phylogeny construction. **Option B is incorrect** because discovery of a few fossils in these rather diverse phyla is unlikely to demonstrate the origin of segmentation. **Option C is incorrect** because interactions between cells might provide data on cell signaling, but it will not provide data on the origin of segmentation. **Option D is incorrect** because chromosome numbers provide no indication about similarity or dissimilarity of gene sequences or evolution of segmentation. Back to Question
21	011	B	**Option B is correct** because development of the vascular tissue common to all land plants enabled the transport of water and so prevented dehydration of the plants. **Option A is incorrect** because spore production bears no relation to terrestriality, and spores are produced by many different types of organisms. **Option C is incorrect** because many plants, such as conifers, do not shed their leaves in cold weather. **Option D is incorrect** because the aquatic organisms from which land plants arose already performed photosynthesis, and these organisms were in turn derived from ancient photosynthetic prokaryotes. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
22	012	C	**Option C is correct** because water is far more plentiful in the taiga than in the desert. Desert mammals have evolved mechanisms for conserving water that include more efficient water extraction from oxidation of macromolecules in their food and production of more concentrated urine. **Option A is incorrect** because some species of mammals in both regions burrow into the ground. **Option B is incorrect** because mammals in both regions use fur color as camouflage. **Option D is incorrect** because mammals in both regions use sexual reproduction. Parthenogenesis is not a characteristic of mammals. Back to Question
23	012	B	**Option B is correct** because the presence or absence of peptidoglycan is a major structural distinction between bacteria and archaea. **Option A is incorrect** because both bacteria and archaea have nucleoids; nuclei are a characteristic of eukarya only. **Option C is incorrect** because the chromosomes of both bacteria and archaea are circular. **Option D is incorrect** because some bacteria perform photosynthesis using chlorophyll embedded in infoldings of the plasma membrane, but neither chlorophyll nor photosynthesis has been demonstrated in any archaea. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
24	013	C	**Option C is correct** because vaccination produces clones of lymphocytes specific to the introduced material, and many of the lymphocytes are memory cells that are activated much more rapidly than naïve cells upon subsequent encounter with a pathogen similar to the material in the vaccination. **Option A is incorrect** because vaccination has no effect on the rate at which material is carried through the lymphatic system. **Option B is incorrect** because the vaccine is typically completely cleared from the body within a few weeks. **Option D is incorrect** because phagocytic cell populations do not expand upon preexposure to a vaccine and the cells exhibit no memory. Back to Question
25	013	D	**Option D is correct** because sieve-tube elements are the cells that conduct sugars and other organic nutrients in the phloem of angiosperms. The sieve-tube elements are alive but lack most organelles as this leaves maximal space for nutrient passage through the cells. **Option A is incorrect** because sclereids are cells with very thick secondary cell walls that provide support to a plant or to its products such as seed coats and that are often dead at maturity. **Option B is incorrect** because tracheids are cells of the xylem that extend in the direction of water movement and that possess pits to allow water movement between the cells. **Option C is incorrect** because collenchyma cells are flexible cells that are alive at maturity and that provide support to a plant, especially to new growth. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
26	014	A	**Option A is correct** because this is an example of a counter-current heat exchanger. To conserve body heat, venous blood that has cooled in the flipper and is returning to the body core absorbs heat from arterial blood that is directed to the flipper. **Option B is incorrect** because there is no gas exchange between blood in the artery and the veins. **Option C is incorrect** because veins are soft and do not provide protection for an artery, although the muscles will protect all the blood vessels to some extent. **Option D is incorrect** because while flipper movement does help blood flow in veins, it does not ensure an equal rate to the flow in the artery and it does not explain the particular arrangement of the vessels. Back to Question
27	015	C	**Option C is correct** because imprinting involves a period when young animals such as cranes innately recognize an adult animal caring for them as a parent and a learning component as the young animals mimic behaviors from the perceived parent. **Option A is incorrect** because an attraction to a pheromone is strictly innate. **Option B is incorrect** because a cichlid does not learn to hold eggs and fry in its mouth but is exhibiting an innate behavior. **Option D is incorrect** because this is an example of operant conditioning, in which a behavior may be changed by a consequence; in the case of the rat, the behavior is reinforced by a food reward. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
28	016	D	**Option D is correct** because corals primarily live around islands and along the edges of some continents in the zone of water that exhibits great clarity. The abundant sunlight promotes the growth of photosynthetic algae that live in a symbiotic relationship with the corals, a relationship that contributes to the great productivity of the reefs. Most corals live in warm water, and all appear to be very sensitive to a high concentration of nutrients and have in fact declined in areas exposed to sewage and fertilizer runoff. **Option A is incorrect** because most corals do not live in deep water, where the Sun does not penetrate and deep water is unlikely to be lower in salt and higher in CO_2. **Option B is incorrect** because high nutrient concentrations that often promote plankton growth kill corals. **Option C is incorrect** because the vast majority of corals grow in warm water, and very few grow in cool — but not cold — water. Back to Question
29	017	B	**Option B is correct** because trophic efficiencies generally range from 5–20%. Energy is lost between trophic levels through respiration and feces as well as through energy in the lower trophic level that is not consumed by organisms in the next trophic level. **Option A is incorrect** because organisms at higher trophic levels often live as long as or longer than organisms at lower trophic levels. **Option C is incorrect** because, while the statement may often be true, it does not address energy transfer from a lower to a higher trophic level. **Option D is incorrect** because recycling occurs with about the same efficiency at all trophic levels, but there is simply less energy to recycle at higher levels. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
30	017	D	**Option D is correct** because the phytoplankton continually replace their biomass at a very rapid rate, so they keep up with the energy demands of the zooplankton, which are actually lower than those of the phytoplankton. **Option A is incorrect** because individual phytoplankton are neither particularly dense nor energy rich. **Option B is incorrect** because zooplankton are only heterotrophic and feed on phytoplankton. **Option C is incorrect** because energy is always lost between trophic levels through respiration and feces; zooplankton cannot create more energy from less. Back to Question
31	018	C	**Option C is correct** because the size of the child-bearing population in 25 years will be smaller than the size of the current child-bearing population. **Option A is incorrect** because the population is heavily weighted toward individuals who will be of child-bearing age in 25 years. **Option B is incorrect** because there are more individuals who will be of child-bearing age in 25 years than are currently of child-bearing years. **Option D is incorrect** because the number of individuals of child-bearing age is fairly constant for the next 25 years and is greater than the current older population; the population will probably grow slowly over the next 25 years. Back to Question

Question Number	Competency Number	Correct Answer	Rationales
32	020	A	**Option A is correct** because the ability to write a report and infer, from the experimental results, the mechanisms by which materials the student did not test cross cell membranes, suggests that a student truly understands the significance of the results. **Option B is incorrect** because it is difficult to determine how much the students learned if they are only talking with one other. **Option C is incorrect** because the process does not assess the understanding of all students but only of those who volunteer to speak. **Option D is incorrect** because a quiz on the procedure and observations made, particularly a multiple-choice quiz, does not allow the students to describe the broader significance of the results. Back to Question

Study Plan Sheet

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

Preparation Resources

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

JOURNALS

American Biology Teacher, National Association of Biology Teachers.

American Scientist, Sigma XI, the Scientific Research Society.

Natural History, American Museum of Natural History.

Nature, The Nature Publishing Group.

Texas Science Teacher, Science Teachers Association of Texas.

The Science Teacher, National Science Teachers Association.

OTHER RESOURCES

Audesirk, T., Audesirk, G., and Byers, B. (2011). *Life on Earth with Physiology*, Ninth Edition. Benjamin/Cummings.

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

Trowbridge, L. W., Bybee, R. W., and Powell, J. C. (2008). *Teaching Secondary School Science: Strategies for Developing Scientific Literacy*, Ninth Edition. Prentice-Hall.

Volpe, E. P. (2010). *Understanding Evolution*, Seventh Edition. McGraw-Hill.

ONLINE RESOURCES

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

American Institute of Biological Sciences — www.aibs.org

National Association of Biology Teachers — www.nabt.org

National Science Teachers Association — www.nsta.org