GACE
Georgia Assessments for the Certification of Educators®

GACE® Study Companion

Biology Assessment

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Last Updated: January 2016

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About the Assessment

Assessment Name	Biology
Grade Level	6–12
Test Code	Test I: 026 Test II: 027 Combined Test I and Test II: 526
Testing Time	Test I: 2 hours Test II: 2 hours Combined Test I and Test II: 4 hours
Test Duration	Test I: 2.5 hours Test II: 2.5 hours Combined Test I and Test II: 5 hours
Test Format	Computer delivered
Number of Selected-response Questions	Test I: 80 Test II: 80 Combined Test I and Test II: 160
Question Format	The test consists of a variety of short-answer questions such as selected-response questions, where you select one answer choice or multiple answer choices (depending on what the question asks for), questions where you enter your answer in a text box, and other types of questions. You can review the possible question types in the ***Guide to Taking a GACE Computer-delivered Test***.
Number of Constructed-response Questions	Test I: 0 Test II: 0 Combined Test I and Test II: 0

The GACE Biology assessment is designed to measure the professional knowledge of prospective teachers of secondary school Biology in the state of Georgia.

This assessment includes two tests. You may take either test individually or the full assessment in a single session. The testing time is the amount of time you will have to answer the questions on the test. Test duration includes time for tutorials and directional screens that may be included in the test.

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

The questions in this assessment assess both basic knowledge across content areas and the ability to apply principles.

The total number of questions that are scored is typically smaller than the total number of questions on the test. Most tests that contain selected-response questions also include embedded pretest questions, which are not used in calculating your score. By including pretest questions in the assessment, ETS is able to analyze actual test-taker performance on proposed new questions and determine whether they should be included in future versions of the test.

Content Specifications

Each test in this assessment is organized into content **subareas**. Each subarea is further defined by a set of **objectives** and their **knowledge statements**.

- The objectives broadly define what an entry-level educator in this field in Georgia public schools should know and be able to do.
- The knowledge statements describe in greater detail the knowledge and skills eligible for testing.
- Some tests also include content material at the evidence level. This content serves as descriptors of what each knowledge statement encompasses.

See a breakdown of the subareas and objectives for the tests in this assessment on the following pages.

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

Test I Subareas

Subarea	Approx. Percentage of Test
I. Cell Biology: Cell Structure and Function	50%
II. Genetics and Evolution	50%

Test I Objectives

Subarea I: Cell Biology: Cell Structure and Function

Objective 1: Understands the basic biochemistry and metabolism of living organisms

The beginning Biology teacher:

A. Understands the chemical structures and properties of biologically important molecules
- Atomic and molecular structures and chemical bonding
- Organic versus inorganic molecules
- Properties of water based on structure and bonding characteristics
- Major macromolecules, including nucleic acids, proteins, lipids, and carbohydrates

B. Understands that biological processes are dependent on chemical principles
- Chemical and physical gradients, and factors that influence the gradients
- Thermodynamics
- Anabolic and catabolic reactions
- Reduction-oxidation reactions

C. Understands the structure and function of enzymes and the factors that influence their activity
- Active site structure and substrate binding
- Energy profile of a reaction in the presence or absence of an enzyme
- Reaction kinetics, including the effects of temperature, pH, and inhibitors
- Regulation, including cooperative binding and feedback inhibition

D. Understands major biochemical pathways and energy flow within an organism
- Cellular locations of biochemical pathways
- Photosynthesis, including photosystems, electron transport, Calvin cycle, C3 versus C4, CAM
- Cellular respiration, including glycolysis, Krebs cycle, electron transport, fermentation
- Chemosynthesis for photosynthesis and cellular respiration

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

Objective 2: Understands the structure and function of cells and the mechanisms of basic cellular processes

The beginning Biology teacher:

A. Understands the characteristics of living versus nonliving things
   - Cellular organization
   - Obtaining and using energy
   - Growth and reproduction
   - Regulation and responses to the environment

B. Understands the defining characteristics of viruses, bacteria, protists, fungi, plants, and animals
   - Structural differences between prokaryotes and eukaryotes, including organelles, cell walls, and chromosomes
   - Structural characteristics of viruses, bacteria, protists, fungi, plants, and animals
   - Cellular organization, including unicellular versus multicellular
   - Modes of nutrition, including autotrophic versus heterotrophic
   - Modes of reproduction/replication

C. Understands the structure and function of cells and organelles
   - Plant cells versus animal cells
   - Cell membranes
   - Membrane-bound organelles and ribosomes
   - Cytoskeleton

D. Understands how cells maintain their internal environment and respond to external signals
   - Selective permeability
   - Active and passive transport
   - Water movement, including osmolarity and water potential
   - Cell surface proteins, cell communication, and signal molecules
   - Exocytosis and endocytosis
   - Negative-feedback mechanisms

E. Understands eukaryotic cell division, the cell cycle, and regulation of the processes
   - Cell cycle stages
   - Mitosis and meiosis, including functions, stages, and results
   - Cytokinesis, including differences between animals and plants
   - Cell cycle checkpoints

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

Subarea II: Genetics and Evolution

Objective 1: Understands the mechanisms of molecular biology and the predictions of transmission genetics

The beginning Biology teacher:

A. Understands the structure of nucleic acids and chromosomes
   - Sugar-phosphate backbone and complementary base pairing
   - DNA versus RNA
   - Chromosome structure, including nucleosomes and telomeres

B. Understands the transfer of genetic information
   - DNA replication
   - Promoters, enhancers, and transcription factors
   - Process of RNA transcription
   - Pre-mRNA processing in eukaryotes
   - Translation and the genetic code
   - Prokaryotic operons

C. Understands that cells may undergo differentiation and specialization
   - Differential gene expression
   - Stem cells, including characteristics and sources

D. Understands the nature of mutations
   - Cause of mutations, including recombination and mutagens
   - Types of mutations, including point mutation, deletion, inversion, and translocation
   - Significance of somatic versus germ-line mutations
   - Disorders resulting from point mutations, frameshift mutations, changes in chromosome structure, and changes in chromosome numbers

E. Understands basic laboratory techniques and more complex DNA technologies
   - Microscopy
   - Gel electrophoresis
   - Spectrophotometry
   - DNA sequencing and polymerase chain reaction (PCR)
   - Genome sequencing projects
   - Gene therapy
   - Transgenic and genetically engineered cells

F. Understands Mendel's postulates and how to use the postulates to predict probable outcomes of given genetic crosses
   - Dominant and recessive alleles
   - Independent assortment
   - Segregation
   - Monohybrid and dihybrid crosses
   - Pedigree analysis

G. Understands non-Mendelian inheritance
   - Gene linkage and mapping by recombination analysis
   - Sex-linked inheritance
   - Multiple alleles, codominance, and incomplete dominance
   - Polygenic inheritance, epistasis, and pleiotropy
   - Extranuclear inheritance, including mitochondrial and chloroplast inheritance
   - Environmental influences, including epigenetics

Objective 2: Understands mechanisms of evolution as a consequence of genetic variation and factors affecting evolution

The beginning Biology teacher:

A. Understands the sources of genetic variation
   - Mutation
   - Crossing-over
   - Sexual reproduction, including segregation and independent assortment
   - Horizontal genetic exchange, including conjugation, transformation, and transduction

B. Understands the mechanisms of evolution
   - Hardy-Weinberg equilibrium and factors that may alter the equilibrium
   - Effects of mutations, gene flow, genetic drift (including bottleneck and founder effects), and nonrandom mating (including sexual selection)
   - Natural and artificial selection
   - Coevolution
   - Adaptive radiation
   - Convergent versus divergent evolution (analogous versus homologous structures)

C. Understands the evidence that supports evolution
   - Fossil record
   - Endosymbiosis

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

- Structural and developmental evidence, including homology and embryology
- Molecular evidence, including DNA and RNA sequence comparisons
- Major evolutionary trends, including cephalization and multicellularity

D. Understands models of evolutionary rates and the genetic basis of speciation
   - Gradualism
   - Punctuated equilibrium
   - Reproductive isolation, including behavioral and postzygotic
   - Mechanisms of speciation, including allopatric and sympatric

E. Understands scientific explanations for the origin of life on Earth
   - Abiotic synthesis of organic compounds and the Miller-Urey experiment
   - Biological influences on atmospheric composition, including the role of photosynthesis
   - Development of self-replication, including the RNA-first hypothesis

F. Understands factors that lead to the extinction of species
   - Lack of genetic diversity
   - Interspecific competition
   - Environmental pressures, including climate and habitat change
   - Human impacts
   - Meteor impacts

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

Test II Subareas

Subarea	Approx. Percentage of Test
I. Scientific Inquiry, Processes, Technology, and Society	30%
II. Organismal Biology	30%
III. Ecology: Organisms and Environments	40%

Test II Objectives

Subarea I: Scientific Inquiry, Processes, Technology, and Society

Objective 1: Understands the nature of scientific inquiry and processes, including the collection and analysis of data

The beginning Biology teacher:

A. Understands the processes involved in scientific inquiry and experimental design
   - Identifying problems based on observations
   - Formulating and testing hypotheses
   - Identifying experimental variables and controls
   - Drawing scientific conclusions
   - Formulating theories based on accumulated data
   - Using scientific sources and communicating findings appropriately

B. Understands the processes involved in scientific data collection and manipulation
   - Common units of measurement (metric and English units), including unit conversions
   - Scientific notation and significant figures in collected data
   - Linear versus logarithmic scales
   - Choosing appropriate types of graphs or charts
   - Interpreting data, including identifying patterns and trends, drawing conclusions, and making predictions
   - Basic data analysis, including determining mean, precision, accuracy, and sources of error

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

C. Understands the multidisciplinary nature of biology and the use of scientific models
   - Chemical nature of biology
   - Mathematics in biology
   - Physical laws and principles governing biological systems
   - Selecting appropriate models for a given purpose (e.g., physical, conceptual, mathematical) and knowing the limitations of the models

D. Understands the major historical developments of biology and the contributions of major historical figures
   - Accepted principles and theories change and develop over time
   - Development of germ theory and cell theory
   - Developments in heredity, evolution, and ecology
   - Developments in the understanding of the nature and structure of genetic material
   - Developments in the classification of organisms

E. Understands the procedures for correct preparation, storage, use, and disposal of laboratory materials
   - Preparation for classroom or field use of materials, such as preparing solutions and staining slides
   - Appropriate storage of chemicals, biological specimens, and other materials
   - Appropriate and safe use of materials, including chemicals and laboratory specimens
   - Safe disposal of biological specimens, chemicals, and solutions

F. Understands the appropriate and safe use and care of laboratory equipment
   - Optical equipment, such as microscopes, spectrophotometers, and UV light sources
   - Separation equipment, such as equipment used for gel electrophoresis, chromatography, and centrifugation
   - Measurement, mixing, and heating equipment, such as balances, stirrers, and Bunsen burners
   - Sterilization equipment, such as autoclaves and ovens

G. Understands safety and emergency procedures for science classrooms and laboratories
   - Use of material safety data sheets (MSDS)
   - Use of personal safety equipment; e.g., gloves, goggles, lab coats
   - Use of laboratory safety equipment; e.g., fire extinguishers, eyewash stations, emergency showers

Objective 2: Understands the relationship of science and technology to society and the environment

The beginning Biology teacher:

A. Understands the management of natural resources and the impact of science and technology on the environment
   - Agriculture, forestry, wildlife, and fisheries practices
   - Renewable and/or sustainable use of resources
   - Extraction of mineral and energy resources and resource management, including waste management and recycling
   - Conservation, including habitat preservation, habitat restoration, and species protection
   - Pollution, including nonpoint sources of pollution and burning of fossil fuels
   - Pollution mitigation, including green building and environmental cleanup

B. Understands the impact of human activity and natural phenomena on society
   - Economic and social consequences
   - Natural disaster management
   - Climate change (such as global warming), sea levels, and flooding
   - Epidemiology
   - Agriculture and soil erosion
   - Estuary and wetland degradation
   - Water management
   - Production, use, and disposal of consumer products

C. Understands the ethical and societal issues arising from the use of science and technology
   - Ethical research concerns, including use of stem cells and toxic chemicals
   - Ethical use of technology, genetic information, genetically modified organisms, and cloning

Subarea II: Organismal Biology

Objective 1: Understands characteristics contributing to the diversity of life, including classification systems

The beginning Biology teacher:

A. Understands the historical and current biological classification systems of organisms
   - Kingdom system
   - Domain system
   - Cladistics

B. Understands the characteristics of the major animal phyla
   - Body plans, including radial symmetry versus bilateral symmetry
   - Body cavities, including coelomates, pseudocoelomates, and acoelomates
   - Protostomes versus deuterostomes
   - Modes of reproduction (sexual versus asexual)
   - Modes of temperature regulation (endotherm versus ectotherm)

C. Understands the organizational hierarchy of multicellular organisms
   - Cells
   - Tissues
   - Organs
   - Organ systems

Objective 2: Understands anatomy and physiology of major animal phyla

The beginning Biology teacher:

A. Understands the anatomy and physiology of major organ systems
   - Cardiovascular and respiratory
   - Digestive and excretory
   - Nervous and endocrine
   - Reproductive
   - Immune

B. Understands how homeostasis is maintained in organisms
   - Role of organs or tissues, such as the kidney, adrenals, and hypothalamus
   - Role of hormones, such as insulin and antidiuretic hormone
   - Feedback mechanisms, including negative and positive
   - Role of behaviors, including diurnal, nocturnal, hibernation, and basking

C. Understands reproduction, development, and growth
   - Gamete formation
   - Fertilization
   - Embryonic development
   - Growth, development, and aging

Objective 3: Understands anatomy and physiology of major plant phyla

The beginning Biology teacher:

A. Understands the characteristics of the major divisions, including life cycles and reproductive strategies
   - Vascular versus nonvascular
   - Angiosperms versus gymnosperms
   - Monocot versus eudicot (dicot)
   - Alternation of generations, including gametophyte and sporophyte
   - Seed and spore dispersal and pollination strategies

B. Growth and development and response to environment
   - Tissues, including dermal, parenchyma, cortex, and meristems
   - Vascular, including xylem and phloem
   - Flowers, stems, leaves, and roots
   - Plant tropisms

C. Understands how plants obtain and transport water and inorganic nutrients
   - Roots
   - Xylem transport
   - Control of moisture, including transpiration through stomata

D. Understands how plants transport and store products of photosynthesis
   - Products, including simple and complex carbohydrates
   - Phloem transport
   - Storage and structural molecules, including starch and cellulose, respectively
   - Storage structures, including plastids, vacuoles, and tubers

Subarea III: Ecology: Organisms and Environments

Objective 1: Understands biosphere organization and factors affecting organism interactions and population size

The beginning Biology teacher:

A. Understands the hierarchical structure of the biosphere
   - Organisms
   - Populations
   - Communities
   - Ecosystems
   - Biomes

B. Understands relationships within and between species
   - Forms of symbiosis
   - Predation
   - Competition and territoriality
   - Altruistic behaviors

C. Understands how biotic and abiotic components of an ecosystem influence population size
   - Resource availability and abiotic factors
   - Habitat and niche
   - Competition and predation
   - Density-dependent versus density-independent selection

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

D. Understands the relationship between reproductive strategies, mortality rates, and population growth
    - Sexual versus asexual reproduction
    - *r*-strategists versus K-strategists
    - Exponential growth
    - Logistic growth and carrying capacity

Objective 2: Understands the characteristics of biomes, energy flow in ecosystems, and major biogeochemical cycles

The beginning Biology teacher:

A. Understands the changes that occur during ecological succession
    - Primary versus secondary succession
    - Biomass, diversity, productivity, and habitat changes during succession
B. Understands the types of biomes and energy flow in the biomes
    - Aquatic versus terrestrial biomes
    - Trophic levels, including pyramids of biomass and pyramids of energy
    - Food chains and food webs
    - Keystone species
    - Flow of energy versus flow of matter
C. Understands biogeochemical cycles
    - Water cycle
    - Carbon cycle
    - Nitrogen cycle
    - Phosphorus cycle

Objective 3: Understands interactions among ecosystems and effects of their disruption by natural disturbances or humans

The beginning Biology teacher:

A. Understands the effects of natural disturbances on biodiversity and ecosystems
    - Temporal and spatial disturbances, including climate, fire, and disease
    - Fragmentation of ecosystems
    - Natural ecosystem recovery

B. Understands the connections among ecosystems on a local and a global scale
   - Natural flow of material between ecosystems
   - Movement of organisms

C. Understands how humans affect ecological systems and biodiversity
   - Pollution, including greenhouse gases and acid precipitation
   - Habitat destruction
   - Introduced and re-introduced species
   - Remediation, including reforestation and mine reclamation
   - Transport of materials by humans

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

Practice Questions

The practice questions in this study companion are designed to familiarize you with the types of questions you may see on the assessment. While they illustrate some of the formats and types of questions you will see on the test, your performance on these sample questions should not be viewed as a predictor of your performance on the actual test. Fundamentally, the most important component in ensuring your success is familiarity with the content that is covered on the assessment.

To respond to a practice question, choose one of the answer options listed. Be sure to read the directions carefully to ensure that you know what is required for each question. You may find it helpful to time yourself to simulate actual testing conditions. A correct answer and a rationale for each sample test question are in the section following the practice questions.

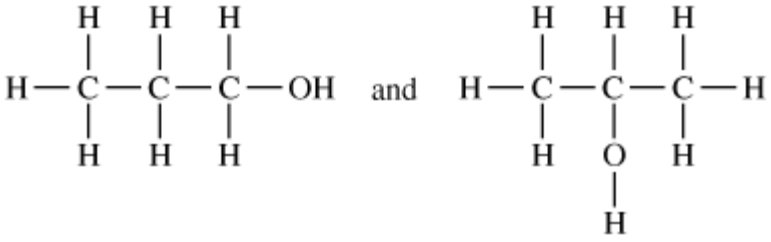
Keep in mind that the test you take at an actual administration will have different questions, although the proportion of questions in each subarea will be approximately the same. You should not expect the percentage of questions you answer correctly in these practice questions to be exactly the same as when you take the test at an actual administration, since numerous factors affect a person's performance in any given testing situation.

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

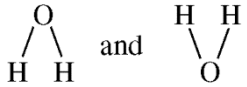
Directions: Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case.

1. Which of the following are isomers?

A.

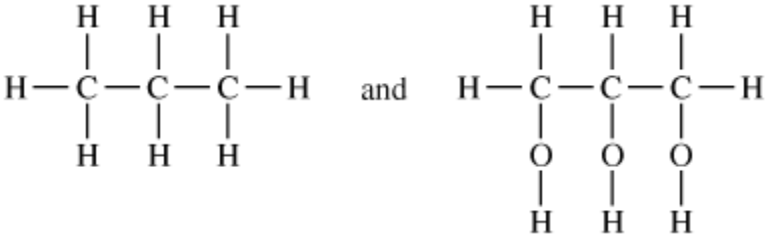


B.



C. NaCl and KCl

D.



Answer and Rationale

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

2. By which of the following mechanisms does feedback inhibition most likely occur in a metabolic pathway?

   A. A molecule competes for the active site of an enzyme
   B. A molecule early in the pathway stimulates the activity of an enzyme later in the pathway
   C. The end product of a pathway regulates an enzyme early in the pathway
   D. An energy-yielding reaction is coupled to an energy-requiring reaction

Answer and Rationale

3. Which of the following cellular processes normally produces ATP from glucose in the absence of oxygen?

   A. Krebs cycle
   B. Glycolysis
   C. Chemiosmosis
   D. Calvin cycle

Answer and Rationale

4. A unicellular organism that has cell walls containing chitin and that reproduces by budding is most likely

   A. an animal.
   B. a fungus.
   C. a protist.
   D. a plant.

Answer and Rationale

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

5. Which of the following best describes the pathway of a protein from its manufacture to its secretion from the cell?

   A. Endoplasmic reticulum → Golgi apparatus → secretory vesicle
   B. Secretory vesicle → endoplasmic reticulum → Golgi apparatus
   C. Secretory vesicle → Golgi apparatus → endoplasmic reticulum
   D. Golgi apparatus → endoplasmic reticulum → secretory vesicle

Answer and Rationale

6. Which of the following mechanisms best accounts for the higher concentrations of mineral nutrients in the root cells of vascular plants than in the surrounding soil environment?

   A. Osmosis
   B. Diffusion
   C. Facilitated diffusion
   D. Active transport

Answer and Rationale

7. Red blood cells (RBCs) are placed in a sucrose solution that is hyperosmotic with respect to the cells. Which of the following will most likely occur immediately?

   A. Sucrose will diffuse into the RBCs
   B. Water will diffuse out of the RBCs
   C. Sucrose will diffuse into the RBCs and water will diffuse out of the RBCs
   D. Sucrose will diffuse into the RBCs and water and ions will diffuse out of the RBCs

Answer and Rationale

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

8. Which of the following events signals the end of the M and S phases of the cell cycle?

   A. Receptor-mediated endocytosis of growth factors
   B. Dimerization of cyclin-dependent kinases
   C. Degradation of cyclins bound to cyclin-dependent kinases
   D. Inactivation of tumor-suppressor proteins

Answer and Rationale

9. If a DNA template has the base sequence 5' – TAG – 3', the corresponding base sequence of an mRNA transcript will be

   A. 5' – ATC – 3'
   B. 5' – CTA – 3'
   C. 5' – AUC – 3'
   D. 5' – CUA – 3'

Answer and Rationale

10. A segment of mouse genomic DNA encoding gene X is inserted into an expression plasmid containing a promoter sequence, and the plasmid is introduced into bacteria. The bacteria transcribe mRNA from the recombinant plasmid and produce protein X, but the protein differs in sequence from the protein normally produced by mice. Which of the following is the most likely reason for the different protein sequence produced?

    A. The genetic code differs between prokaryotes and eukaryotes.
    B. Prokaryotic ribosomes bind less efficiently to eukaryotic mRNAs than to prokaryotic mRNAs.
    C. Gene X contains exons and introns, and bacteria cannot remove introns from mRNAs.
    D. The prokaryotic RNA polymerase is more likely to make errors in transcription when the template is eukaryotic DNA.

Answer and Rationale

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

11. Which of the following mutations to the coding region of a gene is expected to have the smallest effect on the sequence of the protein produced?

    A. A single-base substitution
    B. A single-base deletion
    C. A four-base insertion
    D. A twelve-base inversion

Answer and Rationale

12. A visual representation of an individual's chromosomes that have been stained, photographed, enlarged, and arranged in order of size from largest to smallest is known as a

    A. karyotype.
    B. linkage map.
    C. pedigree.
    D. DNA fingerprint.

Answer and Rationale

13. Two parents who do not exhibit phenylketonuria (PKU) have a son with PKU. Which of the following is the most likely explanation?

    A. The allele for PKU is located on the Y chromosome
    B. PKU is a dominant trait
    C. PKU is a recessive trait
    D. A mutation occurred in the sperm of the father

Answer and Rationale

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

14. The diversity of the finches on the Galápagos Islands is an example of which of the following?

    A. Adaptive radiation
    B. Seasonal isolation
    C. Mechanical isolation
    D. Selective hybrid elimination

Answer and Rationale

15. Males of a certain species of small mammal have either fluffy tails or furless tails. Those with fluffy tails have been observed to attract significantly more mates than those with furless tails. The phenomenon described is an example of

    A. disruptive dimorphism.
    B. disruptive selection.
    C. sexual dimorphism.
    D. sexual selection.

Answer and Rationale

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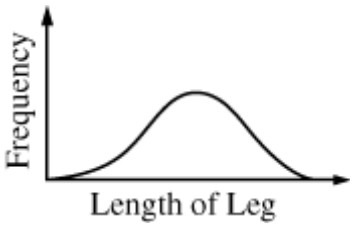
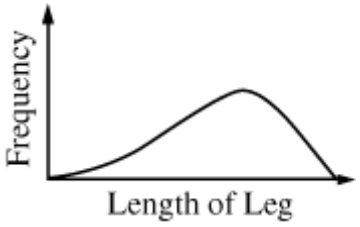
16.

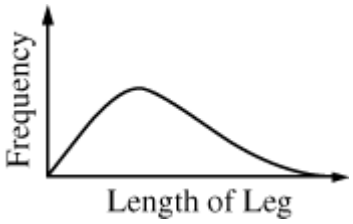


The graph above depicts the frequency of expression of the range of leg lengths in a population of grazing animals. In this species, leg length is directly related to speed, which is a heritable characteristic. These grazers are being preyed on by a newly introduced species of swift-running predators. Which of the following graphs represents the range of expression most likely to result from this selection pressure over a long period of time?

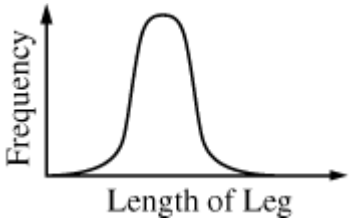
A.



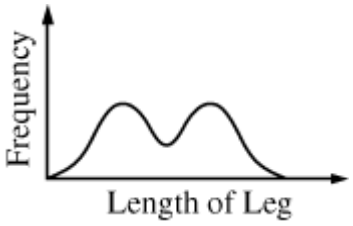
B.



C.



D.



Answer and Rationale

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

17. Which of the following is a unit for density?

A. kg
B. kg/m^2
C. g/m^3
D. m^3/sec

Answer and Rationale

18.

Test Tube	Materials Added	Initial Color	Final Color
1	Aquatic plant, bromothymol blue solution	Blue	Blue
2	Aquatic plant, bromothymol blue solution, carbonated water	Yellow	Blue
3	Bromothymol blue solution, carbonated water	Yellow	Yellow

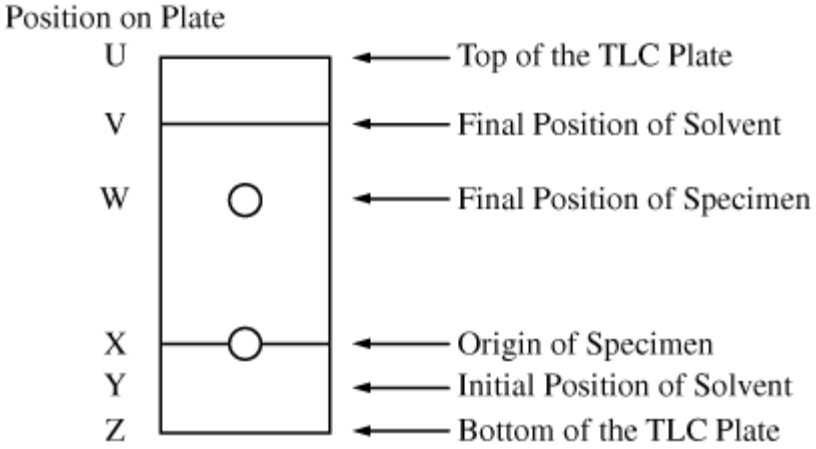
In a lab investigation designed to demonstrate one aspect of photosynthesis, three test tubes were treated as shown in the table. The test tubes were then placed under a bright lamp for 24 hours. Which of the following is the best explanation for the observed color change in tube 2?

A. The light from the lamp bleached the solution, causing it to change from its original color of yellow to blue.
B. The aquatic plant produced carbon dioxide, which changed into carbonic acid and caused the color change.
C. The aquatic plant used carbon dioxide, raising the pH of the solution and causing it to change from yellow to blue.
D. The plant produced oxygen during photosynthesis, which caused the color change.

Answer and Rationale

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

19.



Thin-layer chromatography (TLC) is a technique that can be used to separate and identify compounds such as flower pigments. A plate is coated with a thin layer of silica or alumina, spotted with the compound-containing specimen, and placed on end in a pool of a solvent. The solvent slowly rises up the plate, carrying the compound a characteristic distance depending on its composition. The distances traveled by the compound and the solvent are used to calculate the retention factor (Rf) of the compound. Using the letters from the diagram above, which of the following calculations provides the correct Rf for a particular compound?

A. $W - X$

B. $\frac{W - X}{V - Y}$

C. $\frac{W - X}{V - X}$

D. $\frac{W - X}{U - Z}$

Answer and Rationale

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

20. Many native freshwater fish populations have been depleted as a result of human activities, particularly those activities causing habitat alteration and destruction. Which of the following fishing practices by recreational anglers will best maintain the native fish populations?

    A. Using only lead-containing fishing tackle
    B. Keeping only adult fish that have a body length within certain limits
    C. Releasing all nonnative species of fish captured
    D. Catching fish preferentially when the fish are spawning

Answer and Rationale

21. Observations from lakes in areas with granitic bedrock indicate that the lakes are becoming depleted of living organisms. The primary cause of the depletion is considered to be

    A. nuclear waste accumulation.
    B. lowered water levels.
    C. acid rain.
    D. garbage dumping.

Answer and Rationale

22. Which of the following phyla includes the classes Gastropoda and Cephalopoda?

    A. Arthropoda
    B. Annelida
    C. Brachiopoda
    D. Mollusca

Answer and Rationale

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

23. A person touches a finger to a hot object and immediately pulls the finger away. Which of the following structures is the first to receive an impulse triggered by the stimulus?

    A. Synapse
    B. Ventral root ganglion
    C. Motor neuron
    D. Sensory neuron

Answer and Rationale

24. Unfertilized sea urchin eggs can be induced to develop into normal larvae by placing them in appropriate magnesium solutions. This process is an example of

    A. metamorphosis.
    B. oogenesis.
    C. homeostasis.
    D. parthenogenesis.

Answer and Rationale

25. Which of the following structures is the site at which lateral root growth initiates in monocots and eudicots?

    A. Cambium
    B. Pericycle
    C. Xylem
    D. Cortex

Answer and Rationale

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

26. The movement of water upward in xylem vessels of trees is most directly related to which of the following?

    A. Wall pressure
    B. Turgor pressure
    C. Transpiration
    D. Cytoplasmic streaming

Answer and Rationale

27. The remora *Echeneis naucrates* is a marine fish with a modified dorsal fin used to attach to sharks, allowing the remora to travel without expending energy. The remora feeds off leftover bits of prey produced as the shark eats. The shark is unaffected by the remora's presence. Of the following, which term is most applicable to this scenario?

    A. Competition
    B. Mutualism
    C. Commensalism
    D. Parasitism

Answer and Rationale

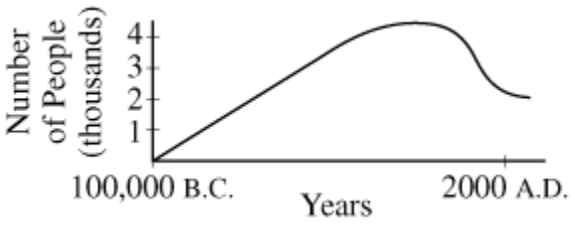
28. Density-independent regulation is most likely related to which of the following?

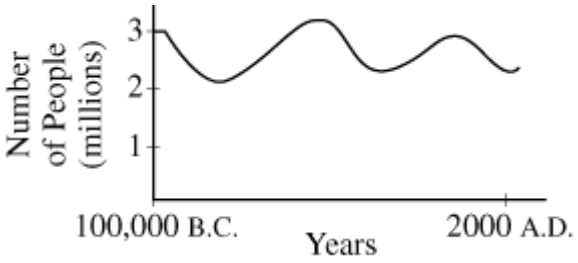
    A. Intense predation
    B. A rare storm event
    C. Competition for a limited food supply
    D. A rapidly progressing communicable disease

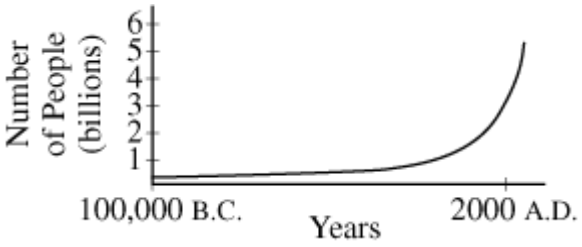
Answer and Rationale

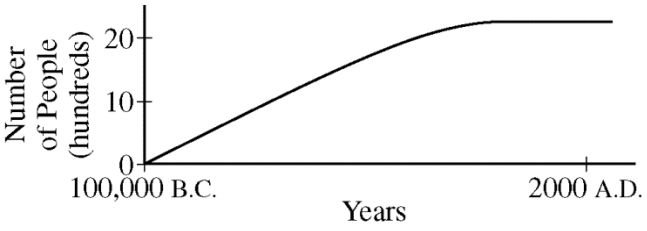
Note: After clicking on a link, right click and select "Previous View" to go back to original text.

29. Which of the following graphs is the best representation of human population growth since 100,000 B.C.?

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.

30. Which of the following is a true statement about the flow of energy in an ecosystem?

    A. Smaller organisms need less energy per gram of body weight than do larger organisms.
    B. Energy transfer between organisms normally involves conservation of heat energy.
    C. Energy flow between trophic levels is inefficient.
    D. Chemical energy is converted into radiant energy, which is then converted into chemical energy at the next trophic level.

Answer and Rationale

31. The dominant vegetation of the taiga biome is best characterized by which of the following types of plants?

    A. Grasses, sedges, and humus
    B. Spruces, firs, and pines
    C. Maples, oaks, and hickories
    D. Lichens, mosses, and ferns

Answer and Rationale

32. Which of the following best explains why many coral reefs are dying?

    A. The acidity of the oceans is increasing
    B. The intensity of ultraviolet radiation reaching the reefs is decreasing
    C. The number of coral-eating fish is increasing
    D. The salinity of the oceans is increasing

Answer and Rationale

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

Answer Key and Rationales

Question Number	Correct Answer	Rationale
1	A	**Option A is correct.** These molecules are examples of structural isomers, compounds that have the same empirical formula but whose atoms are arranged in a different way. Both compounds in option A are alcohols with the formula C_3H_8O, but the position of the OH group is different in each. Back to Question
2	C	**Option C is correct.** Feedback inhibition regulates the amount of end product produced by a metabolic pathway. If the end product of the pathway increases beyond the amount the cells require, the end product binds to an enzyme that catalyzes a reaction early in the pathway and inhibits the enzyme. The end product reversibly binds outside the active site of the enzyme and alters the shape of the active site so that the substrate cannot bind. As the level of the end product drops in the cells, the end product dissociates from the enzyme, releasing inhibition. Back to Question
3	B	**Option B is correct.** In the absence of oxygen, glycolysis can still occur, and it produces a net yield of 2 ATP per molecule of glucose. Neither chemiosmosis nor the Krebs cycle functions in the absence of oxygen. The Calvin cycle normally uses ATP. Back to Question

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

Question Number	Correct Answer	Rationale
4	B	**Option B is correct.** Some fungi are unicellular and others are multicellular. A defining structural feature of all fungal cells is that the cell wall is composed of chitin. Unicellular fungi, such as yeast, reproduce by mitosis and the budding of new cells. Back to Question
5	A	**Option A is correct.** Proteins to be secreted pass from the ribosomes into the lumen of the endoplasmic reticulum. They are then sent to the Golgi apparatus, where they are modified and packaged into vesicles, which transport them to the outside of the cell. Back to Question
6	D	**Option D is correct.** Energy is required to move minerals up their concentration gradient. Active transport involves an input of energy. In both osmosis and diffusion, substances move down a gradient. Back to Question

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

Question Number	Correct Answer	Rationale
7	B	**Option B is correct.** In the example described, the only material that can freely diffuse across the RBC membrane is water. Since the concentration of solutes is greater extracellularly than intracellularly, the net direction of water diffusion will be out of the cells. Back to Question
8	C	**Option C is correct.** Cyclins are synthesized and degraded in a cyclic fashion. As cyclins increase in concentration, they bind to and activate specific cyclin-dependent kinases, which in turn phosphorylate proteins that promote M or S phases of the cell cycle. After a period of time, the cyclins are degraded, leading to the inactivation of the cyclin-dependent kinases and signaling the end of the M or S phase of the cell cycle. Back to Question
9	D	**Option D is correct.** The sequence of bases in an mRNA molecule is determined by antiparallel hybridization between A, T, C, and G of the template DNA and U, A, G, and C of the mRNA molecule, respectively. Back to Question

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

Question Number	Correct Answer	Rationale
10	C	**Option C is correct.** Genomic eukaryotic DNA includes both exon and intron sequences. When a pre-mRNA is transcribed in eukaryotes, splicing machinery that includes small nuclear ribonucleoproteins (snRNPs) removes the introns and joins the exons. No such machinery is present in prokaryotic cells since prokaryotic genomic DNA does not contain introns. Back to Question
11	A	**Option A is correct.** Each amino acid is specified by a codon of three nucleotides. Altering one nucleotide in the codon will at most lead to a change of one amino acid in the resulting protein. If the nucleotide is in the third position of the codon, the substitution may not change the specified amino acid. Any nucleotide addition or deletion that is not a multiple of three will alter the reading frame and completely change the encoded amino acid sequence from the point of the mutation. An inversion within the coding region of a gene will reverse the order of the nucleotides and thus alter the encoded amino acids. Back to Question
12	A	**Option A is correct.** A karyotype is basically a pictorial representation of the metaphase-stage chromosomes contained in a cell. Back to Question

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

Question Number	Correct Answer	Rationale
13	C	**Option C is correct.** PKU must be a recessive trait because the parents did not exhibit the disorder but must have been carriers for the disorder. Back to Question
14	A	**Option A is correct.** The Galápagos finches are a classic example of adaptive radiation of a single species that arrived from the continent, diversified, and underwent speciation following isolation on several islands. Back to Question
15	D	**Option D is correct.** Mate selection based on a physical feature is an example of sexual selection. Back to Question

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

Question Number	Correct Answer	Rationale
16	A	**Option A is correct.** Selection pressure would favor longer legs in the prey animals, and option A depicts a population with a large number of individuals with longer legs. Back to Question
17	C	**Option C is correct.** Density is defined as mass per unit volume. The gram is a unit of mass and cubic meters is a volume. Back to Question
18	C	**Option C is correct.** Bromothymol blue can be used as an indicator of CO_2 concentration. CO_2 dissolves in solution and a small percent becomes carbonic acid. Plants utilize CO_2 during photosynthesis, thus raising the pH of the solution and changing the color of the solution from yellow to blue. Back to Question

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

Question Number	Correct Answer	Rationale
19	C	**Option C is correct.** The migration of the compound relative to the migration of the solvent is of interest, and for this reason the initial positions of both the specimen containing the compound and the solvent are the same, specifically the initial position of the specimen. Hence, the Rf is calculated by dividing the distance the compound migrated from its initial position (W – X) by the distance the solvent migrated from the initial position of the specimen (V – X). Back to Question
20	B	**Option B is correct.** Regulations specify the minimum and sometimes the maximum size requirements for keeping different species of fish caught by anglers. The captured fish should be adults that have already spawned, so that the fish populations can be replenished. Tackle containing lead causes neurological and muscular degeneration in fish and birds that might ingest any of it, just as lead causes problems in people when ingested. Nonnative species compete with native species for habitat and resources, often leading to a decrease in the numbers of native species, so preferentially releasing nonnative fish will not help to maintain the native fish populations. Back to Question
21	C	**Option C is correct.** Rain combines with various types of air pollution, particularly sulfur dioxide and nitrogen oxides resulting from fossil fuel combustion, and forms acid rain. Lakes formed in limestone bedrock can neutralize the acidity of the rain, but lakes with granitic bedrock have limited capacity to neutralize the acid rain. The increasing acidity of these lakes has had a negative impact on the organisms normally inhabiting the lakes. Back to Question

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

Question Number	Correct Answer	Rationale
22	D	**Option D is correct.** Mollusca is a large phylum of invertebrates that includes Gastropoda (freshwater and marine snails and slugs) and Cephalopoda (only marine organisms such as squid and octopuses). Back to Question
23	D	**Option D is correct.** This question describes a motor reflex loop between a thermosensory neuron and a motor neuron. Most reflex loops involve an impulse being initiated in a sensory neuron and then passing either directly from a sensory neuron to a motor neuron or from the sensory neuron to an interneuron and then from the interneuron to a motor neuron. The neurons are separated by synapses. Back to Question
24	D	**Option D is correct.** Parthenogenesis is a form of asexual reproduction in which offspring are produced from unfertilized eggs. There are a variety of animals that can reproduce in this fashion. Back to Question

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

Question Number	Correct Answer	Rationale
25	B	**Option B is correct.** The pericycle is a layer of cells on the inner side of the endoderm in plant roots. Root branching is initiated in the pericycle. Back to Question
26	C	**Option C is correct.** The upward movement of water is caused by a "pull" generated by water loss in the leaves (transpiration) and facilitated by the cohesive properties of water in narrow tubes such as xylem vessels. Back to Question
27	C	**Option C is correct.** A commensal relationship is defined as one in which one organism benefits while the other organism neither benefits nor is adversely affected. In this situation, the remora benefits and the shark is unaffected. Back to Question

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

Question Number	Correct Answer	Rationale
28	B	**Option B is correct.** Increasing population density will likely lead to increased death rate by increased predation, increased competition for food, and increased disease communicability, but has no correlation with the chance of a rare storm causing fatalities. Back to Question
29	C	**Option C is correct.** Human population has grown exponentially since about A.D. 1700. It currently stands at more than 7 billion. Back to Question
30	C	**Option C is correct.** Biologists estimate that large amounts of the energy available to one trophic level are not transferred to the next trophic level. Back to Question

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

Question Number	Correct Answer	Rationale
31	B	**Option B is correct.** Taigas are evergreen temperate forests composed mostly of conifers (spruces, firs, and pines). Back to Question
32	A	**Option A is correct.** The level of atmospheric CO_2 is increasing as a result of global climate change, and the oceans are absorbing much of the CO_2. This is making the oceans more acidic, and coral reefs do not tolerate the increased acidity well. More UV radiation is reaching Earth's surface because of the destruction of the ozone layer. Back to Question

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

Preparation Resources

The resources listed below may help you prepare for the GACE assessment 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 of these materials to obtain information on specific topics for study and review.

Guide to Taking a GACE Computer-delivered Assessment

This guide explains how to navigate through a GACE assessment and how to answer different types of test questions. This free download is available in the Test Preparation Resources section of the GACE website at ***www.gace.ets.org/prepare***.

Reducing Test Anxiety

This guide provides practical help for people who suffer from test anxiety. Designed specifically for GACE test takers, but useful to anyone who has to take tests, this guide reviews the major causes of test anxiety and offers practical advice for how to counter each one. Download this guide for free from the Test Preparation Resources section of the GACE website at ***www.gace.ets.org/prepare***.

Study Tips: Preparing for a GACE Assessment

This document contains useful information on preparing for selected-response and constructed-response tests. The instruction, tips, and suggestions can help you become a better-prepared test taker. See the Test Preparation Resources section of the GACE website at ***www.gace.ets.org/prepare*** for this free download.

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

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.

Chiappetta, E. L., Koballa, T. R., and Collette, A. T. (2009). *Science Instruction in the Middle and Secondary Schools*, Seventh Edition. Allyn and Bacon.

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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***

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