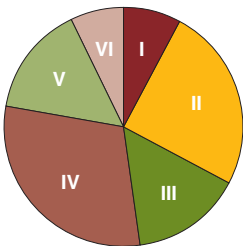


Biology: Content Knowledge (0235)

Test at a Glance

Test Name	Biology: Content Knowledge		
Test Code	0235		
Time	2 hours		
Number of Questions	150		
Format	Multiple-choice		
	Content Categories	Approximate Number of Questions	Approximate Percentage of Examination
	<ul style="list-style-type: none"> I. Basic Principles of Science II. Molecular and Cellular Biology III. Classical Genetics and Evolution IV. Diversity of Life, Plants, and Animals V. Ecology VI. Science, Technology, and Society 	<ul style="list-style-type: none"> 12 38 23 45 22 10 	<ul style="list-style-type: none"> 8% 25% 15% 30% 15% 7%

About This Test

The Biology: Content Knowledge test is designed to measure the knowledge and competencies necessary for a beginning teacher of secondary school Biology. Examinees have typically completed or nearly completed a bachelor's degree program with appropriate coursework in Biology and education. This test may contain some questions that will not count towards your score.

The development of the test questions and the construction of the test reflect the National Science Education Standards (NSES) and the National Science Teacher Association (NSTA) standards and recognize that there are conceptual and procedural schemes that unify the various scientific disciplines. These fundamental concepts and processes (systems; models; constancy and change; equilibrium; form and function) are useful in understanding the natural world. Insofar as possible, then, the test questions will have the primary objective of evaluating the content areas by using questions that focus on conceptual understanding, critical thinking, and problem solving in science. The test content is developed and reviewed in collaboration with practicing high school Biology teachers, teacher-educators, and higher education content specialists to keep the test updated and representative of current standards.

The 150 multiple-choice questions include concepts, terms, phenomena, methods, applications, data analysis, and problem solving in Biology, and include an understanding of the impact of science and technology on the environment and human affairs. The topics are typically those covered in introductory college-level Biology courses, although some questions of a more advanced nature are included, because secondary-school teachers must understand the subject matter from a more advanced viewpoint than that presented to their students.

Examinees will not need to use calculators in taking this test.

Topics Covered

Representative descriptions of topics covered in each category are provided below.

I. Basic Principles of Science

A. Processes involved in scientific inquiry

- Making observations (e.g., quantitative versus qualitative)
- Formulating and testing hypotheses
- Identifying experimental variables and controls
- Drawing scientific conclusions (e.g., proof versus support)
- Using scientific sources and communicating findings appropriately

B. Science involves many disciplines

- Chemical nature of biology
- Mathematics in biology (e.g., statistics, proportions)
- Physical laws and principles governing biological systems

C. Differences among facts, hypotheses, theories, and laws

- Testable nature of hypotheses
- Formulation of theories based on accumulated data
- Durability of laws

D. Scientific ideas change over time; contributions made by major historical figures

- Cell theory and germ theory (e.g., Hooke, Pasteur)
- Heredity, evolution, and ecology (e.g., Mendel, Darwin)
- Structure and nature of genetic material (e.g., Hershey and Chase, Franklin, Watson and Crick)
- Classification of organisms (e.g., Linnaeus, Woese)

E. Appropriate use of scientific measurement and notation systems

- Precision versus accuracy
- Metric and SI units
- Unit conversions
- Scientific notation and significant figures
- Linear versus logarithmic scales (e.g., pH)

F. Read and interpret data represented in tables, graphs, and charts

- Identify patterns and trends in data
- Choose appropriate types of graphs or charts
- Error analysis
- Draw conclusions and make predictions

G. Construct and use scientific models to explain complex phenomena

- Limitations of models
- Select models for a given purpose
- Physical (e.g., anatomical models), conceptual (e.g., fluid mosaic model), graphical and/or mathematical models (e.g., population growth models, global climate change)

H. Procedures involved in the safe preparation, storage, use, and disposal of laboratory and field materials

- Molarity and percent solutions
- Acid and base solutions
- Flammable and/or caustic chemicals
- Biological specimens and waste

I. Appropriate and safe use and care of laboratory equipment

- Optical equipment (e.g., microscopes, spectrophotometers, UV light sources)
- Separation equipment (e.g., gel electrophoresis, chromatography, centrifuges)
- Measurement, mixing and heating equipment (e.g., balances, stirrers, burners)
- Sterilization equipment (e.g., autoclave, ovens)

J. 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, labcoats)
- Use of laboratory safety equipment (e.g., fire extinguishers, eye wash stations, emergency showers)

II. Molecular and Cellular Biology

A. Chemical structures and properties of biologically important molecules

- Atomic structure
- Organic versus inorganic molecules
- Chemical bonding (e.g., hydrogen, covalent)
- Molecular structure (e.g., carbon dioxide, ATP)
- Water properties (e.g., cohesion, high specific heat)
- Macromolecules (e.g., carbohydrates, nucleic acids, proteins, lipids)

B. Biological processes are dependent on chemical principles

- Chemical and physical gradients (e.g., osmosis, diffusion, temperature)
- Thermodynamics
- Anabolic and catabolic reactions (e.g., hydrolysis)
- Reduction - oxidation reactions

C. Structure and function of enzymes and factors influencing their activity

- Active site structure and substrate binding (e.g., induced fit, lock and key)
- Reaction kinetics (e.g., effects of temperature, pH, and inhibitors)
- Regulation (e.g., cooperative binding, feedback inhibition)

D. Biochemical pathways and energy flow within an organism

- Cellular locations of biochemical pathways
- Photosynthesis (e.g., photosystems, electron transport, C3 and C4)
- Cellular respiration (e.g., fermentation, Krebs cycle, electron transport)
- Chemosynthesis (e.g., deep sea vent microorganisms)

E. Major differences between prokaryotes and eukaryotes

- Cell size
- Membrane bound organelles
- Cell walls (e.g., peptidoglycan, cellulose)
- Chromosome structure (e.g., circular versus linear)

F. Structure and function of cells and organelles

- Plant cells versus animal cells
- Cell membranes
- Membrane-bound organelles (e.g., nucleus, chloroplast) and ribosomes
- Cytoskeleton

G. Cells maintain their internal environment and respond to external signals

- Selective permeability
- Active and passive transport
- Water movement (e.g., osmolarity, water potential)
- Cell surface proteins and cell communication
- Exocytosis and endocytosis
- Hormone action and feedback

H. Cellular division, the cell cycle, and how they are regulated

- Cell cycle stages (G1, S, G2, M)
- Mitosis and meiosis (e.g., stages, functions, results)
- Cytokinesis (e.g., cleavage furrow, cell plate)
- Cell cycle checkpoints

I. Structure and function of nucleic acids

- Sugar-phosphate backbone
- DNA versus RNA
- Complementary base pairing
- Chromosome structure (e.g., nucleosome, telomeres, linear vs. circular)
- DNA replication

J. Processes involved in protein synthesis

- RNA transcription
- mRNA processing (e.g., poly A tail, splicing)
- Translation (e.g., ribosome structure, tRNA)

K. Regulation of gene expression

- Promoters
- Enhancers
- Transcription factors
- Operons
- Environmental influences (e.g., epigenetics)

L. Cells may undergo differentiation and specialization

- Differential gene expression
- Stem cells (e.g., sources, developmental potential)

M. Nature of mutations

- Cause of mutations (e.g., recombination, translocation, mutagens)
- Types of mutations (e.g., point mutations, deletions, inversion)
- Somatic versus germ-line mutations

N. Use of basic laboratory techniques to study biological processes

- Gel electrophoresis
- Microscopy
- Spectrophotometry

O. Use and applications of DNA technologies and genetic engineering

- DNA sequencing and polymerase chain reaction (PCR)
- Genome sequencing projects
- Gene therapy
- Cloning
- Transgenic and genetically engineered cells

III. Classical Genetics and Evolution

A. Mendel's laws and predicting the probable outcome of given genetic crosses

- Independent assortment
- Law of segregation
- Monohybrid and dihybrid crosses
- Pedigree analysis

B. Non-Mendelian inheritance

- Linkage (e.g., recombination mapping)
- Sex-linked inheritance
- Multiple alleles, codominance and incomplete dominance
- Polygenic inheritance, epistasis and pleiotropy
- Organelle inheritance (e.g., mitochondrial inheritance)

C. Chromosomal and genetic changes that lead to common human genetic disorders

- Changes in chromosome numbers (e.g., Down syndrome)
- Changes in chromosome structure (e.g., deletions, inversion, duplications)
- Common genetic disorders (e.g., Sickle-cell anemia, Tay-Sachs)

D. Sources of genetic variation

- Mutation
- Crossing-over
- Genetic exchange (e.g., transduction, transformation, conjugation)
- Sexual reproduction (e.g., independent assortment)

E. Mutations, gene flow, genetic drift, and nonrandom mating affect the gene pool of a population

- Distribution and movement of alleles within populations
- Distribution and movement of alleles between populations

F. Principles and applications of Hardy-Weinberg equilibrium

- Conditions of HW equilibrium
- Calculating allele frequencies using the HW equation

G. Mechanisms of evolution

- Natural and artificial selection
- Sexual selection
- Genetic drift (e.g., bottleneck, founder effect)
- Coevolution
- Adaptive radiation

H. Evidence that supports evolution

- Molecular evidence (e.g., DNA sequence comparisons)
- Structural and developmental evidence (e.g., homology, embryology)
- Fossil record
- Endosymbiosis
- Convergent versus divergent evolution
- Major evolutionary trends (e.g., cephalization, multicellularity)

I. Genetic basis of speciation

- Reproductive isolation (e.g., behavioral, postzygotic)
- Types of speciation (e.g., allopatric, sympatric)

J. Models of evolutionary rates

- Gradualism
- Punctuated equilibrium

K. Scientific explanations for origin of life on Earth

- Panspermia (e.g., asteroid seeding)
- Abiotic synthesis of organic compounds (e.g., Urey-Miller experiment)
- Biological influences on atmospheric composition (e.g., photosynthesis)
- Development of self-replication (e.g., RNA world)

L. Factors that lead to extinction of species

- Lack of genetic diversity
- Environmental pressures (e.g., climate and habitat change)
- Human impacts
- Interspecific competition

IV. Diversity of Life, Plants, and Animals

A. Characteristics of living versus nonliving things

- Cellular organization
- Growth and reproduction
- Regulation and responses to the environment
- Obtain and use energy

B. Historical and current biological classification systems of organisms

- Kingdom system
- Domain system

C. Defining characteristics of viruses, bacteria, protists, fungi, plants, and animals

- Structure (e.g., capsid, cell wall, organelles)
- Organization (e.g., prokaryote, multicellular)
- Modes of nutrition (e.g., heterotroph, autotroph)
- Reproduction/replication (e.g., viral replication, binary fission, budding)

D. Characteristics of the major animal phyla

- Body plans (e.g., radial versus bilateral symmetry)
- Body cavities (i.e., coelomates, pseudocoelomates, acoelomates)
- Modes of reproduction
- Modes of temperature regulation (e.g., endotherm, ectotherm)

E. Organizational hierarchy of multicellular organisms

- Cells
- Tissues
- Organs
- Organ systems

F. Anatomy and physiology of major organ systems in animals

- Cardiovascular and respiratory
- Reproductive
- Digestive and excretory
- Nervous and endocrine
- Immune

G. Maintenance of homeostasis in organisms

- Role of structural components (e.g., kidney, hypothalamus)
- Feedback mechanisms
- Role of hormones (e.g., antidiuretic hormone (ADH), insulin)
- Role of behaviors (e.g., diurnal, nocturnal, basking)

H. Reproduction, development and growth in animals

- Gamete formation
- Fertilization
- Embryonic development
- Growth, development and aging

I. Characteristics of major plant divisions

- Vascular versus nonvascular plants
- Flowering versus nonflowering plants
- Monocot versus dicot

J. Structure and function of major plant tissues and organs

- Dermal
- Vascular (xylem, phloem)
- Ground (e.g., parenchyma, cortex)
- Meristems
- Flowers, stems, leaves, and roots

K. Plant life cycles and reproductive strategies

- Alternation of generations (i.e., gametophyte, sporophyte)
- Pollination strategies (e.g., wind, insect)
- Seed dispersal

L. Plants obtain and transport water and inorganic nutrients

- Roots
- Xylem transport
- Control (e.g., stomata)

M. Plants transport and store products of photosynthesis

- Products (e.g., simple and complex carbohydrates)
- Phloem transport
- Storage molecules (e.g., starch, cellulose)
- Storage structures (e.g., plastids, vacuoles, tuber)

V. Ecology

A. Hierarchical structure of the biosphere

- Populations
- Communities
- Ecosystems
- Biomes

B. Biotic and abiotic components of an ecosystem influence population size

- Resource availability and abiotic factors (e.g., nutrients and temperature)
- Habitat and niche
- Competition and predation

C. Models of population growth

- Exponential growth
- Logistic growth (e.g., carrying capacity)

D. Relationship between reproductive strategies and mortality rates

- Sexual versus asexual reproduction
- Parental investment
- Numbers of offspring produced versus numbers that survive

E. Relationships within and between species

- Symbiosis (e.g., parasitism, commensalism, mutualism)
- Predation
- Competition and territoriality
- Altruistic behaviors

F. Changes occur during ecological succession

- Primary versus secondary succession
- Biomass, diversity, productivity, and habitat changes during succession

G. Types and characteristics of biomes

- Aquatic (e.g., stream, estuary, coral reef)
- Terrestrial (e.g., desert, grassland, tropical rain forest)

H. Energy flow in the environment

- Trophic levels (e.g., pyramids of biomass, pyramids of energy)
- Food webs

I. Biogeochemical cycles

- Water cycle
- Carbon cycle
- Nitrogen cycle
- Phosphorus cycle

J. Effects of natural disturbances on biodiversity and ecosystems

- Temporal and spatial disturbances (e.g., climate, fire, disease)
- Fragmentation of ecosystems
- Natural ecosystem recovery

K. Humans affect ecological systems and biodiversity

- Pollution (e.g., greenhouse gases, acid precipitation)
- Habitat destruction (e.g., deforestation)
- Introduced species (e.g., non-native, reintroduced)
- Remediation (e.g., reforestation, mine reclamation)

L. Connections among ecosystems on a local and global scale

- Natural flow of material between ecosystems
- Transport of materials by humans
- Movement of organisms (e.g., migration)

VI. Science, Technology, and Society

A. Impact of science and technology on the environment

- Pollution and pollution mitigation (e.g., burning fossil fuels, green building, environmental cleanup)
- Resource management (e.g., waste management, recycling)
- Conservation (e.g., habitat protection, habitat restoration, species protection)
- Non-point sources of pollution (e.g., lawn fertilizers)

B. Impact of human activity and natural phenomena on society

- Consequences (e.g., economic, social)
- Disaster management (e.g., hurricane relief and cleanup)
- Global warming, sea levels, flooding
- Epidemiology (e.g., malaria, influenza)
- Agriculture and soil erosion
- Estuary and wetland degradation
- Water management
- Production, use, and disposal of consumer products (e.g., plastics)

C. Societal impacts associated with the management of natural resources

- Habitat preservation (e.g., Endangered Species Act, National Parks)
- Extraction of mineral and energy resources (e.g., mining, drilling)
- Agriculture, forestry, wildlife and fisheries practices
- Renewable and/or sustainable use of resources

D. Ethical and societal issues arising from the use of science and technology

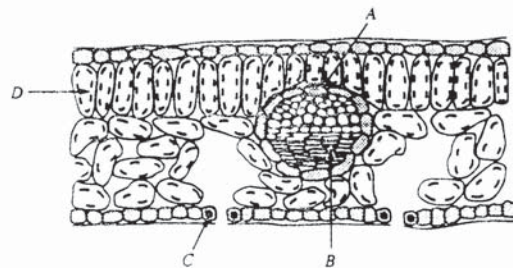
- Ethical research concerns (e.g., stem cells, toxic chemicals)
- Ethical use of technology (e.g., genetically modified organisms, cloning)
- Societal concerns (e.g., security of genetic information, equal access to medical treatment)

Sample Test Questions

The sample questions that follow illustrate the kinds of questions in the test. They are not, however, representative of the entire scope of the test in either content or difficulty. Answers with explanations follow the questions.

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.

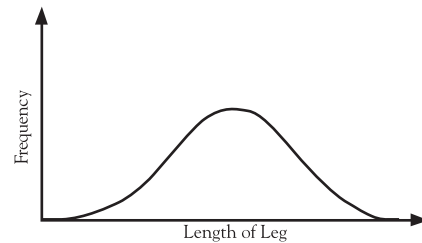
- The movement of water upward in xylem vessels of trees is most directly related to which of the following?
 - Wall pressure
 - Turgor pressure
 - Transpiration
 - Cytoplasmic streaming
- Which of the following is a true statement about the flow of energy in an ecosystem?
 - Smaller organisms need less energy per gram of body weight than do larger organisms.
 - Energy transfer between organisms normally involves conservation of heat energy.
 - Energy flow between trophic levels is inefficient.
 - Chemical energy is converted into radiant energy, which is then converted to chemical energy at the next trophic level.
- The diversity of the finches on the Galápagos Islands is an example of which of the following?
 - Adaptive radiation
 - Seasonal isolation
 - Mechanical isolation
 - Selective hybrid elimination
- Two parents who do not exhibit phenylketonuria (PKU) have a son with PKU. Which of the following conclusions can be drawn from this situation?
 - The allele for PKU is located on the Y chromosome.
 - PKU is a dominant trait.
 - PKU is a recessive trait.
 - A mutation occurred in the sperm of the son.
- All of the following represent primary consumers feeding on first-trophic-level organisms EXCEPT
 - paramecia feeding on green algae
 - mice feeding on seeds
 - deer feeding on branches of trees
 - slugs feeding on mushrooms



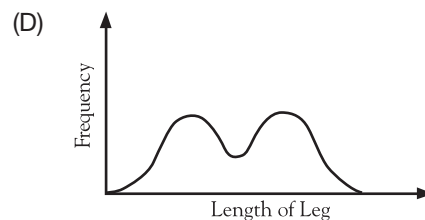
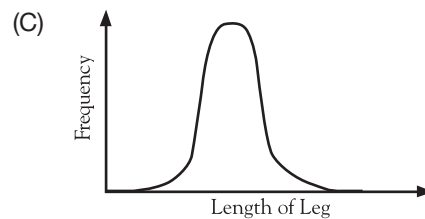
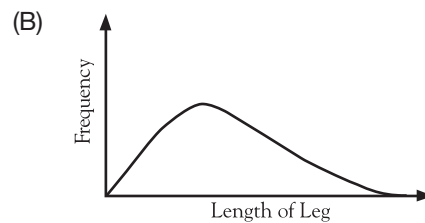
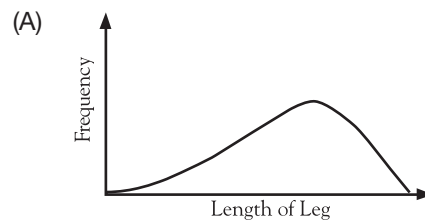
The diagram above represents a cross section of a leaf. Which region serves primarily to regulate the stomatal opening?

- A
- B
- C
- D

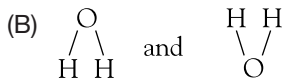
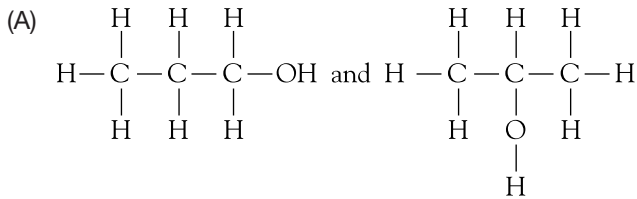
7. Which of the following best describes the pathway of a protein from its manufacture to its secretion from the cell?
- (A) Endoplasmic reticulum → Golgi complex → secretory vesicle
 - (B) Secretory vesicle → endoplasmic reticulum → Golgi complex
 - (C) Secretory vesicle → Golgi complex → endoplasmic reticulum
 - (D) Golgi complex → endoplasmic reticulum → secretory vesicle
8. All of the following are likely to increase after large areas of tropical rain forests are cut down EXCEPT the
- (A) species diversity of the areas
 - (B) erosion by rivers flowing through the areas
 - (C) rate of nutrient loss from the areas
 - (D) average surface temperature of the soil in the areas



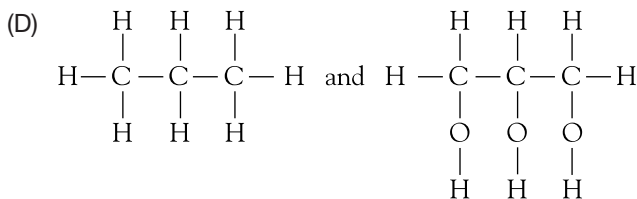
9. The graph above depicts the frequency of expression of the range of leg lengths in a population of grazing animals. In this species, leg length is directly related to speed, which is a heritable characteristic. These grazers are being preyed on by a newly introduced species of swift-running predators.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



10. Which of the following are isomers?



(C) NaCl and KCl



11. If a DNA template has the base sequence 5' -TAG- 3', the corresponding base sequence on an mRNA transcript would be

- (A) 5' -ATC- 3'
- (B) 5' -CTA- 3'
- (C) 5' -AUC- 3'
- (D) 5' -CUA- 3'

12. Which of the following structures is present in the roots of vascular plants but NOT in stems?

- (A) Cambium
- (B) Pericycle
- (C) Xylem
- (D) Cortex

13. A certain autosomal recessive trait is expressed in 1 percent of a population. Assuming that the population is in Hardy-Weinberg equilibrium, what percent of the population are carriers but do not express the trait?

- (A) 10%
- (B) 18%
- (C) 27%
- (D) 50%

14. 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

15. Which of the following mechanisms can best account 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

16. A person touches a hot object and immediately moves her finger away from it. 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

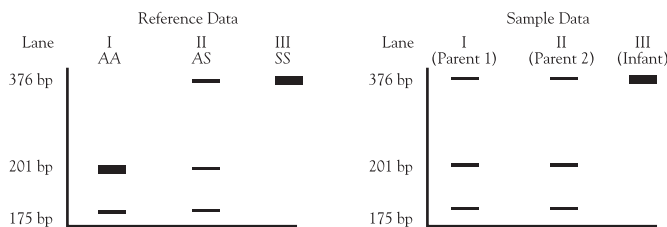
17. Males of a certain species of small mammal have been observed to have either fluffy tails or furless tails. Those with the fluffy tails have been observed to attract significantly more mates than those with furless tails. The phenomenon described is an example of

- (A) disruptive dimorphism
- (B) disruptive selection
- (C) sexual dimorphism
- (D) sexual selection

Directions for Questions 18–19: The group of questions below describes an experimental situation. First study the description of the situation; then choose the one best answer for each question and fill in completely the space on the answer sheet.

Sickle cell anemia is a genetic disorder. Specialized techniques for DNA analysis are used to detect carriers of the sickle cell anemia allele and infants that are homozygous for the trait. The DNA is cut into fragments that are separated according to size by use of gel electrophoresis. Radiolabeled probes can then be used to identify both the normal allele and the mutant (sickle cell) allele.

The reference data shown below indicate that the DNA in lane I is from a noncarrier (AA), the DNA in lane II is from a carrier (AS), and the DNA in lane III is from an individual having sickle cell anemia (SS). The sample data are from two parents (lanes I and II) and their infant (lane III).



18. Which of the following is correct concerning the sickle cell trait in Parent 1 (lane I)?
- (A) Parent 1 is a carrier (AS).
 - (B) Parent 1 is a noncarrier (AA).
 - (C) Parent 1 has sickle cell anemia (SS).
 - (D) The occurrence of the sickle cell trait cannot be determined from the data.
19. Which of the following can be concluded from the sample data?
- (A) The infant is homozygous for the sickle cell allele (SS).
 - (B) The infant is a carrier of the sickle cell allele (AS).
 - (C) The infant is a noncarrier of the sickle cell allele (AA).
 - (D) The occurrence of the sickle cell trait cannot be determined for the infant.

Directions for Questions 20–21: The group of questions below consists of four lettered headings followed by a list of phrases or sentences. For each sentence, select the one heading that is most closely related to it. One heading may be used once, more than once, or not at all.

- (A) Nephrons
 - (B) Flame cells
 - (C) Malpighian tubules
 - (D) Skin gills
20. Function in both arachnids and insects
21. Have cilia to drive waste products to excretory pores
22. The bat is most closely related to which of the following animals?
- (A) Hummingbird
 - (B) Wolf
 - (C) Butterfly
 - (D) Chameleon
23. Which of the following is a unit for density?
- (A) kg
 - (B) kg/m^2
 - (C) g/m^3
 - (D) m^3/sec
24. 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

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

25. In a lab investigation designed to demonstrate one aspect of photosynthesis, three test tubes were treated as shown above. 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 bleached the solution 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.
 - (D) The plant produces oxygen during photosynthesis, which caused the color change.
26. Unfertilized sea urchin eggs can be induced to develop into normal larvae by placing them in appropriate magnesium solutions. Which of the following best describes this process?
- (A) Metamorphosis
 - (B) Oogenesis
 - (C) Homeostasis
 - (D) Parthenogenesis
27. Which of the following includes the classes Gastropoda and Cephalopoda?
- (A) Arthropoda
 - (B) Annelida
 - (C) Brachiopoda
 - (D) Mollusca

Answers

1. The correct answer is C. 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.
2. The correct answer is C. Biologists estimate that large amounts of energy available to one trophic level are lost and not transferred to the next trophic level.
3. The correct answer is A. The Galapágos finches are a classical example of adaptive radiation of a single species that arrived from the continent, diversified, and underwent speciation following isolation on several islands.
4. The correct answer is C. PKU must be a recessive trait because the parents did not exhibit the disorder, yet must have been carriers for the disorder.
5. The correct answer is D. The first trophic level consists of producers. Neither slugs nor mushrooms are producers. In choices A, B, and C, the producers are green algae, seeds, and tree branches, and the primary consumers are paramecia, mice, and deer.
6. The correct answer is C. These are the guard cells that regulate the stomatal opening.
7. The correct answer is A. Proteins to be secreted pass from the ribosomes into the lumen of the endoplasmic reticulum. They are then sent to the Golgi complex, where they are modified and packaged into vesicles, which transport them to the outside of the cell.
8. Choice A is the exception. The continuing loss of the diverse habitats found in tropical rain forests will cause a decrease in species diversity, not an -increase. Thus, A is the correct answer.
9. The correct answer is A. Selection pressure would favor longer legs in the prey animals, and choice A depicts a population with a large number of individuals with longer legs.
10. The correct answer is A. 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 choice A are alcohols with the formula C_3H_8O , but the position of the OH group is different in each.
11. The correct answer is D. 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.
12. The correct answer is B. In plant roots, the vascular tissue is located in the center of the root and is surrounded by a layer of endoderm cells. The pericycle is a layer of cells on the inner side of the endoderm in plant roots. Root branching is initiated in the pericycle.
13. The correct answer is B. The Hardy-Weinberg equation states $p^2 + 2pq + q^2 = 1$, where p = the frequency of the dominant allele of a gene and q = the frequency of the recessive allele of a gene. If a recessive trait is expressed in 1% of the population ($q^2 = 0.01$), the frequency of the allele in the population is 0.1 (square root of 0.01). If the frequency of the recessive allele = 0.1, then the frequency of the dominant allele must be 0.9 (i.e., $1.0 - 0.1 = 0.9$). Therefore, $2pq = (2)(0.9)(0.1) = 0.18$.
14. The correct answer is B. 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 function in the absence of oxygen. The Calvin cycle normally uses ATP.
15. The correct answer is D. Energy is required to move minerals up their concentration gradient. In both osmosis and diffusion, substances move down a gradient.
16. The correct answer is D. 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.
17. The correct answer is D. Mate selection based on a physical feature defines sexual selection.
18. The correct answer is A. By comparing the data from Parent 1 to the reference data, it is clear that Parent 1 is a carrier (AS).
19. The correct answer is A. The infant is homozygous for the sickle cell allele. This can be seen by comparing lane III of the reference data with lane III of the sample data.
20. The correct answer is C. Malpighian tubules are found in arthropods; arachnids and insects are arthropods.
21. The correct answer is B. Flame cells contain cilia.
22. The correct answer is B. Bats and wolves are both mammals. While bats, hummingbirds, and butterflies all fly, their wings are analogous structures; the organisms are not closely related.
23. The correct answer is C. Density is defined as mass per unit volume. The gram is a unit of mass and cubic meters is a volume.

24. The correct answer is B. 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.

25. The correct answer is C. Bromothymol blue can be used as an indicator of CO₂ concentration. CO₂ dissolves in solution and a small percent becomes carbonic acid. Plants utilize CO₂ during photosynthesis, thus raise the pH of the solution and change the color of the solution from yellow to blue.

26. The correct answer is D. Parthenogenesis is a form of asexual reproduction in which offspring are produced from unfertilized eggs. In nature, there are a variety of animals that can reproduce in this fashion.

27. The correct answer is D. Mollusca is a large phylum of invertebrates that includes Gastropoda (freshwater and marine snails and slugs) and Cephalopoda (includes only marine organisms such as squid and octopuses).



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