

Biology: Content Knowledge, Part 1 (0231)

Test at a Glance

Test Name	Biology: Content Knowledge, Part 1		
Test Code	0231		
Time	1 hour		
Number of Questions	75		
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"> 13 12 11 19 10 10 	<ul style="list-style-type: none"> 17% 16% 15% 26% 13% 13%

About This Test

The Biology: Content Knowledge, Part 1, test is designed to assess whether an examinee has the knowledge and competencies necessary for a beginning teacher of biology in a secondary school. The 75 basic multiple-choice questions address examinees' knowledge of the biological sciences; the basic principles of science; and the issues and applications concerning science, technology, and society. Questions are derived from topics typically covered in an introductory college-level biology course. The test covers content in basic principles of science; molecular and cellular biology; classical genetics and evolution; diversity of life, plants, and animals; ecology; and science, technology, and society.

This test may contain some questions that will not count toward your score.

Topics Covered

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

I. Basic Principles of Science

- Scientific methodology: scientific methods, process skills, facts, concepts, models, commonly shared scientific ideals, and history and philosophy
- Mathematics, measurement, and data manipulation:
 - measurement and notation systems
 - data collection, manipulation, interpretation, and presentation, including tables, graphs, charts, and error analysis
- Laboratory, field activities, and safety procedures:
 - safe preparation, storage, use, and disposal of laboratory and field materials
 - selection and use of appropriate laboratory equipment
 - legal responsibilities
 - emergency procedures

II. Molecular and Cellular Biology

- Chemical basis of life:
 - basic chemical structures
 - atoms, molecules, and chemical bonds
 - buffers
 - pH
 - biologically important molecules
 - thermodynamics and free energy
 - cellular bioenergetics
 - photosynthesis
 - respiration
 - enzymes
- Cell structure and function:
 - membranes, organelles, and subcellular components of prokaryotic and eukaryotic cells
 - mitosis and cell cycle
 - cytokinesis
 - meiosis
- Molecular genetics: structure and function of nucleic acids, protein synthesis, gene regulation, transposable elements, mutation, cancer, viruses, recombinant DNA, microbial genetics

III. Classical Genetics and Evolution

- Classical genetics: Mendelian and non-Mendelian inheritance, probability, linkage, human genetic disorders, environmental influences
- Evolution: evidence, mechanisms, population genetics, speciation, phylogeny, origin of life

IV. Diversity of Life, Plants, and Animals

- Diversity of life: classification schemes, characteristics and representatives of organisms
- Plants:
 - evolution, including adaptation to land and major divisions
 - anatomy, including roots, stems, leaves, and reproductive structures
 - physiology, including C3 and C4 photosynthesis, hormones, photoperiods, water and nutrient uptake, and translocation
 - reproduction, including alternation of generations, fertilization and zygote formation, dispersal, germination, growth and differentiation, and vegetative propagation
- Animals:
 - evolution, including phylogeny and classification, and major phyla
 - life functions and associated structures, including digestion, circulation, respiration, excretion, nervous control, contractile systems and movement, support, integument, immunity, and chemical control
 - reproduction and development, including gametogenesis, fertilization, parthenogenesis, embryogenesis, growth and differentiation, metamorphosis, and aging
 - behavior, including taxes, instincts, learned behaviors, and communication

V. Ecology

- Populations: competition, density factors, population growth, dispersion patterns, life-history patterns, social behavior
- Communities: niche, interspecific relationships, species diversity, succession
- Ecosystems: terrestrial ecosystems, aquatic ecosystems, biomes, energy flow, biogeochemical cycles, stability and disturbances, human impact, interrelationships among ecosystems

VI. Science, Technology, and Society

- Issues and applications: human population growth, energy production and use, production and use of consumer products, biological magnification, biotic and abiotic resource management
- Ethical questions in biology: gene cloning, prolonging life, prenatal testing, radiation
- Current developments

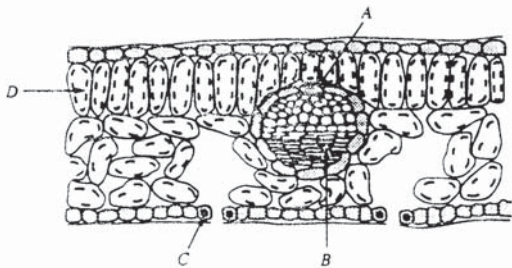
Sample Test Questions

The sample questions that follow illustrate the types 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.

- 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.
- 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

3.

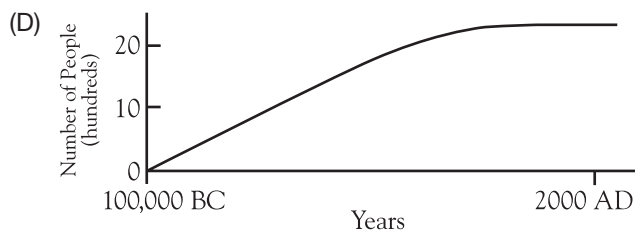
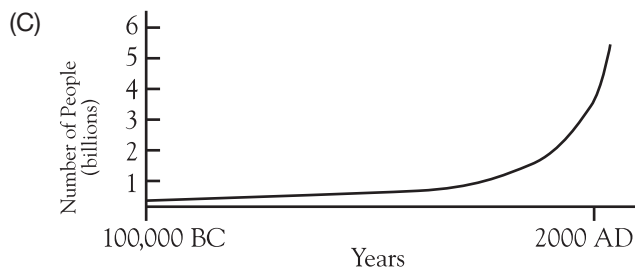
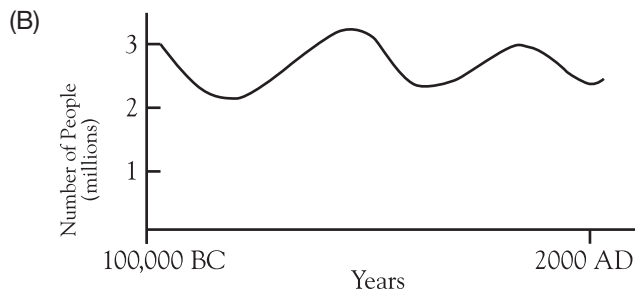
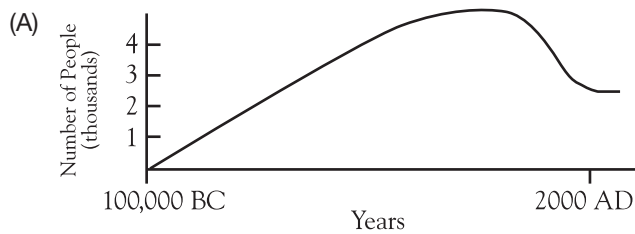


The diagram above represents a cross section of a leaf. Which region serves primarily to regulate the stomatal opening?

- A
- B
- C
- D

- The highest blood pressure in the human circulatory system is found in which of the following?
 - Arteries
 - Arterioles
 - Veins
 - Venules
- All of the following statements about energy flow through a forest ecosystem are true EXCEPT:
 - Energy cycles through the ecosystem.
 - The plants lose energy in the process of cellular respiration.
 - Energy flows through the food web.
 - The ultimate source of energy for the ecosystem is the Sun.
- All of the following represent primary consumers feeding on organisms in the first trophic level EXCEPT
 - paramecia feeding on green algae
 - mice feeding on seeds
 - deer feeding on branches of trees
 - slugs feeding on mushrooms
- 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
 - karyotype
 - linkage map
 - pedigree chart
 - DNA fingerprint

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



9. Which of the following hypotheses is LEAST amenable to verification by experimentation?

- (A) The average size of eukaryotic genes is greater than the average size of prokaryotic genes.
- (B) *Archaeopteryx* was the first flying organism.
- (C) Triploid watermelons exhibit defective meiosis and are therefore seedless.
- (D) Humans and chimpanzees share many of the same genes.

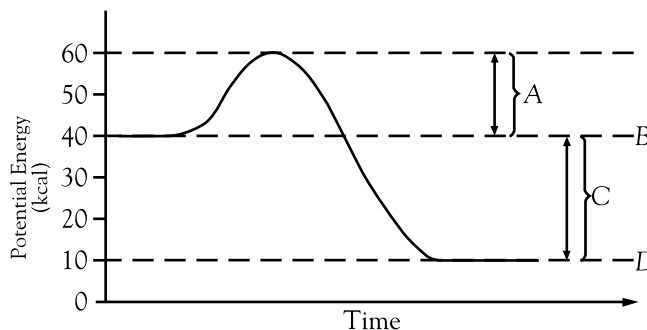
10. All of the atoms of sodium, whether or not in compounds, must have exactly eleven

- (A) ions
- (B) protons
- (C) neutrons
- (D) electrons

11. Toxic materials are often found in high concentrations in the tissues of organisms at the top of food pyramids because these materials are first

- (A) degraded in plants
- (B) excreted as wastes by animals
- (C) absorbed from the abiotic environment by carnivores
- (D) accumulated in the cells of autotrophs and herbivores

Directions for Questions 12–13: The group of questions below consists of four lettered headings followed by a list of numbered words, phrases, sentences, or diagrams. For each word, phrase, sentence, or diagram, select the one heading that is most closely related to it and fill in completely the corresponding space on the answer sheet. One heading may be used once, more than once, or not at all.

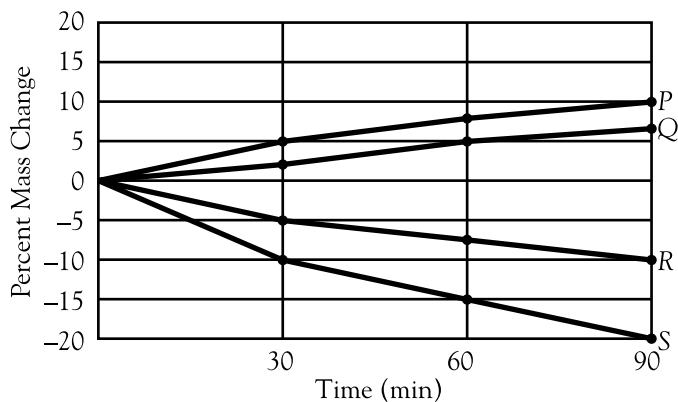


- 12. Represents the activation energy of the reaction
- 13. Represents the net energy given off by the reaction

Directions: The group of questions below concerns a laboratory exercise. First study the description of the situation; then choose the one best answer to each question.

Questions 14–15

The masses of each of twelve 1-centimeter potato cubes were determined. Three cubes were placed in each of four different solutions. After 30, 60, and 90 minutes, the mass of each potato cube was determined. The average percent of mass change for the cubes in each solution was calculated and plotted on a graph.



14. The data representing cubes *P* and *Q* indicate that
 - (A) both cubes gained water, which resulted in an increase in mass
 - (B) both cubes gained salt, which caused the cubes to swell
 - (C) both cubes lost salt, which resulted in an increase in mass
 - (D) cube *Q* gained water and cube *P* lost salt

15. Comparison of the results of cubes *R* and *S* indicates which of the following about the percent loss of mass of cube *S*?
 - (A) It is twice that of cube *R*.
 - (B) It is one-half that of cube *R*.
 - (C) It is one-quarter that of cube *R*.
 - (D) Its extent cannot be determined from the graph.

Answers

1. 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.

2. The correct answer is A. The Galapágos finches are a classical example of adaptive radiation of a single species that arrived from the continent and diversified into many species following isolation on several islands.

3. The correct answer is C. These are the guard cells that regulate the stomatal opening.

4. The correct answer is A. The arteries have thick walls that can withstand the high pressure of blood as it is pumped from the heart. The blood pressure drops as the blood flows from the arteries into arterioles and capillaries, and remains low in the venules and veins.

5. The correct answer is A. Energy is not cycled in the ecosystem; rather, it takes a one-way path. Energy enters as radiant energy from the Sun, and plants convert this energy to chemical energy (choice D). Energy is lost from the cells of a plant during cellular respiration (choice B). Energy also flows through the food web from one trophic level to the other, and heat is lost in this transfer (choice C).

6. 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.

7. The correct answer is A. A karyotype is basically a pictorial representation of the chromosomes contained in a cell.

8. The correct answer is C. Human population has grown exponentially since about A.D. 1700. It currently stands at about 6.7 billion.

9. Choices A, C, and D all involve experimentation in the areas of cell biology and molecular biology. There are well-documented methods for conducting these kinds of experiments. Even if choice B were a correct statement (there were flying insects before *Archaeopteryx*), it is very unlikely that choice B could be verified by experimentation since there is no way to rule out the possibility that flying organisms evolved before *Archaeopteryx* and did not leave fossil evidence. B, therefore, is the best answer.

10. Atoms differ from one another in their number of protons, neutrons, and electrons. It is the number of protons that defines the element of an atom. Sodium atoms always contain eleven protons; thus, choice B is the correct answer.

11. When organisms take in water and nutrients, they may accumulate toxic compounds in their tissues. The organisms cannot break these compounds down or excrete them. When these organisms are eaten, biological magnification takes place because the biomass at each trophic level is being produced from a much larger biomass at a lower trophic level. When autotrophs and herbivores accumulate the toxic nonfood materials in their cells and are in turn eaten by omnivores and carnivores, the toxic chemicals will then accumulate in the latter. D, therefore, is the correct answer.

12. The correct answer is A. The activation energy is the amount of energy required to overcome the energy barrier in a reaction. In this reaction, 20 kilocalories represents the activation energy.

13. The correct answer is C. The difference between the energy content of the reactants and of the products indicates the net energy released during the reaction (30 kcals).

14. The correct answer is A. Cubes P and Q increased their mass with time. This is probably due to water gain of the cubes.

15. The correct answer is A. From the graph, it can be seen that cube S lost twice as much percent mass as cube R.



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