ARIZONA EDUCATOR PROFICIENCY ASSESSMENTS®

STUDY GUIDE

07 Biology

**This AEPA test was replaced by a NES test.
Examinees may continue to find this study guide useful as they prepare for the NES, as the previous AEPA test may have covered objectives and content similar to the NES test.**

AZ-SG-FLD007-02

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GENERAL INFORMATION ABOUT THE AEPA® AND TEST PREPARATION

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General Information About the AEPA and Test Preparation

PART 2:
FIELD-SPECIFIC INFORMATION

Field 07: Biology

INTRODUCTION

This section includes a list of the test objectives, practice questions, an answer key for the selected-response questions, and a list of preparation resources.

Test objectives. As noted earlier, the test objectives are broad, conceptual statements that reflect the knowledge, skills, and understanding an entry-level educator needs to practice effectively in Arizona schools. The list of test objectives for each test field is the *only* source of information about what a specific test will cover and therefore should be studied carefully.

Practice questions. The practice questions for the selected-response and performance assignment sections included in this section are designed to give you an introduction to the nature of the questions included in the Arizona Educator Proficiency Assessments® (AEPA®) tests. The practice questions represent the various types of questions you may expect to see on an actual test; however, they are *not* designed to provide diagnostic information to help you identify specific areas of individual strength or weakness or to predict your performance on the test as a whole.

When you answer the practice questions, you may wish to use the sample answer sheet and sample Written Response Booklet provided in Part 1 to acquaint yourself with these materials. Use the answer key located after the practice questions to check your answers. A sample response is provided immediately following the written performance assignment. The sample response in this guide is for illustrative purposes only. Your written response should be your original work, written in your own words, and not copied or paraphrased from some other work.

To help you identify how the test objectives are measured, the objective statement to which the question corresponds is listed in the answer key. When you are finished with the practice questions, you may wish to go back and review the entire list of test objectives and descriptive statements for your test field.

Preparation resources. The list of preparation resources has been compiled to assist you in finding relevant materials as you prepare to take the Biology test. This list is to be considered not as complete, but as representative of the kinds of resources currently available. There may be other materials that may be helpful to you in preparing to take the test.

You may also wish to consult a representative from an Arizona educator preparation program in your area regarding other potential resources specific to this field. Keep in mind that the use of these materials does not guarantee successful performance on the test.

TEST OBJECTIVES

Field 07: Biology

SUBAREAS:

1. Scientific Inquiry
2. Cells and Cell Theory
3. Characteristics of Organisms
4. Human Biology
5. Principles of Heredity
6. Matter and Energy in Ecosystems

SCIENTIFIC INQUIRY

0001 Understand the historical and contemporary contexts of the study of biology.

For example: the significance of key events and contributions of individuals in the history of biology; the historical development of knowledge in biology; and the social and cultural contexts of biology (e.g., genetic understanding, medicine, agriculture).

0002 Understand the nature of science and scientific inquiry.

For example: processes by which new scientific knowledge and hypotheses are generated; processes by which science advances; the role of empirical data, verifiable evidence, and logical reasoning in scientific investigation; ethical issues related to scientific processes (e.g., accurately reporting experimental results, researcher bias); the role of communication among scientists and between scientists and the public in promoting scientific progress; and the relationship of facts, laws, and theories to one another and to scientific inquiry.

0003 Understand principles and procedures of scientific investigations.

For example: the identification of questions that can be answered using methods of scientific inquiry; procedures and considerations in setting up and conducting a scientific investigation; sampling techniques; the use of control and experimental groups to test hypotheses; the appropriateness of a specified experimental design to test a given biology hypothesis; and the selection and use of materials and techniques for biology investigations.

0004 Understand the processes of gathering, organizing, reporting, and analyzing scientific data in the context of biology investigations.

For example: the appropriateness of a given method or procedure for collecting data for a specified purpose; the design and use of models; appropriate and effective graphic representations (e.g., graph, table, diagram) for organizing and reporting experimental data; the application of simple descriptive statistics to data (e.g., mean, median, mode); the analysis of data to identify limitations, make predictions, and draw conclusions; and procedures for formally reporting experimental results and data to the scientific community.

0005 Understand how biology interrelates with society, technology, and the other sciences and applies to everyday life.

For example: unifying concepts and processes (e.g., systems, constancy, form and function) among the sciences; the impact of biology and technology on one another and on society; similarities and differences between science and technology (e.g., science as investigating the natural world, technology as solving human adaptation problems); and the application of biology to daily life and personal decision making.

CELLS AND CELL THEORY

0006 Understand cell structure and function and the cell theory.

For example: structures, functions, and interrelationships between cell organelles and other cell components; specializations of cells and the relationship between a cell's structure and its function; comparison of different types of cells (e.g., plant and animal cells, prokaryotic and eukaryotic cells); and basic tenets and implications of cell theory.

0007 Understand the chemical components of living systems and basic principles of biochemistry.

For example: the physical and chemical characteristics of water and its role in living organisms; and structures, functions, and composition of lipids, carbohydrates, proteins, amino acids, and nucleic acids.

0008 Analyze physiological processes of cells.

For example: processes of protein synthesis, photosynthesis, and respiration (anaerobic and aerobic) and the role of enzymes in regulating these processes; and processes by which cells obtain nutrients and maintain homeostasis (e.g., diffusion, facilitated diffusion, osmosis, active transport, exocytosis, endocytosis).

0009 Analyze cell growth, division, and differentiation.

For example: the cell cycle; processes of mitosis and meiosis; cell structures involved in mitosis and meiosis; consequences of normal and abnormal mitotic and meiotic divisions; the role of mitosis and meiosis in living organisms; and factors that affect cell growth, division, and differentiation.

CHARACTERISTICS OF ORGANISMS

0010 Understand principles of taxonomy and classification in biology.

For example: characteristics of biological classification (e.g., hierarchy of taxonomic levels, importance of heritable characteristics in classifying organisms, relationship of taxonomic classification to evolutionary history); the biological species concept; procedures and criteria used to classify organisms; and taxonomic relationships among organisms (including both living and extinct organisms).

0011 Analyze reproduction, development, and life cycles of living organisms.

For example: characteristics of sexual and asexual reproduction; advantages and disadvantages of sexual and asexual reproduction; reproductive strategies of common organisms; characteristics of developing embryos of plants and animals; processes related to developing embryos (e.g., cleavage, gastrulation); and life cycles of common organisms.

0012 Analyze the processes used by living organisms to obtain, store, and use energy.

For example: processes used by organisms to obtain energy; structures used to store food; processes involved in the distribution of food to all parts of an organism; and ways in which organisms use food.

0013 Analyze the anatomy and physiology of living organisms.

For example: anatomical structures and physiological processes that allow organisms to carry out specific life functions (e.g., maintaining homeostasis, respiration, photosynthesis); levels of biological organization (i.e., tissues, organs, and organ systems) in multicellular organisms; functions of and relationships among given tissues, organs, and organ systems; and adaptations of structures and processes.

HUMAN BIOLOGY

0014 Understand the structures and functions of the human skeletal, muscular, integumentary, circulatory, and immune systems.

For example: types, structures, and functions of bone, muscle, and connective tissues; the relationship between the structure of the skin and its functions; structures and processes of the circulatory and immune systems; components and functions of blood and lymph; common diseases and disorders of the skeletal, muscular, integumentary, circulatory, and immune systems; and homeostatic roles of the skeletal, muscular, integumentary, circulatory, and immune systems within the body.

0015 Understand the structures and functions of the human respiratory, excretory, and digestive systems, and the principles of human nutrition.

For example: structures and processes of the respiratory, excretory, and digestive systems; the relationship between surface area and volume in the functioning of the respiratory, excretory, and digestive systems; the exchange of materials and gases between the blood and other tissues; roles in the body of basic nutrients found in foods (e.g., water, vitamins, proteins, carbohydrates, lipids); common diseases and disorders of the respiratory, excretory, and digestive systems; and homeostatic roles of the respiratory, excretory, and digestive systems within the body.

0016 Understand the structures and functions of the human nervous, endocrine, and reproductive systems, and the processes of embryonic development.

For example: structures and functions of the central and peripheral nervous systems; the transmission of nerve impulses within and between neurons; structures of the endocrine system and the functions of specific hormones; structures and functions of the male and female reproductive systems; the role of feedback mechanisms in the functioning of the nervous, endocrine, and reproductive systems; gametogenesis, fertilization, and the processes and stages of embryonic development; common diseases and disorders of the nervous, endocrine, and reproductive systems; and homeostatic roles of the nervous, endocrine, and reproductive systems within the body.

PRINCIPLES OF HEREDITY

0017 Understand the principles of Mendelian and non-Mendelian genetics.

For example: evidence that certain characteristics are inherited; basic principles of heredity (e.g., independent assortment); the relationship of Mendelian genetics to the structure and behavior of chromosomes; crossing-over and its effect on genotype and phenotype; sex-linked characteristics; incomplete dominance and co-dominance; polygenic inheritance; and application of genetic principles to solve problems involving genetic crosses.

0018 Understand the synthesis of DNA, RNA, and protein.

For example: processes of replication, transcription, and translation; the relationship of molecular structure to these processes; and the genetic code (including analysis of problems involving codons and anticodons).

0019 Understand genes, chromosomes, and changes in genetic material.

For example: gene structure and function; the relationship between genes and chromosomes; factors contributing to genetic mutations and their consequences; the influence of environment on heredity; the use of genetic engineering; and changes in genetic material.

0020 Understand the processes of natural selection and adaptation.

For example: the concept of variation in populations (including genetic and phenotypic variation); the role of natural selection on the survival of individual organisms and species; the influence of selection pressures on species adaptations; factors that contribute to speciation; evidence that species change over time; and proposed mechanisms of biological evolution.

MATTER AND ENERGY IN ECOSYSTEMS

0021 Understand populations and communities.

For example: basic requirements of organisms (e.g., food, habitat, shelter); factors that affect population size (e.g., carrying capacity, competition, predation); common patterns of interdependence and interrelationships among species in a community (including the roles of producers, consumers, and decomposers); the concept of niche; and energy relationships within food chains and food webs.

0022 Understand types and characteristics of ecosystems and biomes, and factors affecting their change over time.

For example: common patterns of interdependence and interrelationships among species in an ecosystem; biotic and abiotic factors that affect ecosystems and biomes; types and characteristics of biomes; characteristic flora and fauna of biomes; and the process of ecological succession.

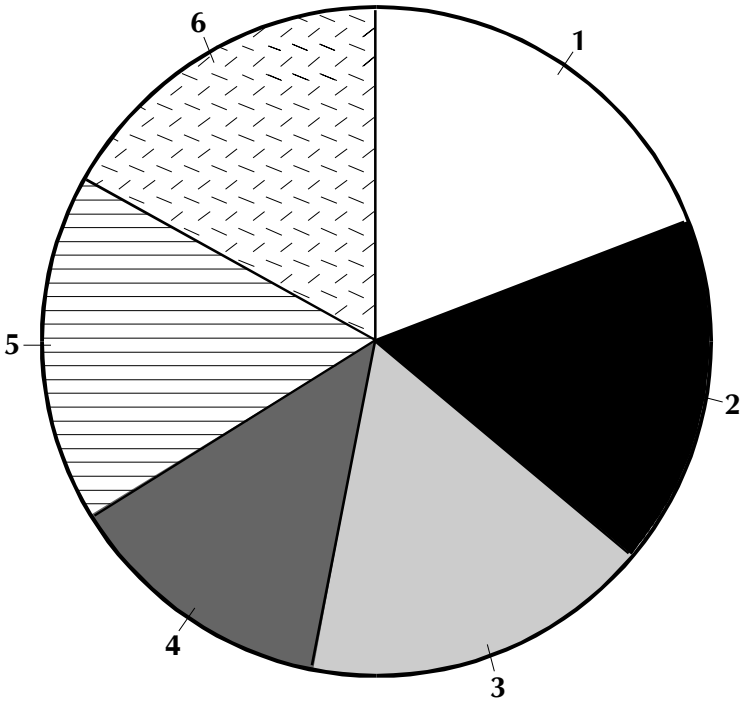
0023 Analyze the cycling of materials through an ecosystem.

For example: characteristics and processes of biogeochemical cycles (e.g., water, carbon-oxygen, nitrogen, phosphorus); roles of organisms in biogeochemical cycles; the concept of limiting factors; and implications of biogeochemical cycles for living things.

0024 Understand the physical and societal effects of human activities on the environment.

For example: characteristics and consequences of human population growth; food production and the world food supply; issues related to the availability, distribution, and use of water, space, and energy; types, sources, and effects of pollution (e.g., depletion of the ozone layer); chemical and physical mechanisms (e.g., burning of fossil fuels) by which pollutants (e.g., acid precipitation) are created; consequences of habitat destruction; and methods of pollution control, resource conservation (e.g., recycling), land reclamation, and environmental preservation.

DISTRIBUTION OF SELECTED-RESPONSE ITEMS ON THE TEST FORM



Subarea	Approximate Percentage of Selected-Response Items on Test Form
1. Scientific Inquiry	22%
2. Cells and Cell Theory	16%
3. Characteristics of Organisms	16%
4. Human Biology	13%
5. Principles of Heredity	16%
6. Matter and Energy in Ecosystems	17%

PRACTICE QUESTIONS

Field 07: Biology

1. In the nineteenth century, Louis Pasteur placed nutrient solutions in flasks and heated their necks in a flame. He then elongated and curved the glass necks while they were hot so that germs would not contaminate the nutrient solutions. Pasteur boiled the solutions for a few minutes and allowed them to cool. No growth occurred in the nutrient solutions. When the necks of the flasks were broken, the growth of germs began. The results of this investigation described above provided support for the argument that:

   A. organisms cannot develop from non-living matter.

   B. pathogens can only exist in non-sterile environments.

   C. bacteria can be transmitted through air and liquids.

   D. microorganisms cannot move on their own.

2. The publication in 1962 of *Silent Spring* by the U.S. ecologist Rachel Carson contributed to the biological sciences by:

   A. describing the impact of various natural disasters on plant and animal populations.

   B. promoting recognition of the great diversity of life on earth.

   C. drawing attention to the evolutionary significance of various animal behaviors.

   D. spreading awareness of the dangers to the environment caused by pesticides.

3. Which of the following advances played a central role in establishing the cell theory in the scientific community?

   A. development of methods for growing and maintaining living tissue in the laboratory

   B. improvements in light microscopy technologies and staining methods

   C. development of procedures for conducting scientific research in a sterile environment

   D. improvements in the tools and techniques used in microdissection

4. Gregor Mendel established which of the following principles through his studies involving the breeding of pea plants?

   A. Traits are duplicated prior to the division of cells.

   B. Genes recombine randomly during meiosis.

   C. Traits are discrete heritable units that retain their identities in offspring.

   D. Genes undergo random mutation.

5. A biologist has completed an investigation of the ecological effects of planting large areas with crops that have been genetically altered to prevent pest damage. In order for other scientists to properly evaluate this research, it is most important that the biologist publish which of the following types of information related to the study?

   A. the results of previous studies dealing with the topic

   B. an explanation of the statistical techniques used to analyze the data

   C. the specific methodology used to obtain the study's results

   D. a list of the sources of funds used to finance the study

6. In which of the following situations is researcher bias most likely to be a factor that could compromise the validity of a scientific investigation?

   A. The funds for the research come from sources that have a vested interest in the outcome of the research.

   B. The researcher's interest in the subject is based on personal experiences.

   C. The time frame in which the work must be completed is shortened by practical considerations.

   D. The researcher's result differs from the expected outcome.

7. In a significant breakthrough, a scientist has uncovered a genetic basis for a certain aspect of a mammalian behavior long believed to be controlled by conditioning. This discovery is most likely to have which of the following effects on research in this field?

   A. Expand interest in and funding for research related to the mechanisms by which genes can affect behavior.

   B. Decrease critical evaluation of data showing a connection between genetics and behavior.

   C. Encourage examination of the motives of researchers who believe conditioning is central to behavior.

   D. Inhibit research supporting the connection between conditioning and behavior.

8. A researcher has documented a decline in the population of wood frogs from an area in which bullfrogs have been introduced. According to the researcher's data, the wood frog population began to decline soon after the introduction of the bullfrogs, and the decline has accelerated since the bullfrog population began growing more rapidly. The researcher notes that bullfrogs are much larger and more aggressive than wood frogs and concludes that the wood frogs are being driven from their breeding areas. This conclusion is questionable because the researcher:

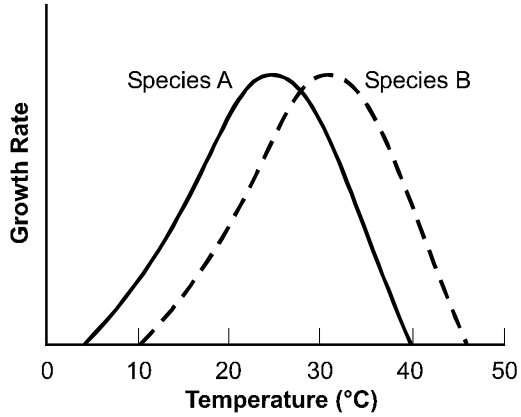
   A. has not shown a correlation between the size of bullfrogs and the size of wood frogs.

   B. has not shown a causal relationship between the establishment of the bullfrog population and the decline of the wood frog population.

   C. has not proposed a mechanism for the proposed effect of the bullfrog population on the wood frog population.

   D. lacks a testable hypothesis.

9. **Use the information below to answer the question that follows.**



A scientist plans to observe interspecific competition between two species of bacteria with a single nutrient source they can both use. The scientist wants to make sure that the temperature does not give either species a reproductive advantage. Based on their growth rate curves above, the best method for growing the two species to study interspecific competition would be to:

A. grow each species in separate cultures and at different temperatures ranging from 0°C to 50°C.

B. grow both species in the same culture and steadily increase the temperature from 0°C to 50°C.

C. grow both species in the same culture and keep the temperature fixed at 27°C.

D. grow each species in separate cultures and keep the temperature fixed at 24°C for Species A and 31°C for Species B.

10. A researcher sets out to test the effect of temperature on the rate of reproduction and locomotion of *Paramecium caudatum*. A control treatment of 15°C is chosen. Experimental treatments of 20°C, 25°C, and 30°C are conducted and the temperature of each culture is kept constant. The organisms are monitored in each treatment using a microscope and two trials are conducted for each treatment. The researcher could most effectively enhance the reliability of the study by:

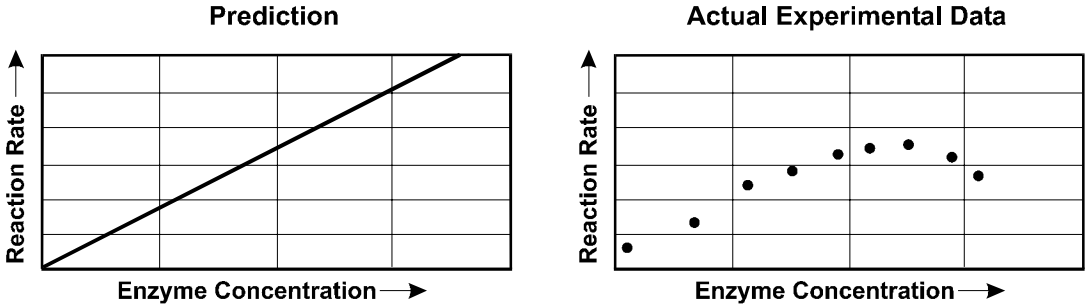
A. evaluating an additional microbial species.

B. introducing additional independent variables.

C. increasing the number of trials for each treatment.

D. having a wider range of control temperatures.

11. **Use the information below to answer the question that follows.**



A scientist is studying an enzyme's effect on a particular reaction. Although the scientist's hypothesis predicts that there is a linear relationship between enzyme concentration and reaction rate as shown above at the left, the actual experimental data set demonstrates that the rate of the reaction levels off after the enzyme reaches a certain concentration. Which of the following should the scientist do to resolve the discrepancy between the research prediction and the actual experimental results?

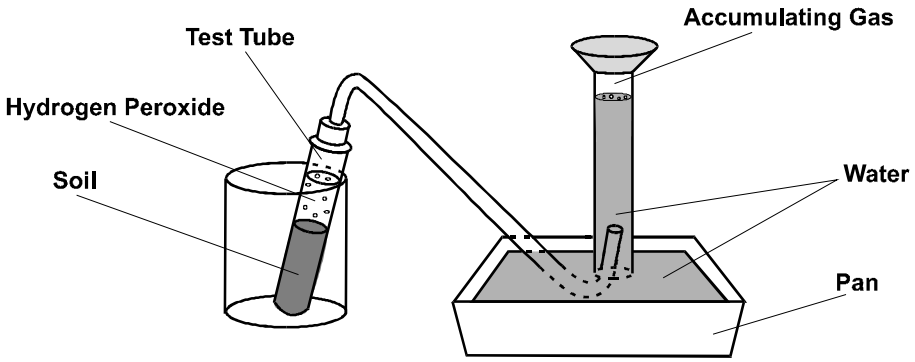
A. Select a set of data points from the experimental data that corroborates the prediction of a linear relationship.

B. Choose a nonlinear regression fit to illustrate how the relationship described by the experimental data differs from the predicted outcome.

C. Include experimental data from an earlier study that used a solution with a different pH to demonstrate the linearity of the relationship.

D. Combine the predictive data with the experimental data to make a linear regression analysis that is more in line with the predicted outcome.

12. **Use the information below to answer the question that follows.**



A scientist collects ten soil samples, each with a different percentage of humus. A small portion of soil from each sample is put in a test tube where it reacts with hydrogen peroxide to produce gas that is collected in an inverted graduated cylinder, as shown above. The volume of collected gas indicates the amount of humus in each sample. An additional portion of each sample is used to create a plot of soil for growing beans. The scientist divides each soil plot into four sections and plants a bean seed in each section. For each soil plot, the scientist records the growth rate of the four corresponding bean plants, while keeping light intensity, temperature, and humidity constant.

The experimental design described above would be most effective for testing the hypothesis that:

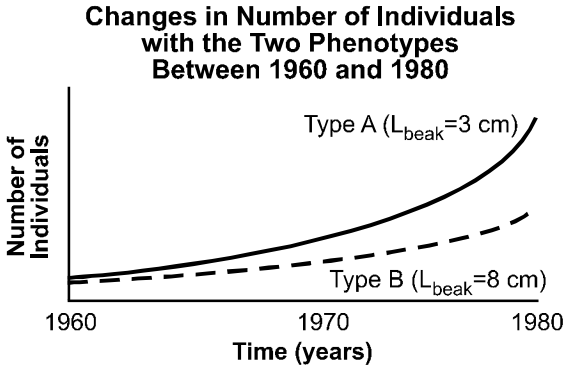
A. the concentration of hydrogen peroxide in soil adversely affects the growth of bean plants.

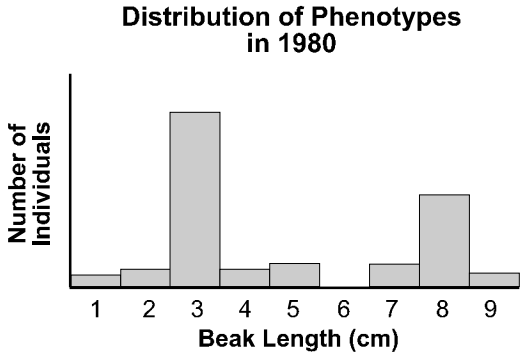
B. the growth of bean plants alters the concentration of gases in soil.

C. the amount of humus in soil can augment the growth of bean plants.

D. the rate of growth of bean plants is related to the decomposition of inorganic matter.

13. **Use the information below to answer the question that follows.**





A researcher studied the results of character displacement in two species of birds on an island. In the study, the two different species of birds were distinguished primarily by beak length. The predominant phenotypes for the two species in 1980 included a beak length of 3 cm and a beak length of 8 cm. The goals of the researcher were to represent the annual changes in frequency of the dominant phenotypes of each species, as well as the overall change in the variation of this trait between 1960 and 1980. In addition to the two graphs shown above, which of the following types of data would have been most effective for achieving these two goals?

A. a picture illustrating the beak length of a typical individual in each species in 1960 and 1980

B. a histogram illustrating the beak lengths of the two different populations in 1960

C. a line graph showing the change in the total number of individuals in each species between 1960 and 1980

D. a histogram showing the distribution of food types available to the two different bird species in 1980

14. **Use the information below to answer the question that follows.**

Plants in Experimental Group (Treated)	Height (cm)
Plant 1	6
Plant 2	5
Plant 3	5
Plant 4	10
Plant 5	9

Plants in Control Group (Untreated)	Height (cm)
Plant 1	5
Plant 2	8.5
Plant 3	8.5
Plant 4	5.5
Plant 5	2.5

Scientists are comparing the growth of a set of plants treated with fertilizer with that of an untreated control group. Their data are represented in the tables shown above. The difference in mean plant height between the two groups is:

A. 1 cm.

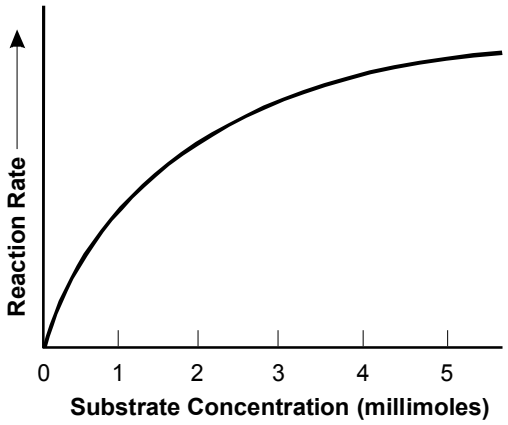
B. 1.5 cm.

C. 4.5 cm.

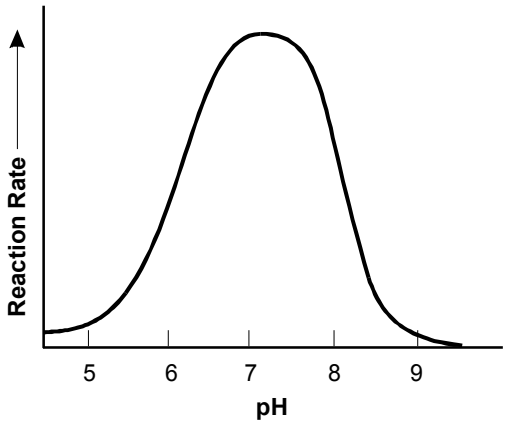
D. 7 cm.

15. **Use the information below to answer the question that follows.**

Plot of Initial Rate of an Enzyme-Catalyzed Reaction Versus Substrate Concentration



Relationship Between pH and Initial Rate of Reaction Catalyzed by Enzyme



A researcher has just tested an enzyme-catalyzed reaction at a pH of 6 and a substrate concentration of 4 millimoles. According to the two graphs shown above, the most effective method for increasing the initial rate of product formation in the next trial would be to:

A. increase the acidity of the solution.

B. decrease the acidity of the solution.

C. increase the substrate concentration.

D. decrease the substrate concentration.

16. A research group has identified a gene that predisposes individuals to a particular type of lung cancer. Which of the following is the most appropriate means for the principal investigator to communicate the research results to colleagues and the general public?

    A. Invite the news media to discuss the research project at a press conference.

    B. Post the results of the research project on the Internet.

    C. Provide biology textbook publishers with a summary of the research project.

    D. Submit a research paper to a scientific journal for peer review.

17. **Use the information below to answer the question that follows.**

The size of an insect's body is limited by the character of its exoskeleton and the nature of its respiratory system.
The large number of root hairs on a root increases a plant's ability to absorb water.
The complexity of capillary networks in the human body allows for effective gas exchange and nutrient absorption.

Which of the following is a unifying concept that most clearly connects the examples listed in the table above?

A. Living systems are regulated by feedback mechanisms.

B. The classification of organisms is based on their adaptive traits.

C. Living systems are composed of interconnected parts.

D. The structural characteristics of an organism are related to its function.

18. Chickens that are raised in very hygienic conditions are more susceptible to intestinal infections by *Salmonella* bacteria than are chickens raised under natural conditions. Researchers have found that feeding chickens a product that contains normal harmless intestinal bacteria reduces the incidence of *Salmonella* infection. Which of the following principles best explains the effectiveness of this product in preventing *Salmonella* infection?

    A. disruptive selection

    B. commensalism

    C. competitive exclusion

    D. biological magnification

19. An abundance of which of the following structures is characteristic of cells whose function involves the active transport of ions?

    A. mitochondria

    B. cilia

    C. Golgi apparatus

    D. lysosome

20. **Use the table below to answer the question that follows.**

Specimen	Cell Wall	Lysosome	Flagellum
1	Yes	Yes	No
2	Yes	No	No
3	No	Yes	Yes
4	No	Yes	No

A researcher examines four types of cells under a microscope and collects the data shown above. Based on the data, which specimen is most likely a prokaryote?

A. Specimen 1

B. Specimen 2

C. Specimen 3

D. Specimen 4

21. **Use the passage below to answer the question that follows.**

After being synthesized on a eukaryotic organelle, a group of proteins is enclosed in a vesicle. The vesicle travels through the cytoplasm and fuses with the membrane of a second organelle. The vesicle's contents are released into this second organelle. The proteins are chemically modified before they are packaged in a second vesicle and sent back into the cytoplasm.

In the passage above, the first vesicle containing the proteins travels from:

A. the lysosome to the ribosome.

B. the Golgi apparatus to the lysosome.

C. the rough endoplasmic reticulum to the Golgi apparatus.

D. the nucleus to the endoplasmic reticulum.

22. The selective permeability of cell membranes is primarily due to the structure and orientation of:

A. carbohydrate chains.

B. cholesterol proteins.

C. phospholipid molecules.

D. sodium-potassium pumps.

23. Which of the following properties of water is most directly related to its ability to rise in the capillary spaces of plants?

A. neutral pH

B. high density

C. low compressibility

D. high surface tension

24. Which of the following best describes the major component of the walls of plant cells?

A. parallel polysaccharide strands cross-linked together by hydrogen bonds

B. long proteins covalently bonded to carbohydrate monomers

C. repeating units of ribose linked to a nitrogenous base and phosphate group

D. long strands of triglycerides joined by covalent bonds

25. Which of the following best describes the role of RNA polymerase in the transcription process?

A. synthesizing enzymes necessary for meiosis

B. promoting ribozyme formation

C. transporting proteins from the nucleus

D. separating the double helix

26. **Use the information below to answer the question that follows.**

Time (min.)	Intracellular [Na^+]	Extracellular [Na^+]
0	0.50 mM	0.60 mM
5	0.40 mM	0.75 mM
10	0.30 mM	0.80 mM

A scientist has been monitoring and recording the intracellular and extracellular concentrations of sodium ions in an animal cell at regular intervals and has collected the data shown in the table above. The type of sodium transport that would cause this particular change in concentrations is most likely:

A. facilitated diffusion.

B. active transport.

C. osmosis.

D. endocytosis.

27. Compared with anaerobic respiration, aerobic respiration:

A. increases ATP generation.

B. decreases ATP generation.

C. creates more energy.

D. takes place outside cells.

28. A cell that contains a decreased concentration of an enzyme essential for DNA replication will cause a rate-limiting step during:

    A. interphase.

    B. the gap phases.

    C. cytokinesis.

    D. mitosis.

29. During mitosis, a defect in the mitotic spindles will most directly cause a problem with:

    A. the condensation of DNA into chromosomes.

    B. the reforming of the nuclear envelope.

    C. the expansion of the cellular membrane.

    D. the pulling of chromatids to the opposite ends of the cell.

30. The packaging of DNA during prophase is aided by which of the following?

    A. proteins

    B. lipids

    C. carbohydrates

    D. RNA

31. Most cases of Down syndrome are caused by the presence of a third copy of chromosome 21 associated with the chromosome 21 pair. This genetic condition, known as trisomy 21, is caused by:

    A. a frame-shift mutation.

    B. chromosome nondisjunction.

    C. fragile X syndrome.

    D. chromosome translocation.

32. Which of the following would provide the best source of evidence for determining the placement of an animal in a particular taxonomic group?

    A. characteristics of the animal's embryonic development

    B. the functional adaptation of the animal to its habitat

    C. data from the analysis of the animal's DNA

    D. the morphology of the animal's skeletal structure

33. Horses and donkeys share many physical characteristics and matings between the two produce sterile offspring called mules. Using the biological species concept, which of the following can be concluded about horses and donkeys?

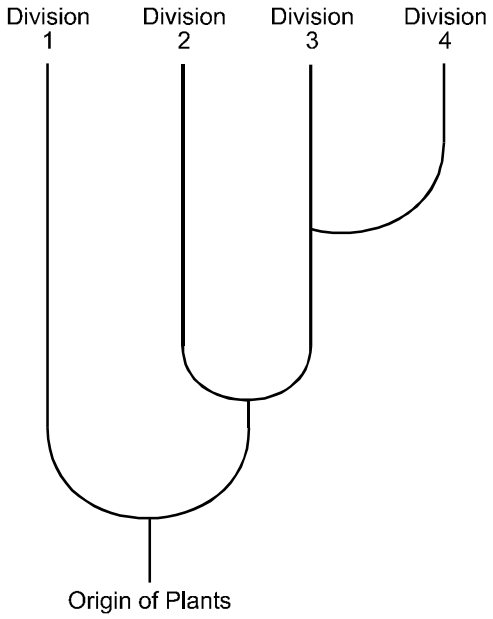
A. Horses and donkeys evolved from distinct ancestral lineages.

B. Donkeys are members of the same species as horses.

C. Horses and donkeys represent two distinct species.

D. Donkeys are considered a sub-species of horses.

34. **Use the information below to answer the question that follows.**



The cladogram shown above depicts the evolutionary relationship of the major taxonomic divisions of the plant kingdom. Which of the two divisions are most closely related?

A. Divisions 1 and 3

B. Divisions 2 and 4

C. Divisions 3 and 4

D. Divisions 1 and 4

35. In contrast to reproduction in other divisions of plants, successful reproduction in many angiosperms:

    A. results in distinct and independent sporophyte and gametophyte generations.

    B. involves the union of male and female gametes that are identical in appearance.

    C. produces offspring that have different genotypes than the parent plants.

    D. depends on animals rather than abiotic factors in the physical environment.

36. In an animal embryo, which of the following sets of parts arises from the mesodermal layer?

    A. spinal cord, nerves, brain

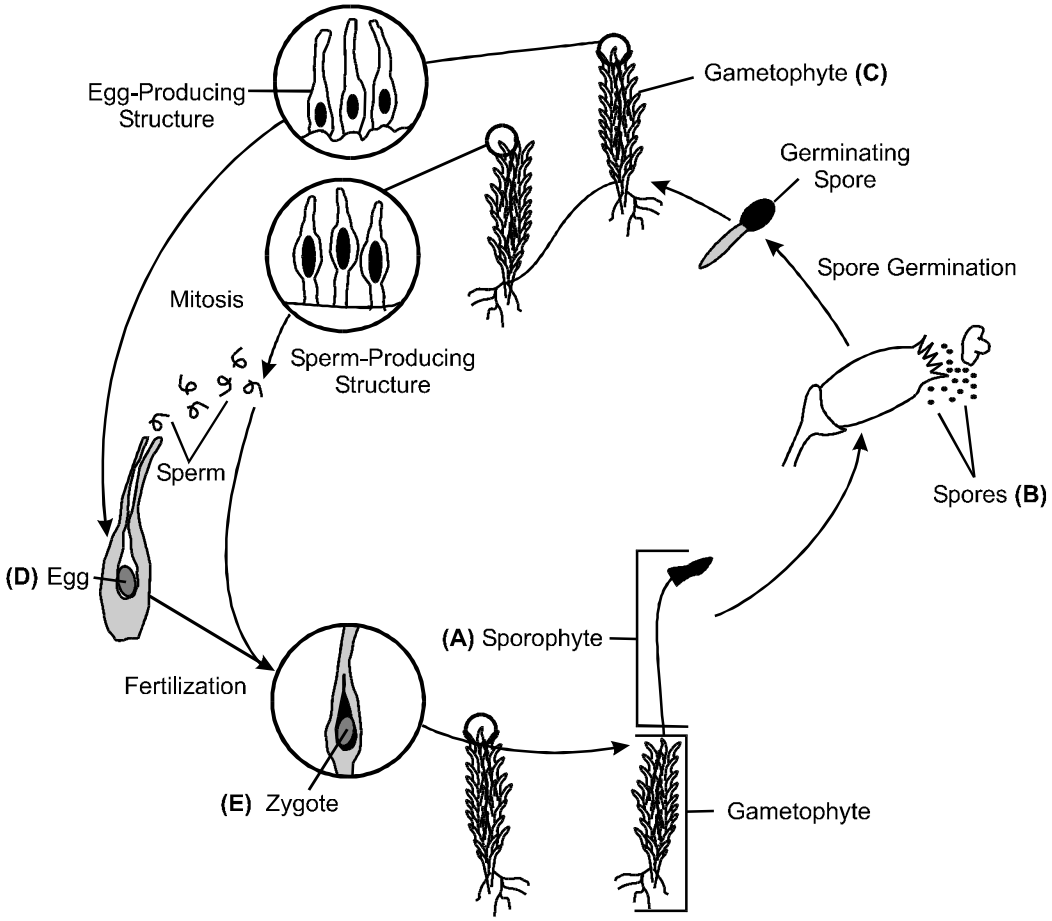
    B. liver, pancreas, lungs

    C. muscles, gonads, skeleton

    D. eye cup, nose, ears

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

Life Cycle of a Moss



The diagram shown above illustrates the life cycle of common moss. Like many primitive plants, it involves the alternation of generations, from the sporophyte to the gametophyte, and back.

37. Which of the following correctly assigns the haploid and diploid designations for the different labeled stages of the moss life cycle?

A. A=2N; B=2N; C=1N; D=1N; E=2N

B. A=1N; B=1N; C=1N; D=2N; E=1N

C. A=2N; B=1N; C=1N; D=1N; E=2N

D. A=1N; B=1N; C=2N; D=2N; E=2N

38. In which of the following labeled structures does meiosis take place?

A. structure A

B. structure B

C. structure C

D. structure D

39. Which of the following cellular processes is used by amoebas and many other protozoa to ingest and break down food?

    A. Active transport moves food particles and nutrients across the plasma membrane into the cytoplasm where they are broken down by enzymes.

    B. Phagocytosis encapsulates food particles in a vacuole, which then fuses with a lysosome, allowing for digestion by enzymes contained within the lysosome.

    C. Digestive enzymes on the outside of the plasma membrane break down food particles into nutrient molecules that pass by osmosis into the cytoplasm.

    D. Endocytosis uses special receptors that form on the outer plasma membrane to trap food molecules, which are then digested in coated vesicles in the cytoplasm.

40. The amount of glycogen present in cells will typically increase as a result of:

    A. a buildup of glucose in the bloodstream.

    B. a drop in the level of oxygen available for aerobic respiration.

    C. the breakdown of disaccharides during hydrolysis.

    D. the attachment of epinephrine to cell receptors.

41. Some species of angiosperms have a large bulb directly below the soil surface. Which of the following best describes the primary function of the bulb portion of these plants?

    A. absorption of water and nutrients from the soil

    B. support of the stem and leaves

    C. production of complex proteins used for seed development

    D. storage of starch produced in leaves

42. Which of the following best describes the structure and function of epithelial tissue?

    A. layers of elongated cells that work with muscle cells to regulate movement

    B. an interconnected network of cells that regulates nutrient flow between the stomach and circulatory system

    C. clusters of cells that provide a strong connection between muscle and bone

    D. a tightly packed layer of cells that serves as a protective barrier for the skin and organs

43. The labyrinth of empty space found within the spongy mesophyll of a typical dicot leaf functions primarily to:

    A. increase the water storage capacity of leaves during periods of extended drought.

    B. improve the removal of heat from parenchyma cells in leaves exposed to direct sunlight.

    C. maximize the diffusion of gases between photosynthesizing cells in leaves and the atmosphere.

    D. improve the ability of leaves to respond to changes in the angle of light by decreasing their weight.

44. Following ingestion of sugar-rich foods, the pancreas of mammals secretes the hormone insulin. Insulin helps regulate blood glucose by:

    A. stimulating the transport of glucose across cell membranes.

    B. controlling the rate of glucose metabolism in the cell cytoplasm.

    C. regulating the breakdown of glycogen in the liver.

    D. stimulating the kidney to excrete excess glucose in urine.

45. A low level of platelets in the blood would most directly interfere with the blood's capacity to:

    A. signal the presence of an allergen.

    B. provide oxygen to cells.

    C. develop an immune response.

    D. initiate the process of clotting.

46. A patient who comes to the doctor for a fever reports regularly having shortness of breath and often feeling tired. Further evaluation shows that the patient has abnormally shaped red blood cells. These symptoms and the abnormal structure of the patient's hemoglobin indicate that the patient most likely has:

    A. sickle cell anemia.

    B. cystic fibrosis.

    C. high blood pressure.

    D. hemophilia.

47. Which of the following is the site of T lymphocyte maturation and development?

    A. thyroid

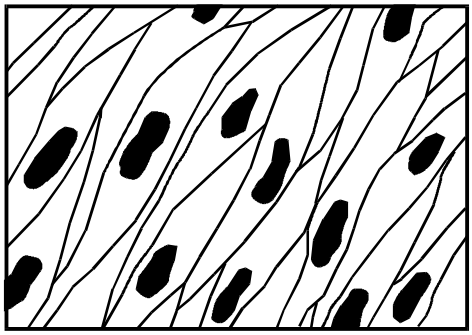
    B. bone marrow

    C. thymus

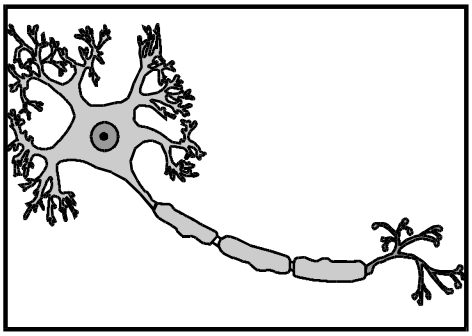
    D. spleen cells

48. Which of the following illustrates muscle tissue?

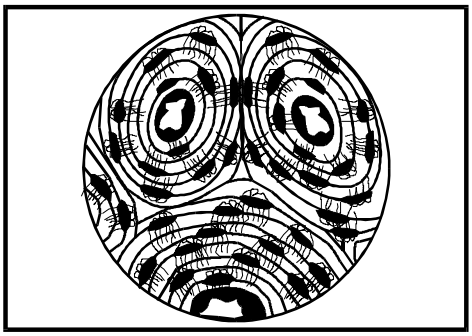
A.



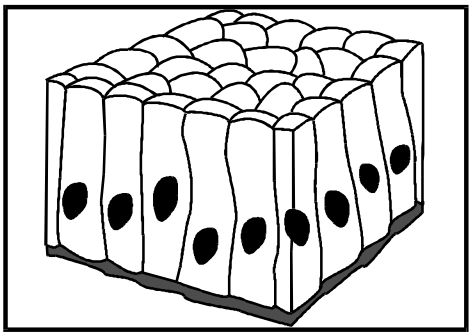
B.



C.



D.



49. Which of the following identifies the role of bile in chemical digestion in the small intestine?

A. Controls the pH.

B. Degrades protein.

C. Hydrolyzes carbohydrates.

D. Emulsifies fat.

50. Which of the following best explains how contraction of the human diaphragm causes ventilation of the lungs?

    A. by establishing an oxygen concentration gradient between the air and lungs

    B. by expanding the volume of space surrounding the alveoli

    C. by activating thoracic muscles involved in pushing air into the lungs

    D. by lowering the internal pressure of the chest cavity

51. In the digestive system, the villi aid in digestion primarily by:

    A. separating water from the remaining waste material.

    B. secreting pepsin, which digests proteins into polypeptides.

    C. providing a large surface area for nutrient absorption.

    D. assisting in mechanical digestion through peristalsis.

52. A defect in the axon terminal of a nerve cell would most directly interfere with the cell's ability to:

    A. release neurotransmitters.

    B. receive signals.

    C. open and close ion channels.

    D. initiate an action potential.

53. Which of the following best describes the interaction of the pancreas and the liver in response to a drop in blood-sugar levels?

    A. The liver releases glucagon, causing the pancreas to cease insulin production, which in turn increases glucose uptake by cells.

    B. The pancreas stops producing insulin, triggering the liver to produce glycogen, which is broken down in the blood to glucose.

    C. The pancreas releases glucagon, causing the liver to break down glycogen and release glucose into the bloodstream.

    D. The liver releases insulin, triggering the production of glycogen by the pancreas, which in turn slows the uptake of glucose by cells.

54. A particular type of autoimmune disease causes antibodies to destroy acetylcholine receptors of neurons. Which of the following effects will this have on nervous system functioning?

A. Presynaptic neurons will be unable to release neurotransmitters into the synaptic clefts.

B. Neurons will be unable to propagate action potentials along their axons.

C. Depolarized neurons will be unable to reestablish an ionic gradient across their membranes.

D. Postsynaptic neurons will be unable to detect signals from presynaptic neurons.

55. The process of crossing over during meiosis is most likely to lead to which of the following genetic changes?

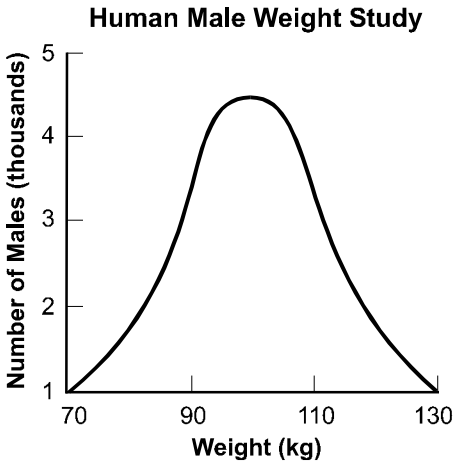
A. Genes deleted from one chromosome are randomly inserted into another.

B. Introns are inserted into the genes of sister chromatids.

C. Gametes containing an extra chromosome are produced.

D. Alleles are exchanged between homologous pairs of chromosomes.

56. **Use the information below to answer the question that follows.**



The frequency diagram shown above depicts data from a study analyzing the weights of a large population of randomly selected human males. The normal distribution of weights depicted in the diagram most likely results from:

A. the codominance of the two alleles responsible for weight.

B. the polygenic character of the inherited trait for weight.

C. the inheritance of a single gene that regulates the weight range of individuals.

D. the inheritance of traits that follow classic Mendelian inheritance patterns.

57. In watermelons, the alleles for green color and short fruit are dominant over the alleles for striped color and long fruit. Two watermelon plants that are heterozygous for both characteristics are bred. What fraction of offspring from this cross would be expected to have green color and long fruit?

A. $\frac{9}{16}$

B. $\frac{7}{16}$

C. $\frac{3}{16}$

D. $\frac{1}{16}$

58. In certain cell types, translation begins before transcription is completed. The coupling of these two processes is found in which of the following types of cells?

A. yeast cell

B. oocyte

C. muscle cell

D. bacteria

59. Which of the following describes the role of transfer RNA in protein synthesis?

A. replication of protein-coding DNA sequences

B. translation of messenger RNA sequences into proteins

C. transcription of DNA sequences into RNA sequences

D. transport of messenger RNA sequences to ribosomes

60. A point mutation occurs in a messenger RNA (mRNA) sequence. This mutation does not alter the protein that is produced. Which of the following best explains why the correct protein is produced even though there is a point mutation in the mRNA sequence?

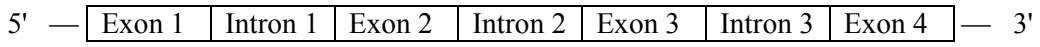
A. The same amino acid can be coded from more than one sequence of bases.

B. To affect the production of polypeptide chains, the original DNA template must be altered.

C. The same enzymes that mediate synthesis of polypeptide chains repair the altered sequence.

D. To affect amino acid production, at least three bases in the sequence must be altered.

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



The diagram above shows a eukaryotic gene that codes for protein M. Genes such as the one for protein M are common in the eukaryotic genome. Using the example of the protein M gene shown above, which of the following best describes how proteins are translated from noncontiguous coding sequences?

A. RNA polymerase recognizes the DNA present in exons 1 through 4 as noncoding sequences and omits them from the mRNA transcript that consists of introns 1 through 3.

B. Four separate mRNA transcripts, each corresponding to an individual exon, are synthesized and translated separately.

C. A primary RNA transcript corresponding to the entire gene is generated and is subsequently edited to produce an mRNA transcript consisting of exons 1 through 4 spliced together.

D. The mRNA transcript used in translation corresponds directly with the DNA sequence of exons and introns present in the gene.

62. Which of the following best explains why regions with endemic malaria such as central and western Africa are correlated with a high frequency of the sickle-cell allele?

    A. Endemic malaria has led to the elimination of the allele for normal hemoglobin in the populations of central and western Africa.

    B. Normal gene flow among the populations of central and western Africa has been interrupted by the presence of endemic malaria.

    C. Occurrence of the sickle-cell allele in regions with endemic malaria results from the founder effect, a form of genetic drift.

    D. Expression of the sickle-cell trait in heterozygotes causes erythrocytes to be less susceptible to the infectious agent of malaria.

63. Gene cloning and polymerase chain reaction are both methods that are used to amplify segments of DNA. Polymerase chain reaction is typically the preferred amplification method when:

    A. minute quantities of DNA are available.

    B. the DNA sequence contains an open reading frame.

    C. long sequences of DNA are involved.

    D. the DNA sequence is being used to prepare a genomic library.

64. How has the commercial manufacturing of insulin been changed by the development of genetic engineering techniques?

    A. Human insulin is manufactured synthetically using its amino acid sequence.

    B. Procedures for isolating insulin from animal sources have been improved, reducing the cost to the consumer.

    C. Insulin from animal sources is manufactured with a long shelf life.

    D. Human insulin is produced in large amounts by bacteria, making it readily available.

65. Compared to a very large isolated animal population, a very small isolated population of the same species would be likely to undergo speciation:

    A. more rapidly, due in part to founder effect.

    B. more slowly, due in part to the presence of coadapted genes.

    C. more rapidly, due in part to punctuated equilibrium.

    D. more slowly, due in part to stabilizing selection.

66. The evolutionary biologists Stephen Jay Gould and Niles Eldredge observed that the fossil record of the trilobite, an ancient marine creature, lacked intermediate forms. This observation was an important part of the evidence used to support their hypothesis that evolution:

    A. occurs due to the reproductive success of individuals best adapted to the selective pressures of their environment.

    B. may require the long-term geographic isolation of populations of shared ancestry.

    C. results from the steady accumulation of physiological and morphological adaptations over long periods of time.

    D. may involve long periods of little or no change followed by short periods of rapid change.

67. In an effort to eliminate dandelions on a lawn, a gardener applies an herbicide to the lawn. The herbicide is effective in producing a relatively weed-free lawn for a period of time, but eventually the lawn is again covered with dandelions. The gardener reapplies the herbicide and observes that it is no longer effective. Which of the following best explains the gardener's observations?

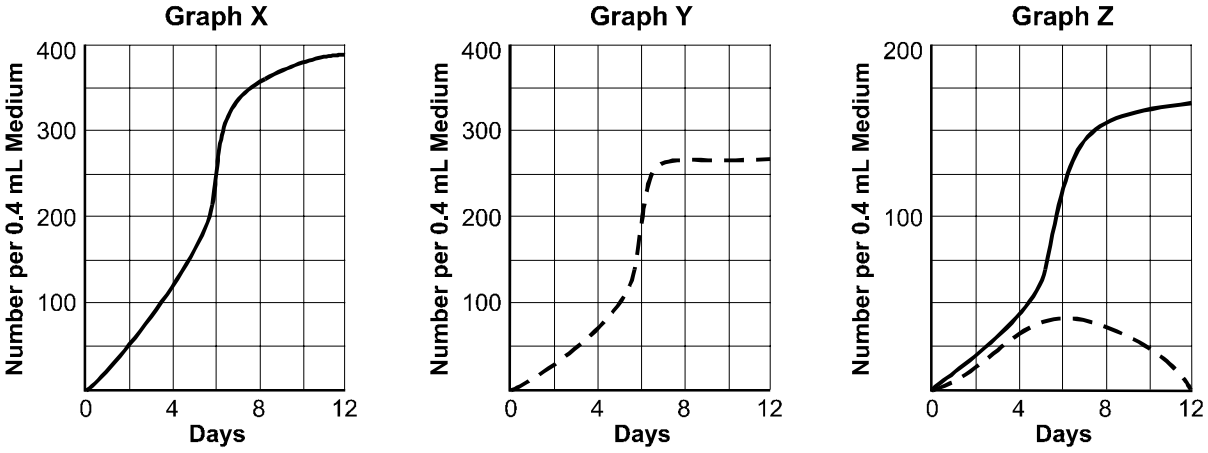
    A. The dandelions exposed to the initial application underwent genetic modification resulting in herbicide resistance and passed on these changes to their offspring.

    B. The dandelion is a variety of weed that is capable of acclimatizing to a vast array of environmental conditions and then reestablishing its numbers.

    C. Some of the dandelions exposed to the initial application possessed genes that enabled them to withstand the effects of the herbicide and the offspring of these plants repopulated the lawn.

    D. Dandelion seeds from a nearby untreated lawn were blown into the gardener's lawn and without competition for resources established a robust population.

68. **Use the information below to answer the question that follows.**



The graphs above show an experiment conducted with two species of amoebae. In phase one of the experiment, each species was placed in a separate culture. A type of bacterium that both species could consume was maintained at a constant level. The growth of each population was measured and recorded (Graphs X and Y). In phase two, the two species were placed together in the same culture. A constant supply of the same bacterium was available. The growth of each population was measured and recorded (Graph Z). In both phases, wastes were eliminated at regular intervals. The rise of one species and the decline of the other species in Graph Z is most likely due to:

A. predation.

B. competition.

C. succession.

D. parasitism.

69. Productivity pyramids of terrestrial ecosystems often depict a 90 percent decrease in biomass at each trophic level. Which of the following is an important factor in this decrease of biomass between trophic levels?

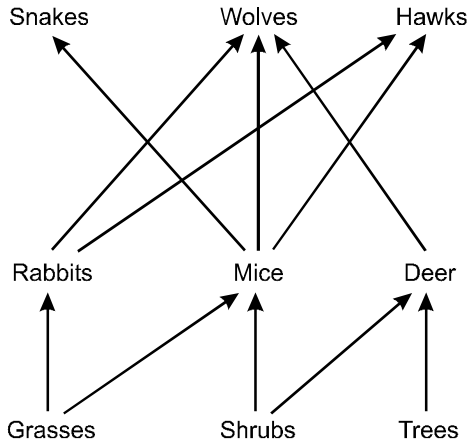
A. Species representative of higher trophic levels are more susceptible to predation.

B. The population of primary consumers in terrestrial ecosystems typically exceeds the population of plant species present.

C. A large percentage of the energy from consumed biomass is lost as heat during metabolism.

D. Competition between the decomposer food chain and the grazing food chain reduces the amount of biomass available to primary consumers.

70. **Use the information below to answer the question that follows.**



The food web shown above represents the key populations of organisms in a model ecosystem. Although the population of each type of organism fluctuates during the year, the population of one of the groups tends to be more stable than the other populations in the food web. Based on the relationships depicted in the food web, which of the following groups is likely to have the most stable population?

A. wolves

B. snakes

C. hawks

D. rabbits

71. Which of the following statements about an animal most accurately describes its niche?

    A. Females of a species of finch are duller in coloration than males and are much less frequently seen or heard by humans.

    B. A species of toad can survive periods of drought by burrowing in the soil and reducing metabolic function to very low levels.

    C. Males of a species of woodpecker are highly territorial and drive away other males of its own and related species.

    D. A species of nocturnal lizard lives in desert environments and emerges from hiding to prey primarily on large insects.

72. In a given geographic area, the size of an isolated grizzly bear (*Ursus arctos*) population is relatively stable over time. The most probable explanation for the stability in numbers is that this bear population has:

    A. built up a relatively large number of individuals in the prereproductive age group.

    B. reached its carrying capacity and is prevented from growing by limiting factors in the environment.

    C. balanced the number of bears immigrating into the area with bears emigrating out of the area.

    D. attained a reproductive rate equal to the innate capacity for increase of the species.

73. Nitrogen-fixing bacteria known as rhizobia live in the root nodules of legumes, such as peas and beans. The rhizobia produce nitrogen compounds for the plant, while the plant in turn provides the bacteria with carbohydrates. This type of relationship is best described as:

    A. parasitism.

    B. commensalism.

    C. mutualism.

    D. ammensalism.

74. Scientists have been investigating a pond ecosystem that has been recently altered. The levels of dissolved oxygen in the water are abnormally low. Fish have been dying and an excess of decomposing algae has built up on the bottom of the pond. Which of the following is most likely responsible for this change in the pond ecosystem?

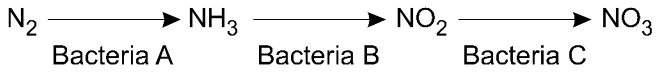
    A. the entrance of phosphates and nitrates into the pond from agricultural runoff

    B. the settling of particulate carbon from the burning of fossil fuels by a nearby factory

    C. a drop in pH due to the long-term build up of acid precipitation

    D. an increase in suspended sediments due to a period of above-average rainfall

75. **Use the information below to answer the question that follows.**



The biochemical reactions shown above take place within bacteria and contribute to the nitrogen cycle. Which of the following best describes the primary role of Bacteria A in this part of the nitrogen cycle?

A. releasing elemental nitrogen into the atmosphere

B. making atmospheric nitrogen available for organisms

C. converting nitrates into elemental nitrogen through decomposition

D. extracting nitrogen from animal waste

76. Carbon dioxide in Earth's atmosphere has increased significantly during the past 100 years. Most climate scientists believe that this is primarily the result of:

A. the burning of fossil fuels.

B. the development of industrialized agricultural methods.

C. the logging of tropical rainforests.

D. the melting of alpine and continental glaciers.

77. Which of the following best explains the localized nature of the phosphorous cycle in comparison to the global nature of the carbon and nitrogen cycles?

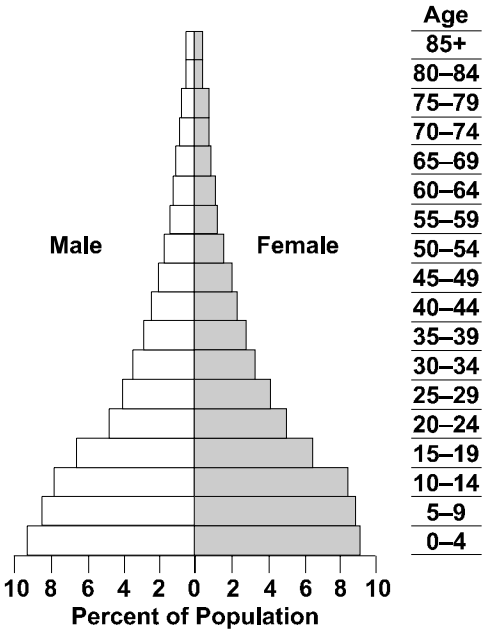
A. the natural abundance of phosphorous in most soils

B. the use of phosphorous in biological molecules

C. the absence of inorganic compounds containing phosphorous

D. the absence of phosphorous-containing atmospheric gases

78. **Use the graph below to answer the question that follows.**



The graph shown above depicts the age profile of a human population. Based on the age structure of the population, the population size will most likely:

A. decline at a constant rate for the next ten years.

B. increase at a constant rate for ten years and then stabilize.

C. decline at a constant rate for the next 15 years and then stabilize.

D. increase at a steady rate over the next 15 years.

79. A high percentage of the world food supply is based on agriculture. Over the next several decades, crops will likely be subject to changes in pest populations and climate conditions. To prepare crop populations for such unpredictable selective pressures, it would be most effective to apply agricultural science and biotechnology to the development of:

    A. crop species with a standard phenotype that demonstrates a high level of fitness under average conditions.

    B. transgenic crops that are more resistant to spoilage following harvest.

    C. crop varieties with increased genetic diversity between and within species.

    D. genetically modified crops that can successfully self-pollinate under a variety of conditions.

80. Bioremediation is an effective strategy for cleaning up soil contaminated with petroleum. Which of the following best describes a typical approach to the bioremediation of soil following an oil spill on land?

    A. Contaminated soil is kept saturated for long periods to promote the growth of anaerobic bacteria that consume petroleum byproducts.

    B. Steam is injected into contaminated soil to drive off volatile compounds in the petroleum and stimulate the growth of beneficial soil organisms.

    C. Contaminated soil is treated with fertilizer and planted with fast-growing crops that take up hydrocarbons found in petroleum.

    D. Bacteria that metabolize petroleum compounds are introduced into the contaminated soil along with nutrients to support their growth.

Below are the directions for the Biology performance assignment.

DIRECTIONS FOR THE PERFORMANCE ASSIGNMENT

This section of the test consists of a performance assignment. **The assignment can be found on the next page.** You are asked to prepare a written response of approximately 2–3 pages on the assigned topic. You should use your time to plan, write, review, and edit your response for the assignment.

Read the assignment carefully before you begin to work. Think about how you will organize your response. You may use any blank space in this test booklet to make notes, write an outline, or otherwise prepare your response. **However, your score will be based solely on the version of your response written in Written Response Booklet B.**

As a whole, your response must demonstrate an understanding of the knowledge and skills of the field. In your response to the assignment, you are expected to demonstrate the depth of your understanding of the content area through your ability to apply your knowledge and skills rather than merely to recite factual information.

Your response will be evaluated based on the following criteria.

- **PURPOSE:** the extent to which the response achieves the purpose of the assignment
- **SUBJECT MATTER KNOWLEDGE:** accuracy and appropriateness in the application of subject matter knowledge
- **SUPPORT:** quality and relevance of supporting details
- **RATIONALE:** soundness of argument and degree of understanding of the subject matter

The performance assignment is intended to assess subject knowledge content and skills, not writing ability. However, your response must be communicated clearly enough to permit scorers to make a valid evaluation of your response according to the criteria listed above. Your response should be written for an audience of educators in this field. The final version of your response should conform to the conventions of edited American English. This should be your original work, written in your own words, and not copied or paraphrased from some other work.

Be sure to write about the assigned topic. Please write legibly. You may not use any reference materials during the test. Remember to review your work and make any changes you think will improve your response.

Below is the scoring scale for the Biology performance assignment.

SUBJECT TESTS—PERFORMANCE ASSIGNMENT SCORING SCALE

Score Point	Score Point Description
4	**The "4" response reflects a thorough knowledge and understanding of the subject matter.** • The purpose of the assignment is fully achieved. • There is a substantial, accurate, and appropriate application of subject matter knowledge. • The supporting evidence is sound; there are high-quality, relevant examples. • The response reflects an ably reasoned, comprehensive understanding of the topic.
3	**The "3" response reflects an adequate knowledge and understanding of the subject matter.** • The purpose of the assignment is largely achieved. • There is a generally accurate and appropriate application of subject matter knowledge. • The supporting evidence is adequate; there are some acceptable, relevant examples. • The response reflects an adequately reasoned understanding of the topic.
2	**The "2" response reflects a limited knowledge and understanding of the subject matter.** • The purpose of the assignment is partially achieved. • There is a limited, possibly inaccurate or inappropriate, application of subject matter knowledge. • The supporting evidence is limited; there are few relevant examples. • The response reflects a limited, poorly reasoned understanding of the topic.
1	**The "1" response reflects a weak knowledge and understanding of the subject matter.** • The purpose of the assignment is not achieved. • There is little or no appropriate or accurate application of subject matter knowledge. • The supporting evidence, if present, is weak; there are few or no relevant examples. • The response reflects little or no reasoning about or understanding of the topic.

U	**The response is unrelated to the assigned topic, illegible, primarily in a language other than English, not of sufficient length to score, or merely a repetition of the assignment.**
B	**There is no response to the assignment.**

Practice Performance Assignment

81. **Read the information below; then complete the exercise that follows.**

A biology teacher is planning a laboratory activity related to enzymes. The teacher plans to have students determine the effect of an enzyme on a reaction. In addition, the students will investigate the effects of temperature and enzyme concentration on enzyme functioning. Students will have available to them starch solution, a solution of amylase (the enzyme), iodine solution, and Benedict's solution. Write an essay describing an experimental design and procedure appropriate for this investigation. In your essay:

- identify any additional materials required for the activity;
- describe an appropriate experimental design, including the use of experimental controls;
- describe the kind of data that will need to be gathered and how the data will be collected, recorded, and analyzed; and
- describe the expected results of this experiment, and explain how these results could be related to the basic properties and functions of enzymes in living organisms.

Sample Performance Assignment Response: Score Point 4

Amylase is normally found in saliva, and it is also produced by the pancreas and found in the small intestine. Amylase breaks down complex carbohydrates, such as starch, to simple sugars. There are several tests that could be performed to learn more about amylase. A few procedures that will provide some basic information about the effects of amylase are described below.

In addition to the starch, amylase, iodine, and Benedict's solutions, the tests will require test tubes, medicine droppers, graduated cylinders, and pipettes.

This procedure will show the effects of amylase on the starch solution. To begin, 10 mL of the starch solution should be added to two test tubes, which will serve as the controls. Then 10 mL of the starch solution and 1 mL of the amylase should be mixed in two additional test tubes and allowed to sit for several minutes. These are the experimental tubes. One control tube should be tested for starch using the iodine solution and the other control tube tested for sugar using the Benedict's solution. The experimental tubes should also be tested for starch and sugar. The results of the control tubes should indicate starch (the iodine turns blue) but no sugar. In the experimental tubes, if the starch has been fully digested by the amylase, then only sugar should be present, as indicated by the formation of a precipitate when Benedict's solution is added.

To gather more information about the effects of the amylase on the breakdown of starch to sugar, several test tubes (seven or eight) should be prepared by adding 10 mL of the starch solution. Then 1 mL of the amylase solution should be added at the same time to every test tube except one, which will serve as the control. Then a few drops of starch solution should be added to one tube immediately, to the next tube after an interval (e.g., 30 seconds), and to each additional tube after an equal time interval, ending with the control tube. The color should be noted immediately after adding the iodine solution. Depending on how fast the amylase works, it might be expected that the first few test tubes may have starch present, while those in which the enzyme has longer to work will have little or no starch. The control tube would show the presence of starch, since there was no enzyme.

To test the effects of enzyme concentration, a similar setup could be used, except different amounts of amylase would be added. For instance, the same procedure outlined in the previous paragraph could be run by adding 0.5 mL of amylase to each tube except the control. The procedure could be run again using 2 mL of amylase. The results from all three concentrations could be compared to see if the enzyme concentration affects how fast the starch is broken down. Probably not much difference in rate would be detected using this particular procedure.

To test the effects of temperature on the reaction, the same procedure could be used again (with 10 mL starch and 1 mL amylase), but once with the tubes submerged in an ice water bath (near 0°C), and again with the tubes in a boiling water bath (near 100°C). The

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Sample Performance Assignment Response: Score Point 4 *(continued)*

control tube in each instance would indicate whether the temperature change itself affects the starch, which would make the results unreliable. Another test could involve heating just the amylase solution to near boiling and cooling it to room temperature before adding it to the starch solution. In either case, the high temperatures would be expected to denature the enzyme, making it unable to digest the starch. At the very low temperature, the rate of digestion might slow somewhat, but it might be difficult to detect the difference with this particular procedure.

Enzymes act as catalysts for chemical reactions–they speed up the rate of reactions that might otherwise occur slowly or not at all under normal body conditions. Enzymes are not used up during a reaction–they can be used over and over–so very little enzyme is required. This would help explain why the changes in enzyme concentration tested in this experiment might be expected to have little observed effect. Optimal enzyme function typically occurs at temperatures close to normal body temperature. However, if an enzyme reaches too high a temperature, its chemical bonds begin to break down (denaturation), so it loses the geometric properties that allow it to catalyze a chemical reaction. This would explain why heating the amylase in the last part of the experiment would be expected to make it unable to catalyze the breakdown of the starch.

ANSWER KEY

Field 07: Biology

Question Number	Correct Response	Objective
1.	**A**	Understand the historical and contemporary contexts of the study of biology.
2.	**D**	Understand the historical and contemporary contexts of the study of biology.
3.	**B**	Understand the historical and contemporary contexts of the study of biology.
4.	**C**	Understand the historical and contemporary contexts of the study of biology.
5.	**C**	Understand the nature of science and scientific inquiry.
6.	**A**	Understand the nature of science and scientific inquiry.
7.	**A**	Understand the nature of science and scientific inquiry.
8.	**B**	Understand the nature of science and scientific inquiry.
9.	**C**	Understand principles and procedures of scientific investigations.
10.	**C**	Understand principles and procedures of scientific investigations.
11.	**B**	Understand principles and procedures of scientific investigations.
12.	**C**	Understand principles and procedures of scientific investigations.
13.	**B**	Understand the processes of gathering, organizing, reporting, and analyzing scientific data in the context of biology investigations.
14.	**A**	Understand the processes of gathering, organizing, reporting, and analyzing scientific data in the context of biology investigations.
15.	**B**	Understand the processes of gathering, organizing, reporting, and analyzing scientific data in the context of biology investigations.
16.	**D**	Understand the processes of gathering, organizing, reporting, and analyzing scientific data in the context of biology investigations.
17.	**D**	Understand how biology interrelates with society, technology, and the other sciences and applies to everyday life.
18.	**C**	Understand how biology interrelates with society, technology, and the other sciences and applies to everyday life.
19.	**A**	Understand cell structure and function and the cell theory.
20.	**B**	Understand cell structure and function and the cell theory.
21.	**C**	Understand cell structure and function and the cell theory.
22.	**C**	Understand the chemical components of living systems and basic principles of biochemistry.
23.	**D**	Understand the chemical components of living systems and basic principles of biochemistry.
24.	**A**	Understand the chemical components of living systems and basic principles of biochemistry.
25.	**D**	Analyze physiological processes of cells.
26.	**B**	Analyze physiological processes of cells.

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Question Number	Correct Response	Objective
27.	**A**	Analyze physiological processes of cells.
28.	**A**	Analyze cell growth, division, and differentiation.
29.	**D**	Analyze cell growth, division, and differentiation.
30.	**A**	Analyze cell growth, division, and differentiation.
31.	**B**	Analyze cell growth, division, and differentiation.
32.	**C**	Understand principles of taxonomy and classification in biology.
33.	**C**	Understand principles of taxonomy and classification in biology.
34.	**C**	Understand principles of taxonomy and classification in biology.
35.	**D**	Analyze reproduction, development, and life cycles of living organisms.
36.	**C**	Analyze reproduction, development, and life cycles of living organisms.
37.	**C**	Analyze reproduction, development, and life cycles of living organisms.
38.	**A**	Analyze reproduction, development, and life cycles of living organisms.
39.	**B**	Analyze the processes used by living organisms to obtain, store, and use energy.
40.	**A**	Analyze the processes used by living organisms to obtain, store, and use energy.
41.	**D**	Analyze the processes used by living organisms to obtain, store, and use energy.
42.	**D**	Analyze the anatomy and physiology of living organisms.
43.	**C**	Analyze the anatomy and physiology of living organisms.
44.	**A**	Analyze the anatomy and physiology of living organisms.
45.	**D**	Understand the structures and functions of the human skeletal, muscular, integumentary, circulatory, and immune systems.
46.	**A**	Understand the structures and functions of the human skeletal, muscular, integumentary, circulatory, and immune systems.
47.	**C**	Understand the structures and functions of the human skeletal, muscular, integumentary, circulatory, and immune systems.
48.	**A**	Understand the structures and functions of the human skeletal, muscular, integumentary, circulatory, and immune systems.
49.	**D**	Understand the structures and functions of the human respiratory, excretory, and digestive systems, and the principles of human nutrition.
50.	**D**	Understand the structures and functions of the human respiratory, excretory, and digestive systems, and the principles of human nutrition.
51.	**C**	Understand the structures and functions of the human respiratory, excretory, and digestive systems, and the principles of human nutrition.
52.	**A**	Understand the structures and functions of the human nervous, endocrine, and reproductive systems, and the processes of embryonic development.
53.	**C**	Understand the structures and functions of the human nervous, endocrine, and reproductive systems, and the processes of embryonic development.

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Question Number	Correct Response	Objective
54.	**D**	Understand the structures and functions of the human nervous, endocrine, and reproductive systems, and the processes of embryonic development.
55.	**D**	Understand the principles of Mendelian and non-Mendelian genetics.
56.	**B**	Understand the principles of Mendelian and non-Mendelian genetics.
57.	**C**	Understand the principles of Mendelian and non-Mendelian genetics.
58.	**D**	Understand the synthesis of DNA, RNA, and protein.
59.	**B**	Understand the synthesis of DNA, RNA, and protein.
60.	**A**	Understand the synthesis of DNA, RNA, and protein.
61.	**C**	Understand the synthesis of DNA, RNA, and protein.
62.	**D**	Understand genes, chromosomes, and changes in genetic material.
63.	**A**	Understand genes, chromosomes, and changes in genetic material.
64.	**D**	Understand genes, chromosomes, and changes in genetic material.
65.	**A**	Understand the processes of natural selection and adaptation.
66.	**D**	Understand the processes of natural selection and adaptation.
67.	**C**	Understand the processes of natural selection and adaptation.
68.	**B**	Understand populations and communities.
69.	**C**	Understand populations and communities.
70.	**A**	Understand populations and communities.
71.	**D**	Understand populations and communities.
72.	**B**	Understand types and characteristics of ecosystems and biomes, and factors affecting their change over time.
73.	**C**	Understand types and characteristics of ecosystems and biomes, and factors affecting their change over time.
74.	**A**	Understand types and characteristics of ecosystems and biomes, and factors affecting their change over time.
75.	**B**	Analyze the cycling of materials through an ecosystem.
76.	**A**	Analyze the cycling of materials through an ecosystem.
77.	**D**	Analyze the cycling of materials through an ecosystem.
78.	**D**	Understand the physical and societal effects of human activities on the environment.
79.	**C**	Understand the physical and societal effects of human activities on the environment.
80.	**D**	Understand the physical and societal effects of human activities on the environment.

PREPARATION RESOURCES

Field 07: Biology

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

Online Sources:

Arizona Collaborative for Excellence in Preparation of Teachers. Arizona State University.
http://acept.la.asu.edu

Arizona Department of Education. (2005). *Academic Standards: Science Standard Articulated by Grade Level—by Strand.*
http://www.ade.state.az.us.

The Biology Project: The University of Arizona.
http://www.biology.arizona.edu

Blackboard Resources: Elementary and Secondary Education Links.
http://resources.blackboard.com/scholar/sa/112/portal.jsp

Center for Science Teaching and Learning. Northern Arizona University.
http://www4.nau.edu/cstl/cstl

Coconino County Math and Science Teachers Resources.
http://co.coconino.az.us/schools.aspx?id=534

Project 2061, Benchmarks for Science Literacy On-line: American Association for the Advancement of Science.
http://project2061.org/publications/bsl/online/bolintro.htm

Journals:

American Biology Teacher, National Association of Biology Teachers.

American Scientist, Sigma Xi, The Scientific Research Society.

Instructor, Scholastic.

Nature, The Nature Publishing Group.

Science News, Science Service.

The Natural Selection, BSCS.

The Science Teacher, National Science Teachers Association.

Other Resources:

Biggs, A. (2002). *Biology: The Dynamics of Life.* New York, NY: McGraw-Hill.

Campbell, N. A. and Reece, J. B. (2002). *Biology* (6th ed.). Menlo Park, CA: Benjamin Cummings.

Cunningham, W. P., Cunningham, M. A., and Saigo, B. W. (2004). *Environmental Science: A Global Concern* (8th ed.). New York, NY: McGraw-Hill.

Dolphin, W. D. (2004). *Biological Investigations: Form, Function, Diversity, and Process* (Lab Manual) (7th ed.). New York, NY: McGraw-Hill.

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

Krogh, D. (2004). *Biology: A Guide to the Natural World* (3rd ed.). Upper Saddle River, NJ: Prentice Hall.

Mader, S. S. (2003). *Biology* (8th ed.). New York, NY: McGraw-Hill.

Miller, K. and Levine, J. (2006). *Biology.* Upper Saddle River, NJ: Prentice Hall.

Molles, M. C. (2002). *Ecology: Concepts and Applications* (2nd ed.). New York, NY: McGraw-Hill.

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

Starr, C. and Taggart, R. (2006). *Biology: The Unity and Diversity of Life* (11th ed.). New York, NY: Wadsworth Publishing Company.

Stern, K. R. (2005). *Introductory Plant Biology* (10th ed.). New York, NY: McGraw-Hill.

Wright, R. T. (2004). *Environmental Science: Toward a Sustainable Future* (9th ed.). Upper Saddle River, NJ: Prentice Hall.