



Massachusetts Department of
ELEMENTARY & SECONDARY
EDUCATION

*Release of
February 2010
MCAS Biology
Test Items*

**April 2010
Massachusetts Department of
Elementary and Secondary Education**



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Foreword

The vision of the Department of Elementary and Secondary Education is to work in partnership with policy makers, communities, parents, school districts, and students to build a system that will prepare all students to succeed as productive and contributing members of our democratic society and the global economy. To assist in the achievement of this vision, the Department regularly releases MCAS test items to provide information regarding the kinds of knowledge and skills that students are expected to demonstrate. In February 2010, an MCAS test in Biology was administered in high schools across the state. All test questions on which student results are based for the February 2010 Biology test are included in this document.

The *Release of February 2010 MCAS Biology Test Items* is available only through the Department website at www.doe.mass.edu/mcas/testitems.html. The test items can be easily printed from this site. The Department encourages local educators to use the relevant sections of this document together with their *Test Item Analysis Report Summaries* and *Test Item Analysis Rosters* as guides for planning changes in curriculum and instruction that may be needed to ensure that schools and districts make regular progress in improving student performance.

I. Document Purpose and Structure

Document Purpose and Structure

Purpose

The purpose of this document is to share with educators and the public all of the test items from the February 2010 MCAS Biology test on which student results are based. Local educators will be able to use this information to identify strengths and weaknesses in their curriculum and instruction, and to guide the changes necessary to more effectively meet their students' needs.

This document is also intended to be used by school and district personnel as a companion document to the test item analysis reports. Each school in which a February Biology test was administered receives a *Test Item Analysis Report Summary* and a *Test Item Analysis Roster* for Biology. These reports provide data generated from student responses. Each report lists, for the school receiving the report, the names of all enrolled students who took the February 2010 Biology test, and shows how each student answered each common test item. The report labels each item as multiple-choice or open-response and identifies the item's MCAS reporting category. Item numbers in this document correlate directly to the "Item Numbers" in the test item analysis reports.

Structure

Chapter II of this document contains information for the February 2010 Biology test and has three main sections. The **first section** introduces the chapter by identifying the Massachusetts curriculum framework content strand assessed by the Biology MCAS test, as well as the MCAS reporting categories under which test results are reported to schools and districts. The first section also provides the Web address for the *Science and Technology/Engineering Curriculum Framework* and the page numbers on which the learning standards assessed by the test items in the chapter can be found. In addition, there is a brief overview of the test (number of test sessions, types of items, reference materials allowed, and cross-referencing information).

The **second section** contains the test items used to generate February 2010 MCAS student results for Biology. The test items in this document are shown in the same order and basic format in which they were presented in the test booklet.

The **final section** of the chapter is a table that cross-references each item with its MCAS reporting category and with the framework standard it assesses. Correct answers to multiple-choice questions are also listed in the table.

Materials presented in this document are **not** formatted **exactly** as they appeared in student test booklets. For example, in order to present items most efficiently in this document, the following modifications have been made:

- Some fonts and/or font sizes may have been changed and/or reduced.
- Some graphics may have been reduced in size from their appearance in student test booklets; however, they maintain the same proportions in each case.
- All references to page numbers in answer booklets have been deleted from the directions that accompany test items.

II. February 2010 Biology Test

February 2010 Biology Test

The February 2010 high school MCAS Biology test was based on learning standards in the Biology content strand of the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2006). These learning standards appear on pages 54–58 of the *Framework*.

The *Science and Technology/Engineering Curriculum Framework* is available on the Department website at www.doe.mass.edu/frameworks/current.html.

In test item analysis reports and on the Subject Area Subscore pages of the MCAS *School Reports* and *District Reports*, Biology test results are reported under the following five MCAS reporting categories:

- Biochemistry and Cell Biology
- Genetics
- Anatomy and Physiology
- Ecology
- Evolution and Biodiversity

Test Sessions

The MCAS high school Biology test included two separate test sessions, which were administered on consecutive days. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

The high school Biology test was designed to be taken without the aid of a calculator. Students were allowed to have calculators with them during testing, but calculators were not needed to answer questions.

The use of bilingual word-to-word dictionaries was allowed for current and former limited English proficient students only, during both Biology test sessions. No other reference tools or materials were allowed.

Cross-Reference Information

The table at the conclusion of this chapter indicates each item's reporting category and the framework learning standard it assesses. The correct answers for multiple-choice questions are also displayed in the table.

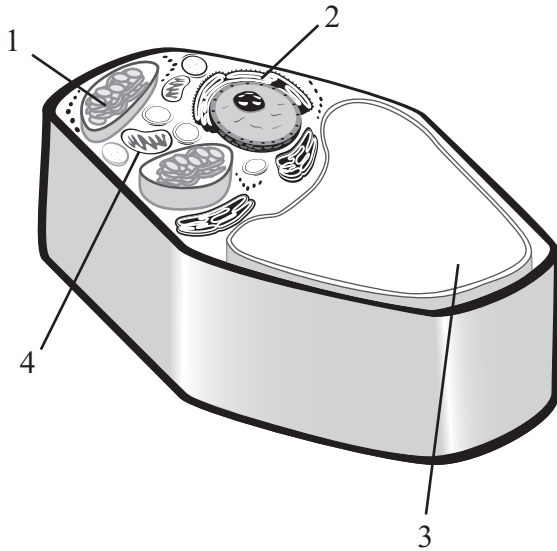
Biology

SESSION 1

DIRECTIONS

This session contains twenty-one multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

- 1 A diagram of a plant cell is shown below.



Which number identifies the organelle that functions to store water and dissolved salts?

- A. 1
- B. 2
- C. 3
- D. 4

- 2 Evolution can be seen in the fossil record in which of the following ways?

- A. Organisms in the fossil record are identical to living organisms.
- B. Individual species disappear and reappear in the fossil record over time.
- C. The fossil record provides evidence that organisms have changed over time.
- D. The fossil record provides evidence that all organisms developed at the same time.

- 3 In mussels, brown (**B**) coloring is dominant, and blue (**b**) coloring is recessive. If a blue mussel has two brown parents, what percentage of the total offspring of these brown parents are expected to be blue?

- A. 100%
- B. 75%
- C. 50%
- D. 25%

- 4 In which of the following ways does perspiring help the body to maintain homeostasis?
- A. by decreasing body temperature
 - B. by increasing blood sugar levels
 - C. by increasing the amount of fluid in the body
 - D. by reducing the amount of carbon dioxide in cells

- 5 Some species of penguins, such as chinstrap penguins, depend on open water for their survival. Other species of penguins, such as Adélie penguins, depend on ice. Over the last 20 years, the population size of chinstrap penguins has increased, and the population size of Adélie penguins has decreased.

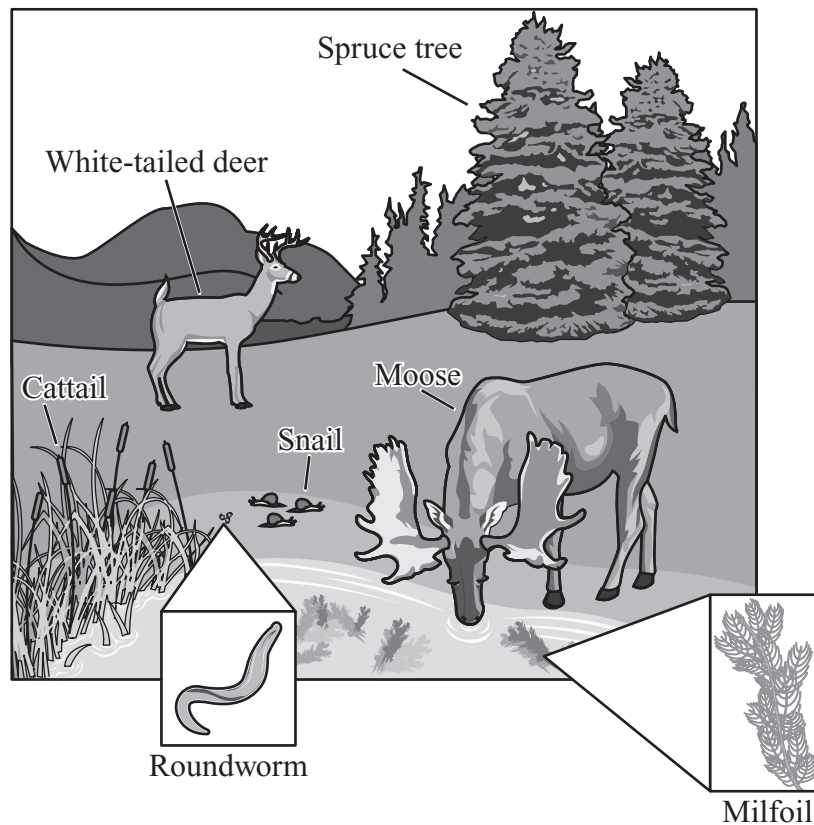
Which of the following **most likely** caused these changes in population size?

- A. an increase in landmass and shorelines
- B. an increase in global air and water temperatures
- C. a decrease in the number of leopard seal predators
- D. a decrease in the length of time before chicks take to sea

- 6 Scientists have discovered a new type of organism. To assign the organism to a domain and kingdom, which of the following is **most** important for scientists to know?
- A. the organism's cell structure
 - B. the organism's population size
 - C. the organism's social behavior
 - D. the organism's reproductive rate
- 7 Which of the following statements correctly describes the processes of photosynthesis and cellular respiration?
- A. Photosynthesis and cellular respiration occur in the same organelle.
 - B. Photosynthesis and cellular respiration are performed by all organisms.
 - C. Photosynthesis produces carbon dioxide, and cellular respiration uses carbon dioxide.
 - D. Photosynthesis stores energy for cells, and cellular respiration releases energy for cells.

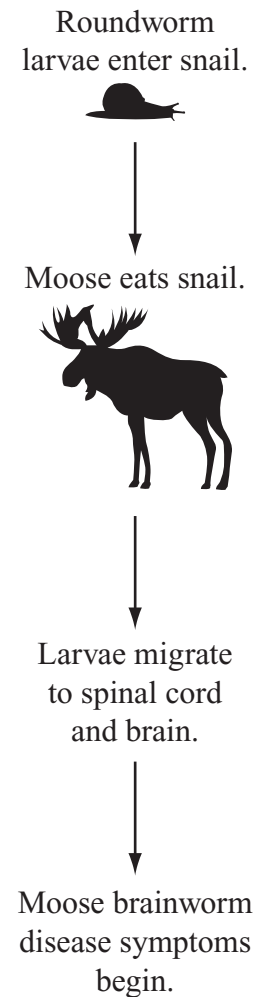
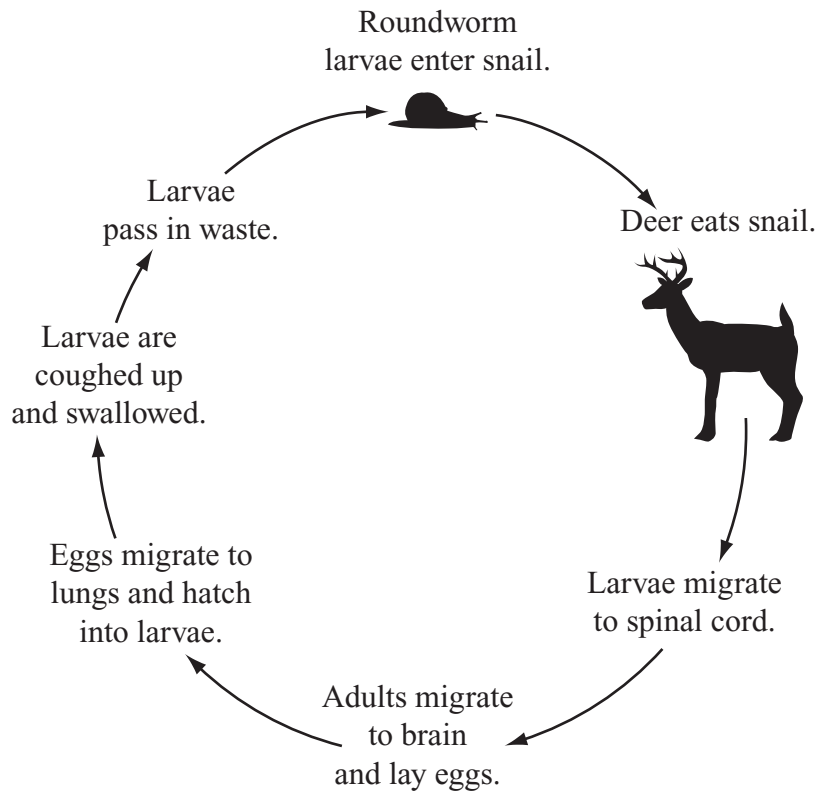
The following section focuses on the effects of a parasitic roundworm on moose and white-tailed deer. Read the information below and use it to answer the four multiple-choice questions and one open-response question that follow.

Forest and wetland ecosystems in Canada and parts of the northern United States are home to moose, *Alces alces*. The illustration below shows a moose and some of the plants and other animals found in its typical habitat.



One serious problem for moose is a disease called moose brainworm. Effects of the disease include aimless walking in circles, poor coordination and balance, weakness, and paralysis of the legs. Many cases of the disease result in death. The disease is caused by a parasitic roundworm, *Parelaphostrongylus tenuis*. The life cycle of this roundworm involves snails, white-tailed deer, and moose, as shown in the diagrams on the next page. Of these organisms, only the moose gets sick from infection by the roundworm.

Roundworm Life Cycle Diagrams



Mark your answers to multiple-choice questions 8 through 11 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

8 The moose belongs to which trophic level in an ecosystem?

- A. producer
- B. consumer
- C. scavenger
- D. decomposer

9 Damage to which of the following body systems causes the symptoms observed in moose infected by the roundworm?

- A. circulatory
- B. digestive
- C. nervous
- D. respiratory

10 A correlation exists between the number of cases of moose brainworm disease and the density of the deer population. Which of the following statements gives the **best** explanation for this relationship?

- A. High deer population density causes individual deer to reproduce more.
- B. High deer population density speeds up the life cycle of the roundworm.
- C. High deer population density attracts more moose to an area where they will become infected.
- D. High deer population density results in more larvae-infected waste for snails to encounter in an area.

11 Which of the following has the **least** influence on the population size of the deer?

- A. annual birthrate
- B. amount of predation
- C. roundworm parasites
- D. emigration over winter

Question 12 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 12 in the space provided in your Student Answer Booklet.

- 12** The introductory information describes one relationship between organisms in the illustration: parasitism. All the organisms pictured in this habitat interact in other ways as well.
- a. Describe one example of competition between the organisms in the illustration. Name the organisms involved, describe their interaction, and explain why their interaction is considered competition.
 - b. Describe one example of commensalism between the organisms in the illustration. Name the organisms involved, describe their interaction, and explain why their interaction is considered commensalism.

Mark your answers to multiple-choice questions 13 through 22 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

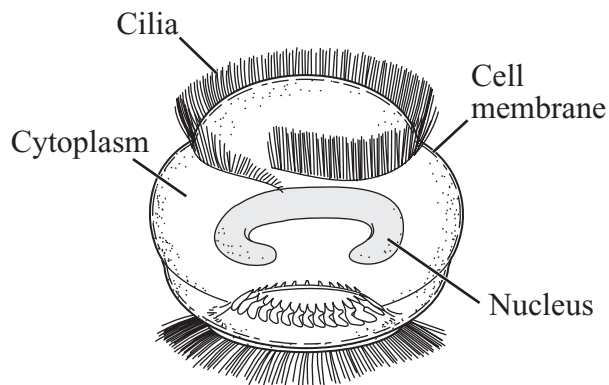
- 13 *Danaus plexippus* and *Danaus gilippus* are two species of butterflies. Which of the following statements **best** explains why scientists classify them as two different species?

- A. Only one of the species migrates in winter.
- B. Only one of the species is found in North America.
- C. The two species are not eaten by the same predators.
- D. The two species cannot produce fertile offspring with each other.

- 14 A mutation in an allele in an individual newt gave that newt faster reflexes. It is found that, after many generations, most of the newt population has the new allele. Which of the following **most likely** caused this change?

- A. The newt gave its mutated allele to other adult newts.
- B. Other newts learned to copy the strategies of the mutated newt.
- C. The same mutation occurred in other newts as a result of environmental conditions.
- D. Newts with the mutation are better able to survive and reproduce than newts without the mutation.

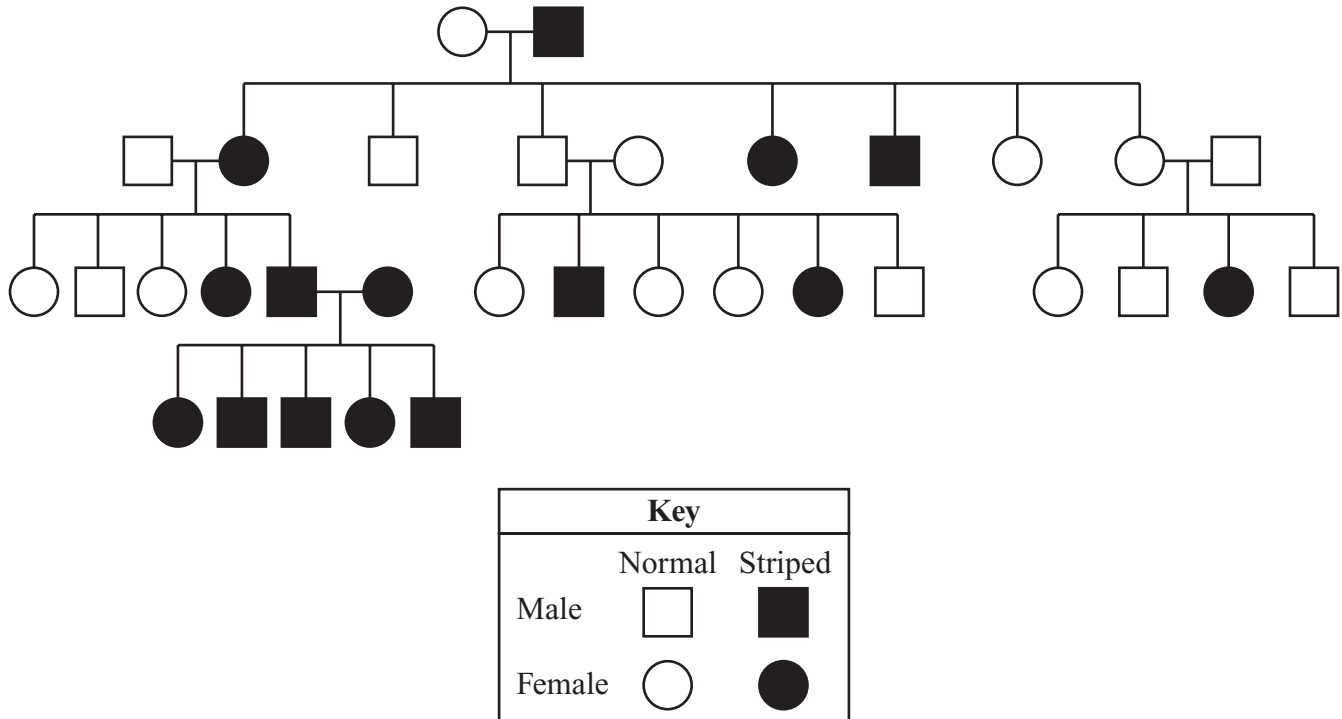
- 15 The diagram below represents *Trichodina*.



Trichodina is a eukaryotic organism that attaches itself to fish and eats bacteria. Which of the following distinguishes *Trichodina* from all prokaryotes?

- A. *Trichodina* is unicellular.
- B. *Trichodina* has a nucleus.
- C. *Trichodina* has cytoplasm.
- D. *Trichodina* is heterotrophic.

- 16 A pedigree showing the inheritance of a gold dorsal stripe pattern in ball pythons is shown below.



According to the pedigree, what type of trait is this stripe pattern in ball pythons?

- A. codominant
- B. polygenic
- C. recessive
- D. sex-linked

- 17 The digestive system of most birds includes a structure called the gizzard. The gizzard crushes and grinds food, often with the help of small stones that the bird has swallowed.

Which of the following structures in the human digestive system has a function **most similar** to that of a bird's gizzard?

- A. esophagus
- B. large intestine
- C. small intestine
- D. teeth

- 18 Which of the following units are repeatedly joined together to form a strand of DNA?

- A. amino acids
- B. fatty acids
- C. nucleotides
- D. polysaccharides

- 19 A hereditary muscular disease in horses causes abnormal opening and closing of the sodium ion channels in the muscle cells. Which of the following statements describes the **most likely** origin of this disease?
- A. A virus evolved specifically to attack the muscle cells of horses.
 - B. Motor neurons near some of the muscle cells degenerated over time.
 - C. High levels of sodium in the blood irreversibly damaged the ion channels.
 - D. A mutation occurred in the gene coding for the sodium ion channel protein.
- 20 A student set up a terrarium, watered the soil, and covered the terrarium tightly with a lid. The next day, the student observed water droplets on the inside of the lid.
- The droplets provide evidence that which of the following steps of the water cycle had occurred in the terrarium?
- A. runoff and evaporation
 - B. precipitation and runoff
 - C. evaporation and condensation
 - D. condensation and precipitation
- 21 Which element is the main component of all organic molecules?
- A. carbon
 - B. nitrogen
 - C. potassium
 - D. sodium
- 22 Scientists believe that three species of lizards living on the Canary Islands descended from a common ancestor. Similarities in which of the following would **most strongly** support the scientists' theory?
- A. body size
 - B. main diet
 - C. population sizes
 - D. amino acid sequences

Question 23 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 23 in the space provided in your Student Answer Booklet.

- 23** DNA replication and transcription are important processes in cells.
- a. Identify the end products of both DNA replication **and** transcription. Be specific in your answer.
 - b. Explain the importance of **each** process in eukaryotic cells.

Biology

SESSION 2

DIRECTIONS

This session contains nineteen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

- 24 The circulatory system is directly responsible for which of the following?

A. breaking down food
B. transmitting nerve impulses
C. transporting nutrients to cells
D. controlling movement of muscles

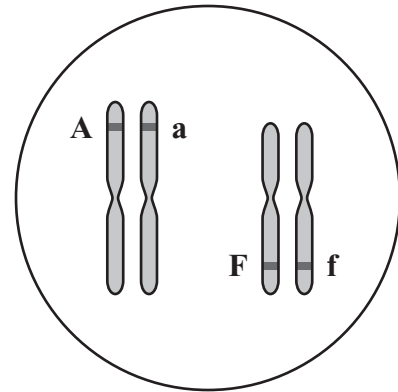
- 25 Some male guppies show variation in their scale pattern. Male guppies can have a dull color that blends with the sand on streambeds, or they can have large spots that are highly visible.

A researcher is studying a sandy portion of a particular stream where most of the male guppies have large spots. A predatory fish species invades the area. The predatory fish find the guppies primarily by sight.

Over time, which of the following is the **most likely** effect of the predators on the male guppies' scale pattern?

A. Most of the males will have large spots.
B. Most of the males will have a dull color.
C. Half of the males will have large spots and half of the males will have a dull color.
D. Half of the males will have even larger spots and half of the males will have smaller spots.

- 26 Two chromosome pairs from a diploid organism are shown below.



Assuming meiosis and fertilization occur normally, which of the following pairs of alleles can an offspring receive from this parent?

A. A and A
B. A and a
C. A and f
D. F and F

- 27 When spring and summer conditions are warm and rainy, mosquito populations often become quite large. Which of the following statements **best** helps to explain this relationship?
- A. Mosquito larvae eat organic debris.
 - B. Adult male mosquitoes feed on plant nectar.
 - C. Mosquitoes are attracted to warm-blooded animals.
 - D. Female mosquitoes lay their eggs in pools of water.
- 28 There are about 136 species of fireflies. Each species produces a different pattern of flashing light. Which of the following statements **best** explains how the different light signals help maintain separate firefly species?
- A. The light signals are flashed only during mating season.
 - B. A male responds only to the light signals of females of his own species.
 - C. The light signals change in pulse duration or frequency every few years.
 - D. A male uses his light signal to repel all other males of the same and other species.
- 29 What is the name of the connective tissue that joins skeletal muscle to bones?
- A. cartilage
 - B. ligaments
 - C. neurons
 - D. tendons
- 30 In a cell, which of the following organelles **most likely** contains digestive enzymes?
- A. centriole
 - B. chloroplast
 - C. lysosome
 - D. ribosome

- 31 According to plate tectonic theory, Australia was a part of the supercontinent Pangea. Millions of years ago Pangea divided, and eventually Australia was separated as its own continent.

Which of the following is **most likely** a result of the isolation of the Australian continent for millions of years?

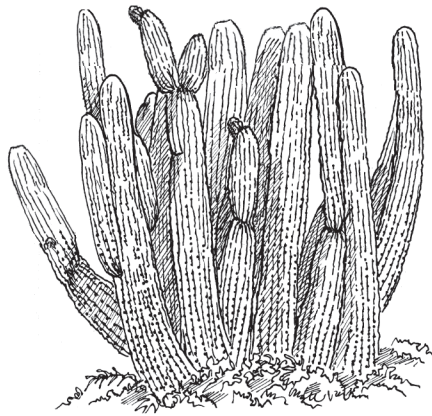
- A. Australia has no fossil record of species evolution.
- B. Australia has a large number of species that are not found anywhere else.
- C. Plant populations in Australia have all evolved to be self-pollinating to maximize their chance for reproduction.
- D. Animal populations in Australia have little genetic diversity and are less likely to survive environmental changes.

Question 32 is an open-response question.

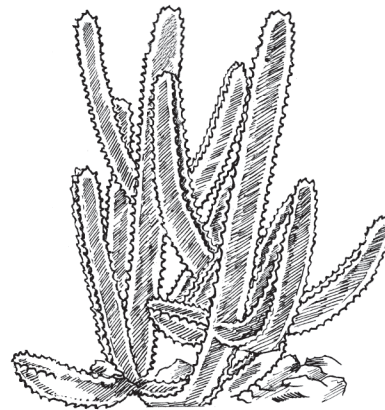
- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 32 in the space provided in your Student Answer Booklet.

32 Illustrations of a cactus and a *Euphorbia* are shown below.



Cactus



Euphorbia

Cacti in the Sonoran Desert in North America share many characteristics with *Euphorbia* in the Sahara Desert in Africa. Both types of plants have reduced leaves, prickly spines, and fleshy stems that contain water. Cacti and *Euphorbia*, however, are not closely related plants.

- Describe how scientists used molecular evidence to determine that cacti and *Euphorbia* are not closely related plants.
- Usually organisms that share many physical characteristics are closely related. Explain why cacti and *Euphorbia* evolved similar features.
- Choose **two** similar characteristics of cacti and *Euphorbia*. Describe how **each** characteristic benefits the plants in their environments.

Mark your answers to multiple-choice questions 33 through 43 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

- 33** Air samples taken in Canada since 1986 show that atmospheric carbon dioxide concentration is higher on average in winter than in summer.

Which of the following statements **best** explains the difference in carbon dioxide concentrations?

- A. The rate of decomposition is slower in winter than in summer.
- B. The greenhouse effect is more pronounced in winter than in summer.
- C. The number of animals that are active is less in winter than in summer.
- D. The amount of photosynthesis by plants is lower in winter than in summer.

- 34** In rabbits, a single gene controlling coat color has four alleles. The inheritance pattern for coat color in rabbits is therefore **best** described as which of the following?

- A. multiple allele
- B. polygenic
- C. recessive
- D. sex-linked

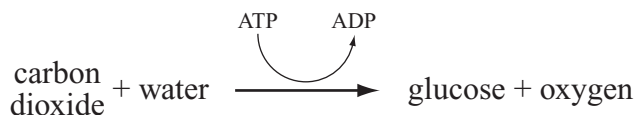
- 35** The table below shows data on reproduction for mouse populations at various population densities.

Average Number of Mice per Cubic Meter	Average Percent of Pregnant Females	Average Number of Mice per Litter
34	58.3	6.2
118	49.4	5.7
350	51.0	5.6
1600	43.3	5.1

Based on the data, which of the following statements **best** describes an effect of population density on mouse populations?

- A. High population density decreases the birthrate.
- B. High population density decreases the death rate.
- C. High population density increases the male to female ratio.
- D. High population density increases the number of successful matings.

- 36 An equation for a biochemical reaction is shown below.



Which of the following happens during this reaction?

- A. Energy from ATP is used to make glucose.
- B. ADP adds a high-energy bond to its structure.
- C. ADP is metabolized to provide oxygen to a cell.
- D. Energy is stored in the molecule ATP for future use.

- 37 One category of organic compounds contains molecules composed of long hydrocarbon chains. The hydrocarbon chains may be saturated or unsaturated.

Which of the following categories of organic compounds contains these molecules?

- A. carbohydrates
- B. lipids
- C. nucleic acids
- D. proteins

- 38 Which of the following examples **best** illustrates the process of evolution by natural selection?

- A. A person with asthma has trouble breathing.
- B. A group of species has common DNA sequences.
- C. A man and a woman have 10 children over the course of their lifetime.
- D. A population becomes immune to a lethal disease over many generations.

- 39 A mutation in which of the following types of cells could be passed on to an organism's offspring?

- A. blood
- B. egg
- C. muscle
- D. nerve

- 40 Some bacteria contain a substance called nitrogenase. Nitrogenase catalyzes the chemical reaction that converts atmospheric nitrogen (N_2) into ammonia (NH_3).

Nitrogenase is an example of which of the following?

- A. a sugar
- B. an enzyme
- C. a nucleotide
- D. an amino acid

- 41 Lung cancer cells do not respond to the signals that regulate the growth of normal lung cells. Which of the following processes is **not** appropriately regulated in the cancerous cells?

- A. fertilization
- B. meiosis
- C. mitosis
- D. transpiration

- 42 In cats, the allele for short hair (**H**) is dominant to the allele for long hair (**h**). If a heterozygous short-hair cat is crossed with a long-hair cat, what percentage of the offspring is expected to be heterozygous for hair length?
- A. 0%
 - B. 25%
 - C. 50%
 - D. 75%
- 43 Which of the following categories of organic molecules is correctly paired with one of its functions?
- A. nucleic acids—digest dead cells
 - B. lipids—give quick energy to cells
 - C. carbohydrates—store genetic information
 - D. proteins—provide structure in skin, hair, and nails

Questions 44 and 45 are open-response questions.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 44 in the space provided in your Student Answer Booklet.

- 44** Organisms in the kingdoms Animalia and Fungi are similar in some ways but are also different in many important ways.
- List one organism classified in kingdom Animalia and one organism classified in kingdom Fungi.
 - Describe **two** similarities between organisms in kingdom Animalia and kingdom Fungi.
 - Describe **two** differences between organisms in kingdom Animalia and kingdom Fungi.

Write your answer to question 45 in the space provided in your Student Answer Booklet.

45 When looking at a child, many people make statements such as “She has her mother’s eyes” and “She has her father’s hair color.”

a. Describe the roles of the following in sexual reproduction:

- meiosis
- gametes
- fertilization
- zygote

b. Explain in detail why children’s features may be similar to, but not exactly the same as, their parents’ features.

Biology
February 2010 Released Items:
Reporting Categories, Standards, and Correct Answers*

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
1	5	<i>Biochemistry and Cell Biology</i>	2.1	C
2	5	<i>Evolution and Biodiversity</i>	5.1	C
3	5	<i>Genetics</i>	3.6	D
4	6	<i>Anatomy and Physiology</i>	4.8	A
5	6	<i>Ecology</i>	6.2	B
6	7	<i>Biochemistry and Cell Biology</i>	2.3	A
7	7	<i>Biochemistry and Cell Biology</i>	2.4	D
8	10	<i>Ecology</i>	6.3	B
9	10	<i>Anatomy and Physiology</i>	4.4	C
10	10	<i>Ecology</i>	6.3	D
11	10	<i>Ecology</i>	6.1	C
12	11	<i>Ecology</i>	6.3	
13	12	<i>Evolution and Biodiversity</i>	5.2	D
14	12	<i>Evolution and Biodiversity</i>	5.3	D
15	12	<i>Biochemistry and Cell Biology</i>	2.2	B
16	13	<i>Genetics</i>	3.4	C
17	14	<i>Anatomy and Physiology</i>	4.1	D
18	14	<i>Genetics</i>	3.1	C
19	15	<i>Genetics</i>	3.3	D
20	15	<i>Ecology</i>	6.4	C
21	15	<i>Biochemistry and Cell Biology</i>	1.1	A
22	15	<i>Evolution and Biodiversity</i>	5.1	D
23	16	<i>Genetics</i>	3.2	
24	17	<i>Anatomy and Physiology</i>	4.2	C
25	17	<i>Evolution and Biodiversity</i>	5.3	B
26	17	<i>Genetics</i>	3.5	C
27	18	<i>Ecology</i>	6.2	D
28	18	<i>Evolution and Biodiversity</i>	5.2	B
29	18	<i>Anatomy and Physiology</i>	4.5	D
30	18	<i>Biochemistry and Cell Biology</i>	2.1	C
31	19	<i>Evolution and Biodiversity</i>	5.2	B
32	20	<i>Evolution and Biodiversity</i>	5.1	
33	21	<i>Ecology</i>	6.4	D
34	21	<i>Genetics</i>	3.4	A
35	21	<i>Ecology</i>	6.1	A
36	22	<i>Biochemistry and Cell Biology</i>	2.5	A
37	22	<i>Biochemistry and Cell Biology</i>	1.2	B
38	22	<i>Evolution and Biodiversity</i>	5.3	D
39	22	<i>Genetics</i>	3.3	B
40	23	<i>Biochemistry and Cell Biology</i>	1.3	B
41	23	<i>Biochemistry and Cell Biology</i>	2.6	C
42	24	<i>Genetics</i>	3.6	C

Biology
February 2010 Released Items:
Reporting Categories, Standards, and Correct Answers*

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
43	24	<i>Biochemistry and Cell Biology</i>	1.2	D
44	25	<i>Biochemistry and Cell Biology</i>	2.3	
45	26	<i>Anatomy and Physiology</i>	4.6	

* Answers are provided here for multiple-choice items only. Each open-response item has its own set of scoring guidelines, which allow for valid alternate interpretations and responses.