MASSACHUSETTS
Department of Elementary
and Secondary Education

Release of Spring 2025 MCAS Test Items

from the

High School Biology Paper-Based Test

July 2025
Massachusetts Department of Elementary and Secondary Education

MASSACHUSETTS
Department of Elementary
and Secondary Education

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Overview of High School Biology Test

The spring 2025 high school Biology test was administered in two formats: a computer-based version and a paper-based version. Most students took the computer-based test. The paper-based test was offered as an accommodation for eligible students who were unable to use a computer. More information can be found on the MCAS Test Administration Resources page at www.doe.mass.edu/mcas/admin.html.

Most of the operational items on the high school Biology test were the same, regardless of whether a student took the computer-based version or the paper-based version. In places where a technology-enhanced item was used on the computer-based test, an adapted version of the item was created for use on the paper test. These adapted paper items were multiple-choice or multiple-select items that tested the same Science content and assessed the same standard as the technology-enhanced item.

This document displays released items from the paper-based test. Released items from the computer-based test are available on the MCAS Resource Center website at mcas.onlinehelp.cognia.org/released-items.

Test Sessions and Content Overview

The high school Biology test was made up of two separate test sessions. Each session included selected-response questions and constructed-response questions. On the paper-based test, the selected-response questions were multiple-choice items and multiple-select items, in which students select the correct answer(s) from among several answer options.

Standards and Reporting Categories

The high school Biology test was based on learning standards in the 2016 *Massachusetts Science and Technology/Engineering Curriculum Framework*. The Framework is available on the Department website at www.doe.mass.edu/frameworks/current.html.

The biology standards are grouped under the four content reporting categories listed below.

- Molecules to Organisms
- Heredity
- Evolution
- Ecosystems

Most items on the high school Biology test are also reported as aligning to one of three MCAS Science Practice Categories. The three practice categories are listed below.

- Practice Category A: Investigations and Questioning
- Practice Category B: Mathematics and Data
- Practice Category C: Evidence, Reasoning, and Modeling

More information about the practice categories is available on the Department website at www.doe.mass.edu/mcas/tdd/practice-categories.html.

The table at the conclusion of this document provides the following information about each released operational item: reporting category, standard covered, science practice category covered (if any), item type, and item description. The correct answers for released selected-response questions are also displayed in the table.

Reference Materials

Each student taking the paper-based version of the high school Biology test was provided with a calculator.

During both high school Biology test sessions, the use of authorized bilingual word-to-word dictionaries and glossaries was allowed for students who are currently or were ever reported as English learners. No other reference tools or materials were allowed.

High School Biology

SESSION 1

This session contains 21 questions.

Directions

Read each question carefully and then answer it as well as you can. You must record all answers in this Test & Answer Booklet.

For some questions, you will mark your answers by filling in the circles in your Test & Answer Booklet. Make sure you darken the circles completely. Do not make any marks outside of the circles. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided. Only responses written within the provided space will be scored.

1 PAH is a protein found in human cells. A change of one amino acid in the structure of PAH can cause PKU, a condition in which the PAH protein no longer functions.

How was PKU most likely introduced into the human population?

Ⓐ A mutation occurred in the *PAH* gene.

Ⓑ The *PAH* gene moved to a different chromosome.

Ⓒ Expression of the *PAH* gene produced lipids instead of proteins.

Ⓓ The *PAH* gene was translated in the nucleus instead of in the cytoplasm.

2 When a person has pneumonia, fluid accumulates in the alveoli. This fluid accumulation directly results in which of the following problems?

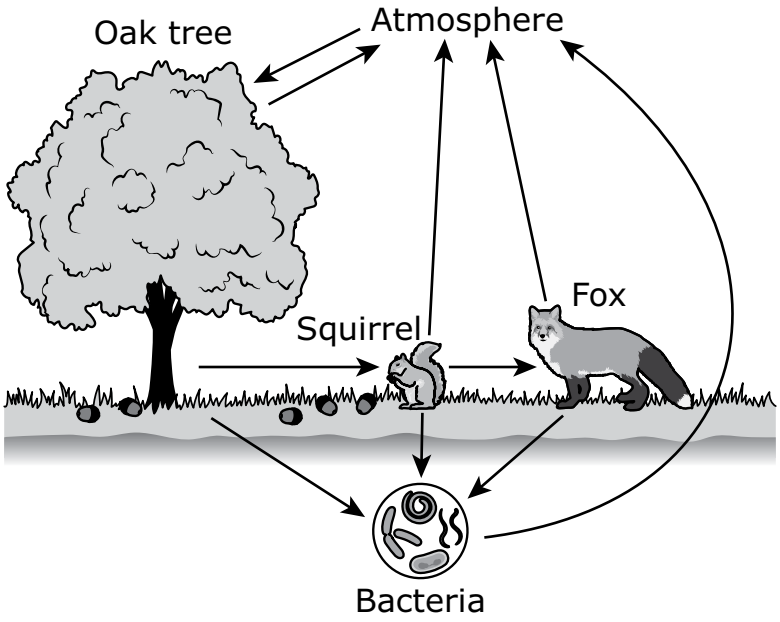
Ⓐ limited production of antibodies

Ⓑ decreased ability to regulate body temperature

Ⓒ slower diffusion of glucose into the bloodstream

Ⓓ reduced gas exchange between the lungs and the blood

3 The model shows how carbon moves through an ecosystem.



Select **all** the actions in which carbon storage occurs.

Ⓐ Oak trees produce sugar.

Ⓑ Foxes use energy to hunt.

Ⓒ Squirrels eat acorns to build up fat.

Ⓓ Bacteria decompose dead oak trees.

4 Pine trees are pollinated when the wind carries pollen grains from male pinecones to female pinecones. The female pinecones contain egg cells.

Which statement describes what happens in a female pinecone during fertilization?

Ⓐ A diploid sperm cell and a diploid egg cell fuse together to form a zygote.

Ⓑ A haploid sperm cell and a haploid egg cell fuse together to form a zygote.

Ⓒ A diploid sperm cell and a diploid egg cell undergo rapid meiosis to form an embryo.

Ⓓ A haploid sperm cell and a haploid egg cell undergo rapid meiosis to form an embryo.

5 As a tadpole becomes a frog, it loses its tail. Lysosomes play an important role in tail cells during this process.

What is the function of lysosomes as tadpoles lose their tails?

Ⓐ Lysosomes absorb ATP, causing the tail cells to die.

Ⓑ Lysosomes cause mutations in DNA that destroy tail cells.

Ⓒ Lysosomes release enzymes that help break down tail cells.

Ⓓ Lysosomes produce hormones, causing the tail cells to differentiate.

This question has two parts.

6 Emperor penguins can dive underwater for over 20 minutes. While underwater, the penguins use oxygen that is stored in their bodies.

Part A

Which of the following **best** describes the importance of oxygen in the penguins' body systems?

Ⓐ Oxygen allows the lungs to grow underwater.

Ⓑ Oxygen diffuses from the muscles to other body parts.

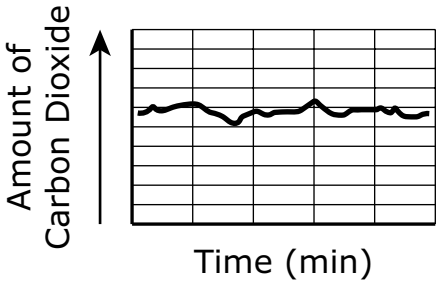
Ⓒ Oxygen is converted into other gases in the bloodstream.

Ⓓ Oxygen is used to produce energy for muscle movement.

Part B

Which of the following graphs shows the amount of carbon dioxide produced over time in a penguin's body as it swims underwater?

Ⓐ



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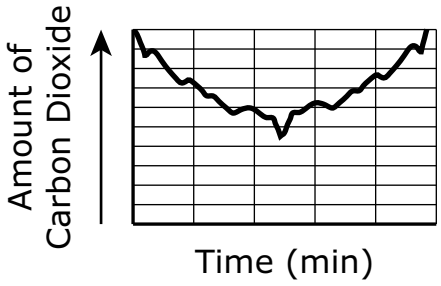

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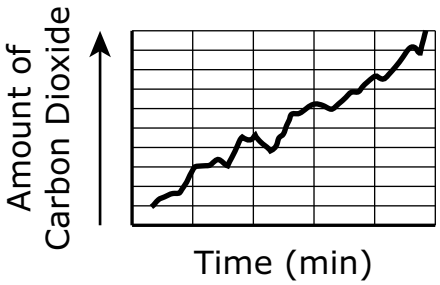

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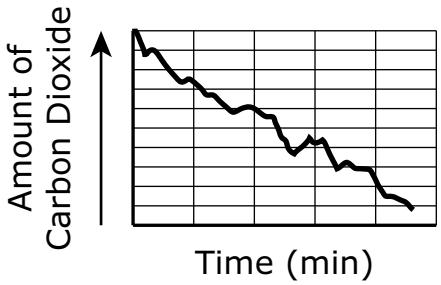


7 Familial hypercholesterolemia (FH) is a genetic condition that can cause high levels of cholesterol in the blood to develop at an early age. The symptoms of FH can be reduced or delayed if a person follows a special course of treatment that includes a low-fat diet and exercise.

Which of the following **best** explains why a person who inherits FH can benefit from a special course of treatment?

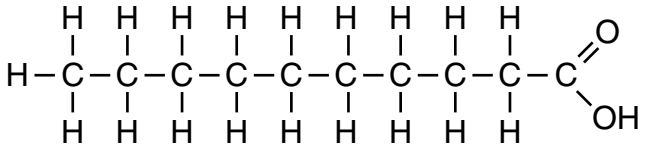
Ⓐ Some genetic conditions are found only in certain populations.

Ⓑ The symptoms of some genetic conditions only cause problems in old age.

Ⓒ Some genetic conditions are caused by bacteria that can be controlled with antibiotics.

Ⓓ The risk of developing some genetic conditions can be influenced by environmental factors.

8 The chemical structure of a fatty acid is shown.



This fatty acid is a building block of which type of organic molecule?

Ⓐ carbohydrate

Ⓑ lipid

Ⓒ nucleic acid

Ⓓ protein

9 When a person is dehydrated, a hormone called ADH is produced that increases the reabsorption of water into the bloodstream. As a result, less water leaves the body.

Which organ does ADH most **directly** affect?

Ⓐ heart

Ⓑ kidney

Ⓒ liver

Ⓓ stomach

10 The mass of DNA in a human body cell is approximately 6.5 picograms (pg). What is the approximate mass of DNA in a human gamete?

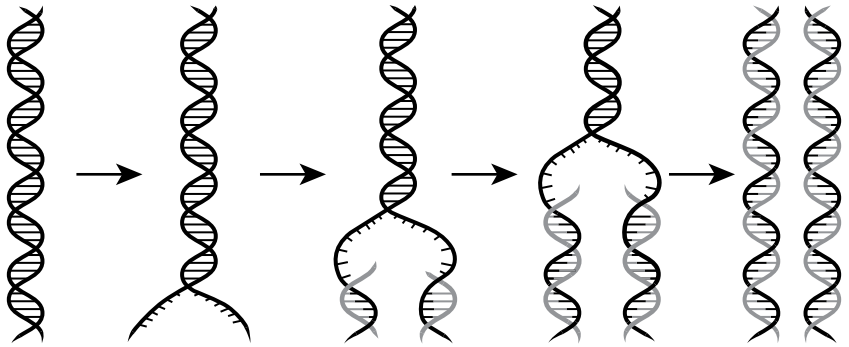
Ⓐ 3.2 pg

Ⓑ 6.5 pg

Ⓒ 9.7 pg

Ⓓ 13 pg

11 A model of a cellular process is shown.



This process is necessary so newly divided cells can

Ⓐ make more carbohydrates.

Ⓑ store more energy molecules.

Ⓒ produce lipids for cell membranes.

Ⓓ have instructions for making proteins.

The following section focuses on island foxes.

Read the information below and use it to answer the selected-response questions and the constructed-response question that follow.

The island fox is a small fox that lives on Santa Cruz Island off the coast of California. It is a descendant of the gray fox that is found on the mainland in California. From 1994 to 2000, the island fox population on Santa Cruz Island declined from 1,465 to only 62 individuals.

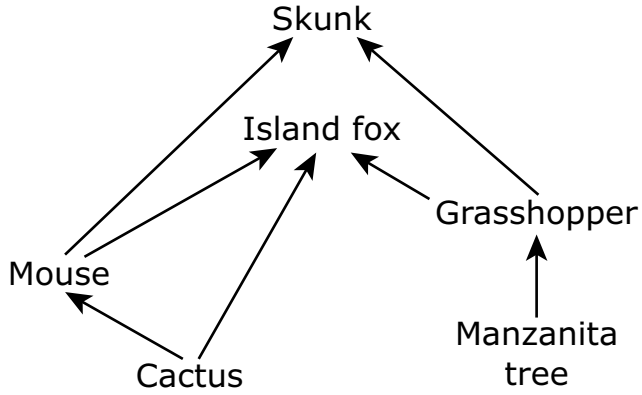
Several events on Santa Cruz Island caused the island fox population to decrease. In the 1800s, people introduced non-native plants and farm animals, including pigs, to the island. Some of the pigs escaped and reproduced in the wild, eventually producing a large population of feral (wild) pigs. The feral pigs dug up and ate native plants, including cactus plants and manzanita trees.

Young, small feral pigs on the island became a food source for visiting golden eagles. However, golden eagles were unable to nest on the island because the bald eagles living there chased them away. The bald eagles hunted fish from the ocean, but they did not eat feral pigs or island foxes. Other small mammals that lived on the island included mice and skunks. The sizes of these animal populations were not directly affected by the visiting golden eagles.

From 1950 to 1980, the bald eagle population on the island was greatly reduced as a result of the use of the chemical DDT. By 1994, there were no longer any bald eagles on the island. Golden eagles then began nesting on the island and hunting island foxes as well as the young feral pigs.

Since 2000, humans have helped restore the island fox population on Santa Cruz Island by removing feral pigs and golden eagles from the island and reintroducing bald eagles.

A food web **after** the island fox population was restored on the island is shown.



12 One type of plant that was introduced to Santa Cruz Island was fennel. The fennel spread and began growing in the wild. Fennel seeds are spread by wind, and fennel plants can grow up to two meters tall.

Which of the following **best** explains how fennel most likely affected smaller native plants when it began to grow in the wild?

Ⓐ Fennel decreased the amount of sunlight that was available to native plants.

Ⓑ Fennel increased the number of native plant seeds that were spread by wind.

Ⓒ Fennel decreased the likelihood that native plants would be eaten by bald eagles.

Ⓓ Fennel increased the amount of energy that native plants used during cellular respiration.

13 After the golden eagles started nesting on the island, the skunk population began to increase. Which of the following **best** explains why the skunk population increased as the island fox population decreased?

Ⓐ The skunk preyed on the island fox.

Ⓑ The skunk competed with the island fox.

Ⓒ The skunk and the island fox had a parasitic relationship.

Ⓓ The skunk and the island fox had a mutualistic relationship.

14 Which of the following describes the genetic diversity in the island fox population from 1994 to 2000?

Ⓐ Genetic diversity increased as the foxes ate more mice.

Ⓑ Genetic diversity remained unchanged as the foxes stayed on the island.

Ⓒ Genetic diversity decreased as the foxes were preyed upon by golden eagles.

Ⓓ Genetic diversity remained unchanged as the number of mutations in the foxes stayed the same.

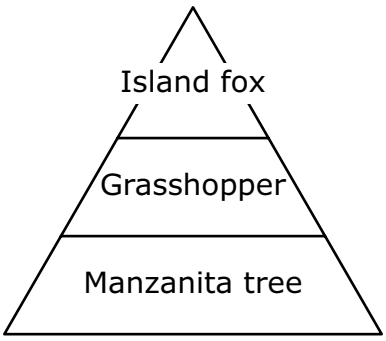
This question has two parts.

15 Island foxes play a role in the transfer of energy in the Santa Cruz Island ecosystem.

Part A

Which of the following best shows an energy pyramid for the Santa Cruz Island ecosystem?

Ⓐ



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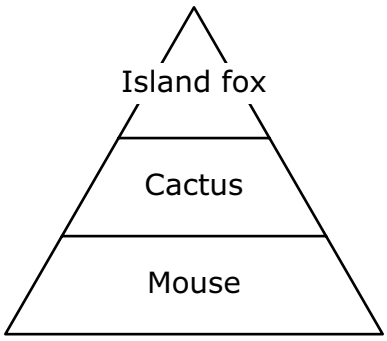

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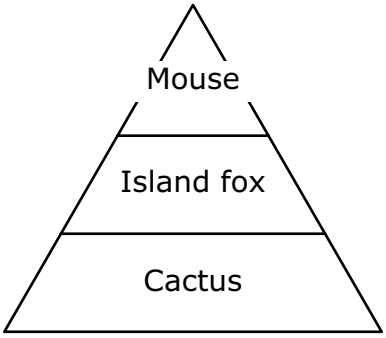

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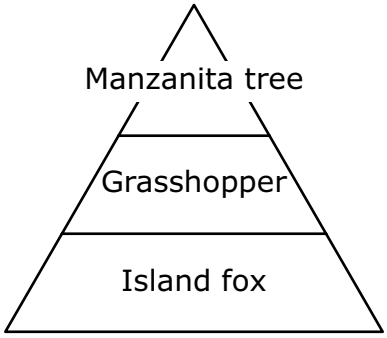


Part B

What percentage of energy from producers is stored in the trophic level of the island fox?

Ⓐ 100%

Ⓑ 10%

Ⓒ 1%

Ⓓ 0.1%

This question has three parts. Be sure to label each part of your response.

16 Humans helped increase the island fox population on Santa Cruz Island by removing feral pigs and golden eagles from the island and by reintroducing bald eagles.

A. Explain how reintroducing bald eagles helped to increase the island fox population.

B. Describe one way the island ecosystem benefited from the removal of feral pigs. Explain how removing feral pigs helped to increase the island fox population.

C. Other than reintroducing bald eagles and removing feral pigs, describe another action that humans could take to increase the island fox population. Explain how this action would increase the size of the island fox population.

16

17 Scientists estimated how quickly a species of bacteria could adapt to an environmental change.

Select the **two** pieces of information about the species of bacteria that most helped the scientists estimate how quickly the bacteria could adapt.

Ⓐ mutation rate

Ⓑ size of ribosome

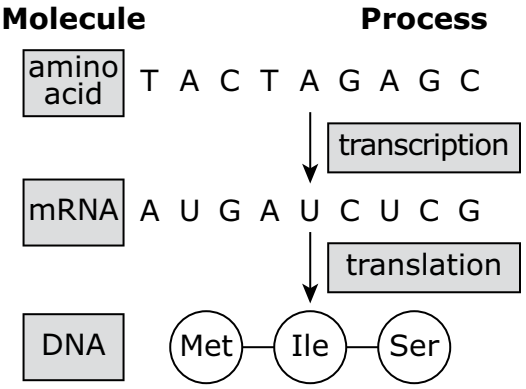
Ⓒ immigration rate

Ⓓ structure of DNA

Ⓔ speed of reproduction

18 Which of the following models of protein synthesis is labeled with the correct molecules and processes?

Ⓐ



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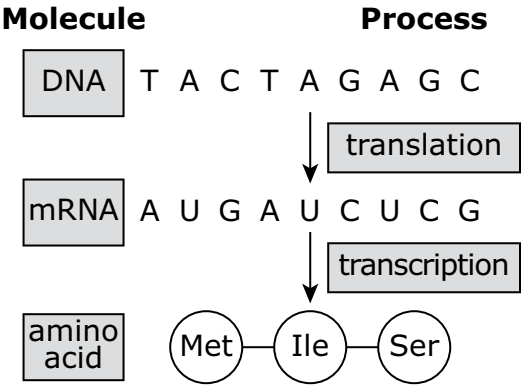

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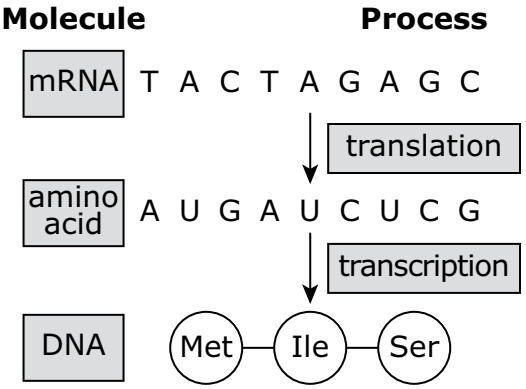

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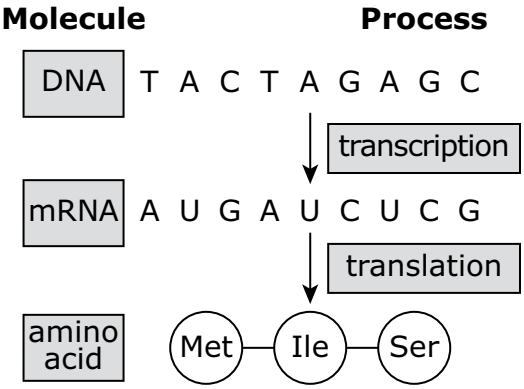


19 Plants watered with treated wastewater often have high levels of caffeine in their cells. Caffeine can interfere with the cellular process of crossing over that occurs between homologous chromosomes.

Based on the information, which of the following cellular processes would be **most directly** affected by caffeine?

Ⓐ interphase

Ⓑ meiosis

Ⓒ replication

Ⓓ transcription

This question has four parts. Be sure to label each part of your response.

20 Yarrow plants are flowering plants that grow in the Sierra Nevada Mountains in California. The average height of the yarrow plant decreases as the elevation increases.

A. Identify **two** environmental factors that vary by location on a mountain and could result in yarrow plants having different heights.

B. Scientists conducted an investigation to determine if the height of yarrow plants is genetically determined. The scientists collected five sets of seeds from yarrow plant populations living at different elevations and planted the seeds in a garden at an elevation of 100 m. The plants received the same amount of water and sunlight. After several weeks, the scientists measured the plants and calculated the average height of the plants in each set. The data are shown in the table.

Seed Set	Elevation Where Seeds Were Collected (m)	Average Height of Plants in Garden (cm)
1	1,100	80
2	1,800	55
3	2,200	40
4	2,700	25
5	3,200	20

Does genetics play a role in determining the height of the yarrow plants in the garden? Describe evidence from the investigation to support your answer.

C. Identify the process that resulted in yarrow plant populations adapting to different elevations.

D. Describe an investigation scientists can perform to determine whether two populations of yarrow plants growing at different elevations are the same species.

20

This question has three parts. Be sure to label each part of your response.

21 Fence lizards can be light or dark in color. The color of fence lizards is determined by a single gene with two alleles. The allele for light color (**R**) is dominant to the allele for dark color (**r**).

A. Identify the **two** possible genotypes for fence lizards that are light in color.

B. A fence lizard that is heterozygous for light color is crossed with a fence lizard that is dark in color.

Using the allele symbols **R** and **r**, complete the Punnett square on the next page to show this cross.

Identify the percentage of the offspring from this cross that are expected to be light in color.

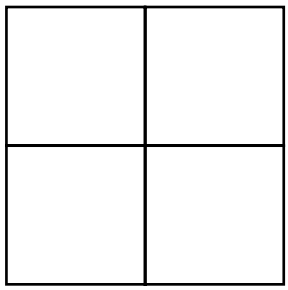
C. Owls and hawks eat fence lizards.

Identify whether the allele for light color in fence lizards is expected to be more common in areas with dark soil or in areas with light soil. Explain your answer using your knowledge of natural selection.

21 A. genotype 1: _____

genotype 2: _____

B.



Percentage of offspring expected to be light in color _____%

High School Biology
SESSION 2

This session contains 21 questions.

Directions

Read each question carefully and then answer it as well as you can. You must record all answers in this Test & Answer Booklet.

For some questions, you will mark your answers by filling in the circles in your Test & Answer Booklet. Make sure you darken the circles completely. Do not make any marks outside of the circles. If you need to change an answer, be sure to erase your first answer completely.

If a question asks you to show or explain your work, you must do so to receive full credit. Write your response in the space provided. Only responses written within the provided space will be scored.

22 In some mammals, a decrease in body temperature causes mitochondria to become active in the cells of specialized tissue called brown adipose tissue. Instead of converting stored energy to ATP, these mitochondria convert stored energy directly to thermal energy.

Why does the body respond in this way?

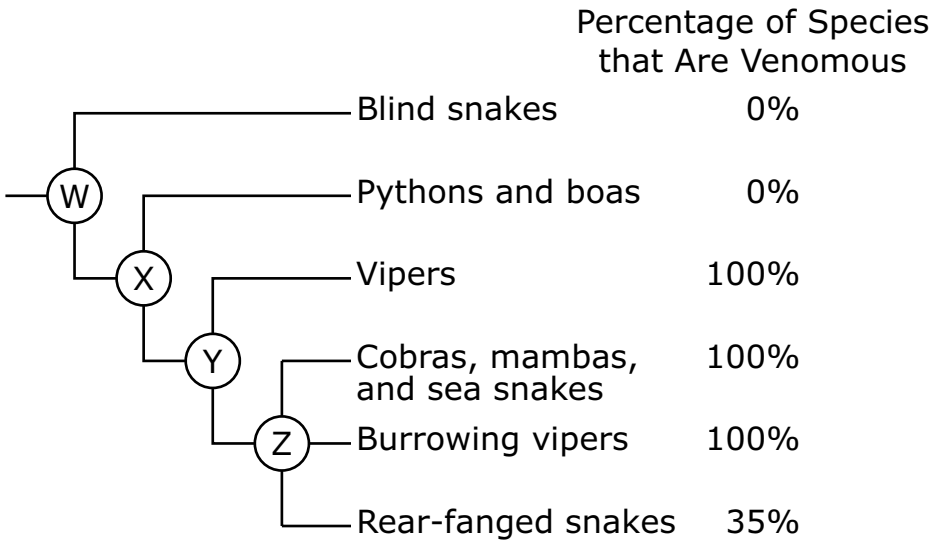
Ⓐ to prevent infection

Ⓑ to speed up osmosis

Ⓒ to reduce perspiration

Ⓓ to maintain homeostasis

23 Some species of snakes can produce a toxin known as venom. Scientists have identified specific genes responsible for producing venom. The cladogram shows groups of snakes and the percentage of venomous species in each group.



Which of the following locations on the cladogram shows where the ability to produce venom most likely originated?

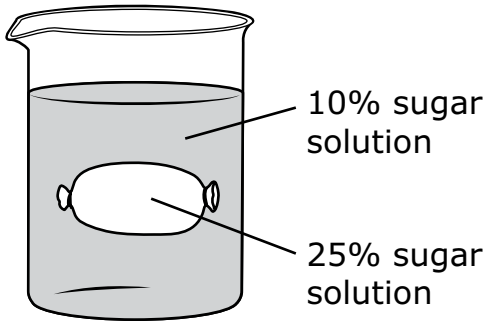
Ⓐ location W

Ⓑ location X

Ⓒ location Y

Ⓓ location Z

24 A student is modeling passive transport in cells. The student places a 25% sugar solution into a semipermeable membrane and seals it. The membrane allows water molecules to pass through, but the sugar molecules are too large to cross the membrane. The membrane is placed in a beaker containing a 10% sugar solution, as shown.



Before reaching equilibrium, the volume of water inside the membrane

Ⓐ increases.

Ⓑ decreases.

Ⓒ stays the same.

This is because the number of water molecules that enter the membrane is

Ⓐ equal to the number of water molecules that leave the membrane.

Ⓑ less than the number of water molecules that leave the membrane.

Ⓒ greater than the number of water molecules that leave the membrane.

This question has two parts.

25 In humans, eye color can be separated into five different color categories. The table shows how two genes, each with two alleles, code for eye color in humans.

Eye Color		Genotype
	light blue	aabb
	deep blue or green	Aabb, aaBb
	light brown	AaBb, AAbb, aaBB
	medium brown	AABb, AaBB
	dark brown or black	AABB

Part A

What is the inheritance pattern for eye color in humans?

Ⓐ polygenic

Ⓑ sex-linked

Ⓒ codominant

Part B

The Punnett square represents a cross between two individuals who are heterozygous for both genes (**AaBb** × **AaBb**).

	AB	**Ab**	**aB**	**ab**
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

Based on the Punnett square, what fraction of offspring are expected to have medium brown eyes?

Ⓐ $\frac{1}{16}$

Ⓑ $\frac{4}{16}$

Ⓒ $\frac{6}{16}$

Ⓓ $\frac{9}{16}$

26 Two species of birds, the pied flycatcher and the collared flycatcher, are found in eastern and central Europe. In areas where the birds are geographically isolated from each other, the two species have similar color patterns. In areas where the birds' ranges overlap, each species has a different color pattern.

In the overlapping areas, the birds usually mate with birds of their own species. Occasionally the two species mate with each other, but these offspring are usually not fertile.

Which of the following **best** explains why natural selection would favor different color patterns in areas where the two flycatcher species overlap?

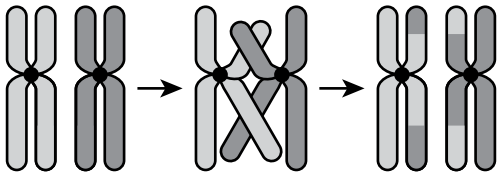
Ⓐ The different color patterns help the birds avoid predators.

Ⓑ The different color patterns help the birds eat a healthy, varied diet.

Ⓒ The different color patterns help increase the amount of heat the birds absorb.

Ⓓ The different color patterns help increase the reproductive success of the birds.

27 The model shows a pair of homologous chromosomes going through a cellular process.



The process shown in the model occurs during

Ⓐ fertilization.

Ⓑ mitosis.

Ⓒ meiosis.

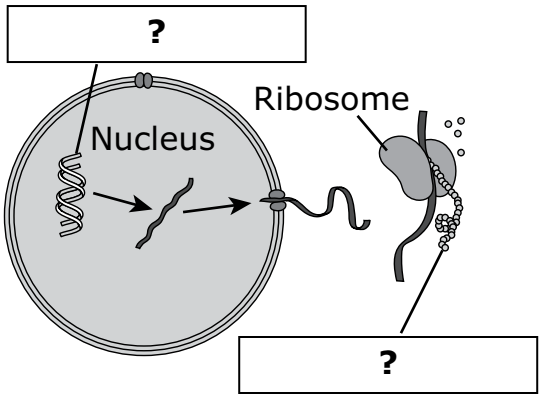
This process is a source of

Ⓐ dominant alleles.

Ⓑ genetic variation.

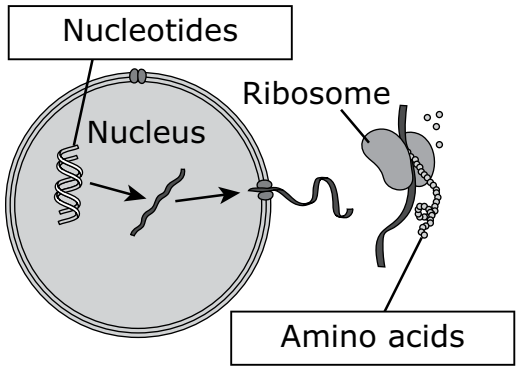
Ⓒ harmful mutations.

28 An incomplete model of protein synthesis is shown.

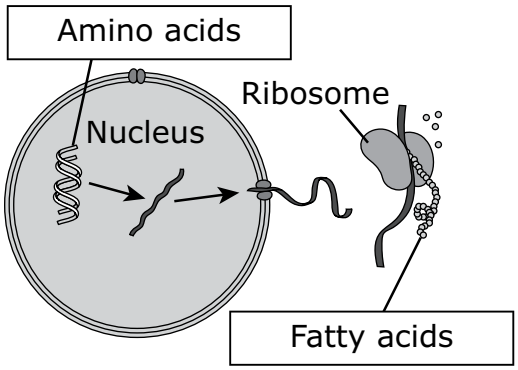


Macromolecules, which are made up of monomers, are involved in this process. Which of the following models best shows the monomers that make up the macromolecules?

Ⓐ



Ⓑ



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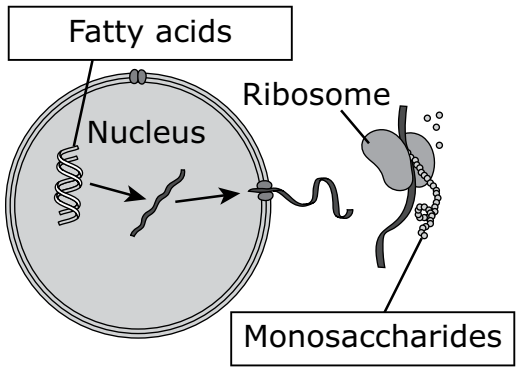

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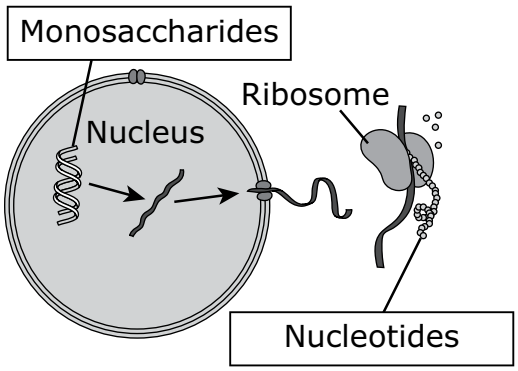


29 In rabbits, the allele for black fur (**B**) is dominant to the allele for brown fur (**b**). Two rabbits that have the heterozygous genotype (**Bb**) for fur color mate and produce a litter of offspring.

What percentage of these offspring are expected to have at least one copy of the allele for black fur (**B**)?

Ⓐ 25%

Ⓑ 50%

Ⓒ 75%

Ⓓ 100%

30 A student planted an oak tree that was three meters tall. The tree was exposed to sunlight, water, and air. One year later, the tree was four meters tall.

Where did the tree obtain **most** of the carbon necessary for its growth?

Ⓐ from the air

Ⓑ from the soil

Ⓒ from sunlight

Ⓓ from fertilizers

31 Which of the following events **most likely** led to speciation as a result of geographic isolation?

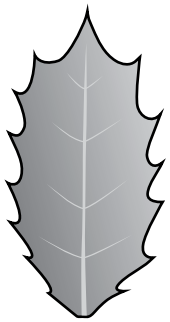
Ⓐ Several primates dispersed from a mainland population to an island off the coast.

Ⓑ A species of beetle expanded its habitat range as the range of its host tree increased.

Ⓒ A species of fox living in a woodland habitat evolved a variety of fur colors over time.

Ⓓ Several birds migrated south for the winter and then flew north for the summer.

32 Holly trees can have a mix of leaves with prickly, sharp edges and leaves with smooth edges. The diagram shows both types of leaves.



Leaf with prickly, sharp edges

Leaf with smooth edges

Deer prefer to eat holly tree leaves with smooth edges, which leads to the growth of more holly tree leaves with prickly, sharp edges. Scientists hypothesize that deer affect gene expression in holly tree leaves.

Which of the following comparisons should be made to determine whether the scientists' hypothesis is correct?

Ⓐ Compare the gene expression in holly tree roots in an area with deer to the gene expression in holly tree leaves in the same area.

Ⓑ Compare the gene expression in one holly tree in an area with deer to the gene expression in another holly tree in the same area.

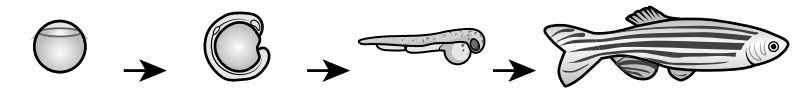
Ⓒ Compare the gene expression in holly tree leaves in an area with deer to the gene expression in holly tree leaves in an area with no deer.

Ⓓ Compare the gene expression in holly tree leaves in an area with deer to the gene expression in leaves of another tree species in an area with no deer.

The following section focuses on zebrafish research.

Read the information below and use it to answer the selected-response questions and constructed-response question that follow.

Zebrafish are small freshwater fish that are often used in scientific research. Zebrafish develop from a zygote into an adult in only three months. A model of zebrafish development is shown.



A group of scientists identified some mutations that affect how the organs of the digestive system develop in zebrafish larvae. The table describes four mutations, W, X, Y, and Z, in zebrafish.

Mutation	Effect on Digestive System Development
W	small intestine wall is thin and lacks villi
X	pancreas does not develop
Y	esophagus* does not fully develop
Z	liver does not fully develop

*esophagus—a tube that connects the mouth to the stomach

33 Zebrafish larvae with the mutation have a change in the

Ⓐ DNA in the nuclei of their cells.

Ⓑ mRNA in the nuclei of their cells.

During transcription, the mutation causes a change in the

Ⓐ DNA and results in a nonfunctioning lipid.

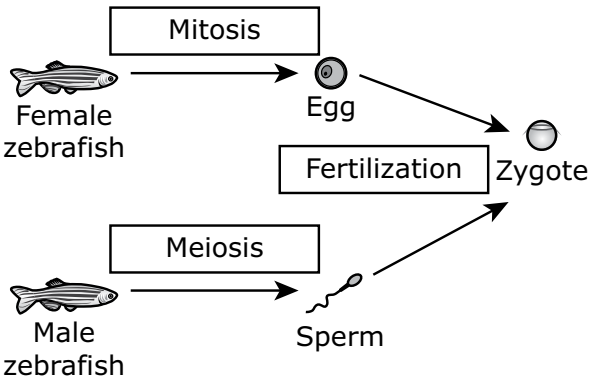
Ⓑ DNA and results in a nonfunctioning protein.

Ⓒ mRNA and results in a nonfunctioning lipid.

Ⓓ mRNA and results in a nonfunctioning protein.

34 Which of the following models best shows how a zebrafish zygote forms?

Ⓐ



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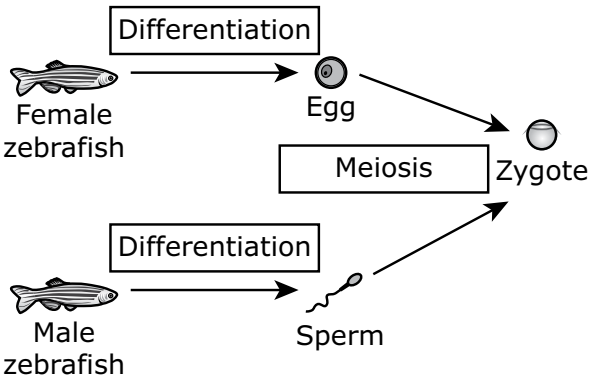

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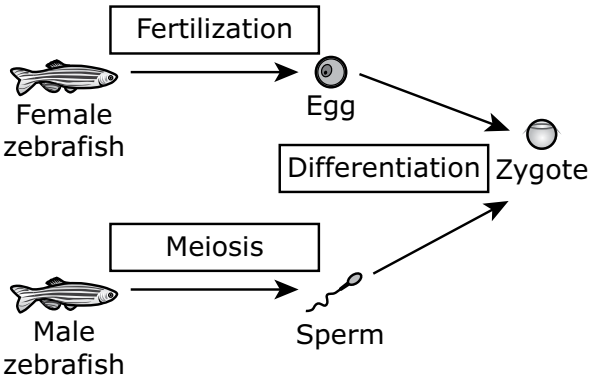

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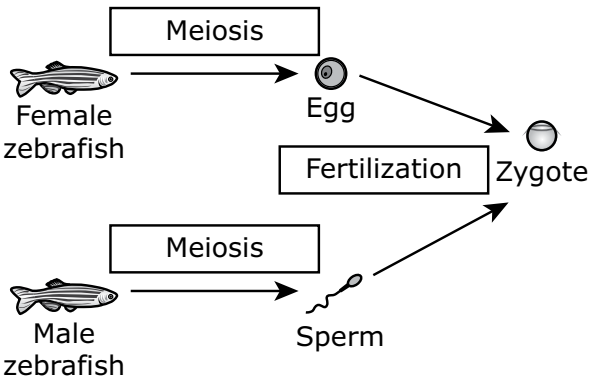


35 Scientists collected small intestine cells from zebrafish with and without mutation W. The percentage of cells in each sample that had replicated DNA is shown in the table.

Type of Zebrafish	Percentage of Cells with Replicated DNA
with mutation W	20%
without mutation W	35%

Which of the following best compares the small intestine cells with mutation W to those without the mutation?

Ⓐ The small intestine cells with mutation W produced more proteins.

Ⓑ The small intestine cells with mutation W had more chromosomes.

Ⓒ The small intestine cells with mutation W spent less time in meiosis.

Ⓓ The small intestine cells with mutation W underwent less cell division.

This question has two parts.

36 Zebrafish take in oxygen as water moves through their gills.

Part A

Which of the following models best shows the steps that occur when oxygen is used by the zebrafish?

Ⓐ
- Oxygen diffuses into mitochondria.
- ↓
- Oxygen is used to produce ATP.
- ↓
- Oxygen diffuses into the bloodstream.
- ↓
- Oxygen is transported to body cells.

Ⓑ
- Oxygen diffuses into the bloodstream.
- ↓
- Oxygen is transported to body cells.
- ↓
- Oxygen diffuses into mitochondria.
- ↓
- Oxygen is used to produce ATP.

Ⓒ
- Oxygen is transported to body cells.
- ↓
- Oxygen diffuses into the bloodstream.
- ↓
- Oxygen diffuses into mitochondria.
- ↓
- Oxygen is used to produce ATP.

Ⓓ
- Oxygen is transported to body cells.
- ↓
- Oxygen diffuses into mitochondria.
- ↓
- Oxygen is used to produce ATP.
- ↓
- Oxygen diffuses into the bloodstream.

Part B

Which of the following best describes how oxygen is used by the zebrafish?

Ⓐ Zebrafish use oxygen and water to perform transcription.

Ⓑ Zebrafish use oxygen and glucose to perform transcription.

Ⓒ Zebrafish use oxygen and water to perform cellular respiration.

Ⓓ Zebrafish use oxygen and glucose to perform cellular respiration.

This question has three parts. Be sure to label each part of your response.

37 The mutations described in the digestive system research table result in the abnormal development of digestive organs.

A. Describe what would most likely happen to a zebrafish with mutation **Y**. Explain your reasoning.

B. The blood of zebrafish with the mutations is different than the blood of zebrafish without the mutations.

Describe one way the blood of a zebrafish with mutation **W** would most likely be different from the blood of a zebrafish without the mutation. Explain your reasoning.

C. Describe one way the blood of a zebrafish with mutation **Z** would most likely be different from the blood of a zebrafish without the mutation. Explain your reasoning.

37

38 Which of the following will **best** help a scientist determine if a sample of soil contains the remains of organisms?

Ⓐ the amount of water in the soil sample

Ⓑ the ages of the rocks in the soil sample

Ⓒ the types of elements in the soil sample

Ⓓ the number of minerals in the soil sample

39 A diverse group of organisms, including insects and mammals, have proteins with almost identical amino acid sequences. These proteins are involved in eye development.

Which of the following conclusions is **best** supported by this information?

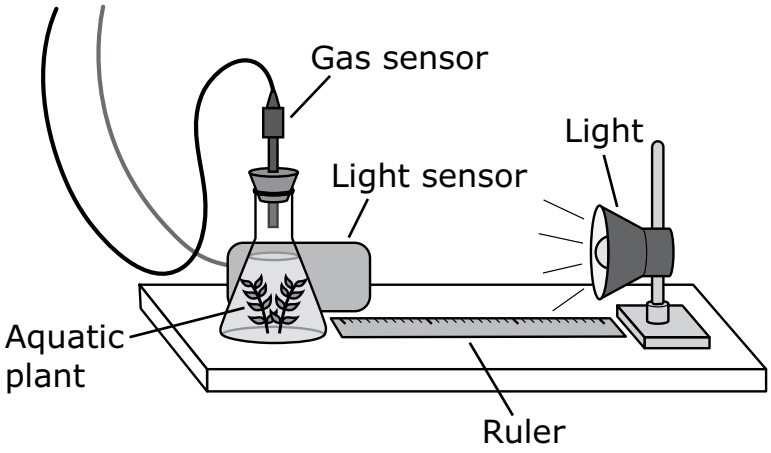
Ⓐ The organisms in the group have eyes that are the same size.

Ⓑ The organisms in the group have similar numbers of chromosomes.

Ⓒ The organisms in the group are descended from a common ancestor.

Ⓓ The organisms in the group interpret sensory information in the same way.

40 A student conducted an investigation. The setup of the investigation is shown in the diagram. A gas sensor measured the amount of a certain gas produced by an aquatic plant, and a light sensor measured the amount of light the plant received. During the investigation, the student moved the light closer and closer to the flask.



Which of the following best describes the investigation?

Ⓐ It was designed to find out how light intensity affects the rate of photosynthesis by measuring the amount of oxygen produced.

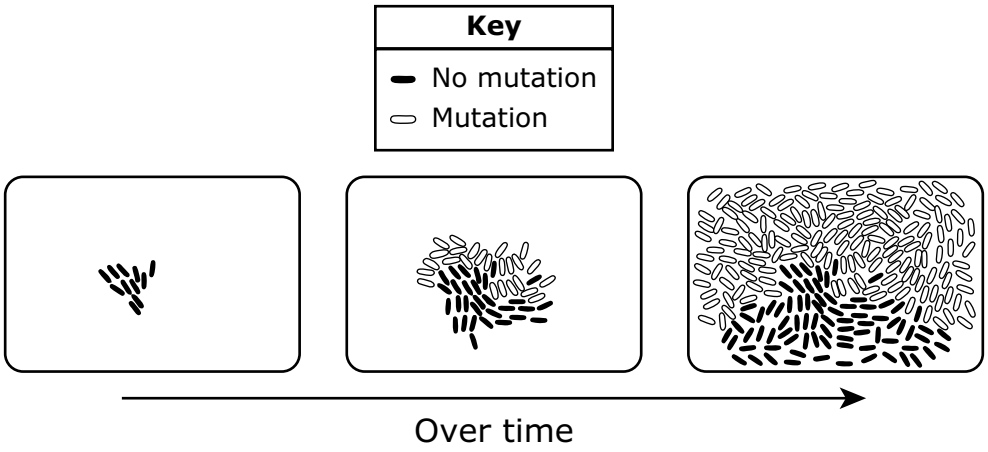
Ⓑ It was designed to find out how gas exchange affects the rate of cellular respiration by measuring the amount of oxygen produced.

Ⓒ It was designed to find out how gas exchange affects the rate of photosynthesis by measuring the amount of carbon dioxide produced.

Ⓓ It was designed to find out how light intensity affects the rate of cellular respiration by measuring the amount of carbon dioxide produced.

This question has two parts.

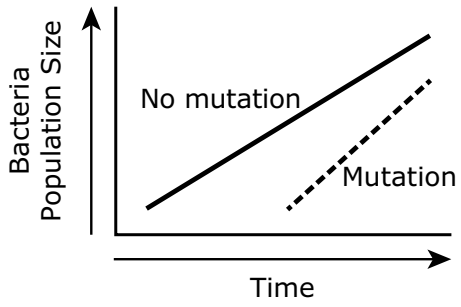
41 The diagrams show a change in a population of bacteria over time. A mutation is introduced into the population. The key shows bacteria with and without the mutation. Natural selection is occurring in the population.



Part A

Which of the following graphs best represents the change in the population of bacteria from the beginning to the end of the diagrams?

Ⓐ



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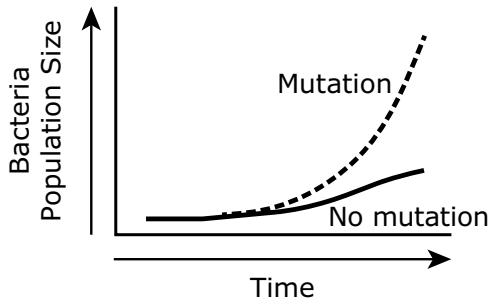

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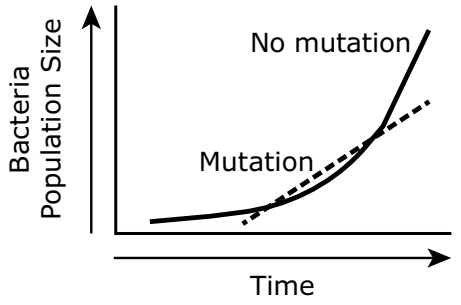

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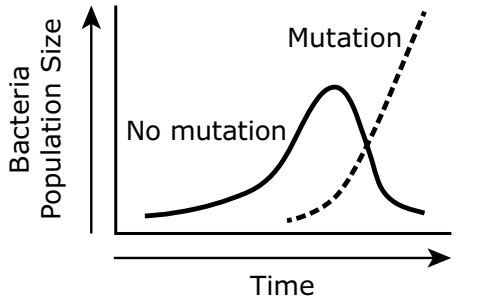


Part B

Which of the following best explains the difference in the numbers of bacteria with and without the mutation in the last diagram?

Ⓐ The bacteria with the mutation move faster than the bacteria without the mutation.

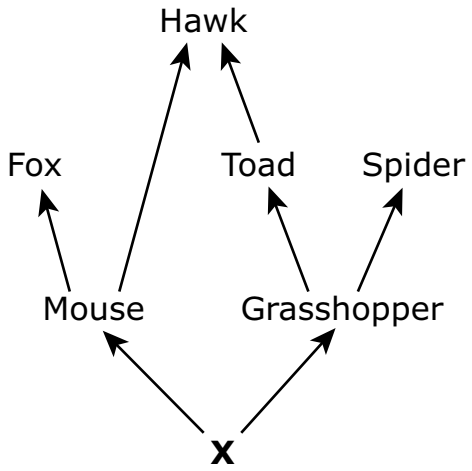
Ⓑ The bacteria with the mutation infect host cells more rapidly than the bacteria without the mutation.

Ⓒ The bacteria with the mutation have a reproductive advantage over the bacteria without the mutation.

Ⓓ The bacteria with the mutation have double the number of genes as the bacteria without the mutation.

This question has two parts. Be sure to label each part of your response.

42 A part of a food web for an ecosystem is shown. One of the organisms is labeled **X**.



A. Identify whether the organism labeled **X** in the food web is a decomposer, primary consumer, producer, or secondary consumer.

B. Identify the organism in the food web whose population size would likely **decrease** the most if the mouse population became extinct. Explain your reasoning.

42

High School Biology
Spring 2025 Released Operational Items

PBT Item No.	Page No.	Reporting Category	Standard	Science Practice Category	Item Type*	Item Description	Correct Answer (SR)**
1	3	*Heredity*	HS.LS.3.2	None	SR	Explain how a mutation that causes a condition most likely was introduced into a population.	A
2	3	*Molecules to Organisms*	HS.LS.1.2	None	SR	Describe a problem that results when fluid accumulates in alveoli.	D
3	4	*Ecology*	HS.LS.2.5	C. Evidence, Reasoning, and Modeling	SR	Use a carbon cycle model to determine which actions store or release carbon.	A,C
4	5	*Heredity*	HS.LS.3.1	None	SR	Describe what happens during fertilization.	B
5	5	*Molecules to Organisms*	HS.LS.1.3	None	SR	Describe the function of lysosomes in cells.	C
6	6	*Molecules to Organisms*	HS.LS.1.7	B. Mathematics and Data	SR	Describe the importance of oxygen for a marine organism and determine the graph that shows how the amount of carbon dioxide produced by an organism changes as the organism swims underwater.	D;C
7	7	*Heredity*	HS.LS.3.4	C. Evidence, Reasoning, and Modeling	SR	Describe how certain conditions are influenced by the interaction of genetics and the environment.	D
8	7	*Molecules to Organisms*	HS.LS.1.6	C. Evidence, Reasoning, and Modeling	SR	Identify a type of organic molecule based on the chemical structure of its monomer.	B
9	8	*Molecules to Organisms*	HS.LS.1.2	C. Evidence, Reasoning, and Modeling	SR	Determine which organ is directly affected by a specific hormone.	B
10	8	*Heredity*	HS.LS.3.1	B. Mathematics and Data	SR	Calculate the approximate mass of DNA in a human gamete.	A
11	9	*Molecules to Organisms*	HS.LS.1.1	C. Evidence, Reasoning, and Modeling	SR	Interpret a model to describe the purpose of the cellular process it represents.	D
12	11	*Ecology*	HS.LS.2.7	C. Evidence, Reasoning, and Modeling	SR	Explain how an introduced plant most likely affected native plants.	A
13	11	*Ecology*	HS.LS.2.1	C. Evidence, Reasoning, and Modeling	SR	Interpret a food web to explain how a change in the population of one organism affected the population of a different organism.	B
14	12	*Evolution*	HS.LS.4.5	C. Evidence, Reasoning, and Modeling	SR	Explain a change in the genetic diversity of a population over a specific time period.	C
15	13	*Ecology*	HS.LS.2.4	B. Mathematics and Data	SR	Identify an energy pyramid based on a food web and calculate the percentage of energy stored in the trophic level of a specific population.	A;C
16	14–15	*Ecology*	HS.LS.2.7	C. Evidence, Reasoning, and Modeling	CR	Explain how the reintroduction of a species affected a native species, describe one way an ecosystem benefited from the removal of an invasive species, explain how removing the invasive species affected the native species, and explain how an action humans could take could help the native species.	

PBT Item No.	Page No.	Reporting Category	Standard	Science Practice Category	Item Type*	Item Description	Correct Answer (SR)**
17	16	*Evolution*	HS.LS.4.4	A. Investigations and Questioning	SR	Determine what information about a species of bacteria would help scientists estimate how quickly the bacteria could adapt to an environmental change.	A,E
18	16	*Molecules to Organisms*	HS.LS.1.1	C. Evidence, Reasoning, and Modeling	SR	Identify a model that shows the molecules and processes involved in protein synthesis.	D
19	17	*Heredity*	HS.LS.3.1	None	SR	Interpret given information to determine the cellular process in which crossing over occurs.	B
20	18–19	*Evolution*	HS.LS.4.5	B. Mathematics and Data	CR	Identify environmental factors that could result in differences in plant height, describe evidence from an investigation to show if genetics plays a role in plant height, identify the process that causes adaptations, and describe an investigation to determine if two populations are the same species.	
21	20–21	*Heredity*	HS.LS.3.3	B. Mathematics and Data	CR	Identify genotypes of a phenotype, complete a Punnett square of a given cross, determine the percentage of offspring with the phenotype, and explain why the frequency of alleles for the phenotype would be more or less common in a certain environment.	
22	23	*Molecules to Organisms*	HS.LS.1.3	None	SR	Interpret given information to explain how homeostasis helps to regulate body temperature.	D
23	23	*Evolution*	HS.LS.4.1	C. Evidence, Reasoning, and Modeling	SR	Analyze a cladogram to determine when a trait was first observed.	C
24	24	*Molecules to Organisms*	HS.LS.1.3	C. Evidence, Reasoning, and Modeling	SR	Explain the expected outcome of an investigation involving the passive transport of water molecules across a membrane.	A;C
25	25–26	*Heredity*	HS.LS.3.3	B. Mathematics and Data	SR	Use a data table to determine the pattern of inheritance for a trait and the fraction of offspring that are expected to inherit a specific phenotype for a given cross.	A;B
26	27	*Evolution*	HS.LS.4.2	C. Evidence, Reasoning, and Modeling	SR	Describe the role of natural selection in favoring a specific trait in an area where the geographic ranges of two similar species overlap.	D
27	28	*Heredity*	HS.LS.3.2	C. Evidence, Reasoning, and Modeling	SR	Interpret a model to identify a cellular process and describe an outcome of the process.	C;B
28	29	*Molecules to Organisms*	HS.LS.1.6	C. Evidence, Reasoning, and Modeling	SR	Complete a model to identify the monomers that make up macromolecules involved in protein synthesis.	A
29	30	*Heredity*	HS.LS.3.3	B. Mathematics and Data	SR	Determine the probability of an organism to inherit a specific trait.	C
30	30	*Molecules to Organisms*	HS.LS.1.5	None	SR	Identify where a tree obtains most of the carbon necessary for growth.	A

PBT Item No.	Page No.	Reporting Category	Standard	Science Practice Category	Item Type*	Item Description	Correct Answer (SR)**
31	30	*Evolution*	HS.LS.4.5	None	SR	Determine which situation most likely led to speciation as a result of geographic isolation.	A
32	31	*Heredity*	HS.LS.3.4	A. Investigations and Questioning	SR	Describe how a hypothesis about an herbivore affecting gene expression in plants could be supported with a comparison of the plants.	C
33	33	*Molecules to Organisms*	HS.LS.1.1	None	SR	Determine where a mutation may occur in a cell and what resulting molecule is changed during transcription.	A;D
34	34	*Heredity*	HS.LS.3.1	C. Evidence, Reasoning, and Modeling	SR	Identify a model that shows how a zygote forms.	D
35	35	*Molecules to Organisms*	HS.LS.1.4	None	SR	Interpret a data table to determine how a mutation that reduces DNA replication would affect cells with the mutation.	D
36	36–37	*Molecules to Organisms*	HS.LS.1.7	C. Evidence, Reasoning, and Modeling	SR	Determine which model shows how oxygen is used by an organism, identify the cellular process oxygen supports, and identify another reactant needed for that process.	B;D
37	38–39	*Molecules to Organisms*	HS.LS.1.2	C. Evidence, Reasoning, and Modeling	CR	Describe what would most likely happen to an organism with a mutation that affects the esophagus, describe how an organism's blood would be affected by mutations in the small intestine and liver, and explain the reasoning for each description.	
38	40	*Molecules to Organisms*	HS.LS.1.6	None	SR	Determine the evidence needed to determine that a soil sample contains the remains of organisms.	C
39	40	*Evolution*	HS.LS.4.1	None	SR	Describe how a diverse group of organisms can produce proteins with almost identical amino acid sequences.	C
40	41	*Molecules to Organisms*	HS.LS.1.5	A. Investigations and Questioning	SR	Analyze the setup of an investigation to determine the purpose of the investigation, the process involved, and the products measured.	A
41	42–43	*Evolution*	HS.LS.4.4	B. Mathematics and Data	SR	Use information to determine which graph best represents changes in a population of bacteria over time and explain a difference between bacteria in the population after time has passed.	B;C
42***	44–45	*Ecology*	HS.LS.2.4	C. Evidence, Reasoning, and Modeling	CR	Interpret a food web to determine the trophic level of an organism and explain why a population would be most affected if another population became extinct.	

* Science item types are: selected-response (SR) and constructed-response (CR).

** Answers are provided here for selected-response items only. Sample responses and scoring guidelines for constructed-response items will be posted to the Department's website later this year.

*** The 2025 Biology test results were reported with item 42 as a two-point item instead of a four-point item. DESE excluded two parts due to irregularities found during scoring. These parts did not count toward any student's score.