

# Tennessee Comprehensive Assessment Program TCAP

## Biology Practice Test



*Please PRINT all information in the box.*

Student Name: \_\_\_\_\_

Teacher Name: \_\_\_\_\_

School: \_\_\_\_\_

District: \_\_\_\_\_

**All practice test items represent the appropriate grade level/content standards—however, the practice test may contain item types that no longer appear on the operational assessment.**



**Directions**

Read the sample and mark the correct answer.

**Hair samples were gathered from five people. A single hair was selected randomly from one of the samples and was marked as an unknown sample. Gel electrophoresis was run from the DNA of each of the five samples.**

Unknown Sample	Sample #1	Sample #2	Sample #3	Sample #4

Which sample is from the person who is most closely related to the person who was selected for the unknown sample?

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



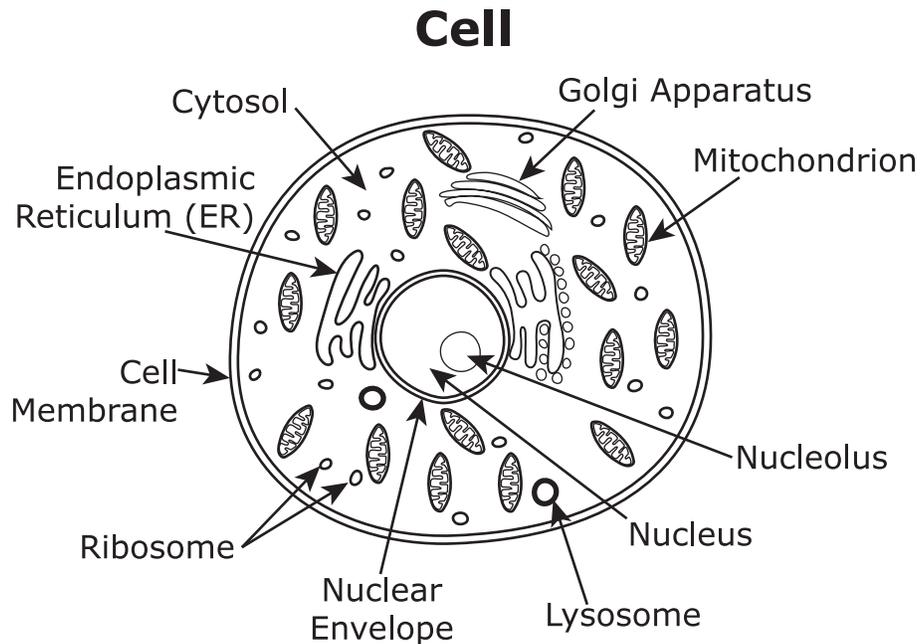
**Do not go on to the next page until told to do so.**

- 1. Which change in DNA will cause a heritable germline mutation?**
- A.** The sugar phosphate backbone of DNA in bone cells breaks due to exposure to X-rays.
  - B.** Thymine dimers form in the DNA of a skin cell due to exposure to UV light.
  - C.** A DNA replication error occurs in a sperm-producing cell.
  - D.** An error occurs during transcription of the DNA in a liver cell.

2. A student is investigating how substrate concentration affects the rate of an enzyme-catalyzed reaction. Which three variables should be kept constant in the setup of the student's investigation?
- M. temperature of the reaction
  - P. amount of enzyme
  - R. amount of substrate
  - S. amount of product
  - T. pH of the reaction

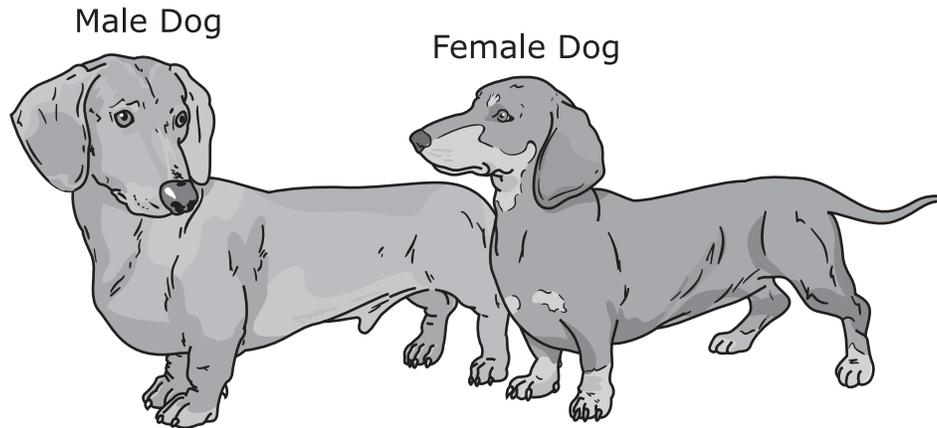
- 3. Tupai is part of the Leeward Islands. For years, people were not allowed on this island. Recently, it has been opened to tourists. How will increased development and human interactions likely affect succession on this island?**
- A.** Lichens will increase quickly, creating a climax community.
  - B.** Mature trees will decrease, creating a pioneer community.
  - C.** Biodiversity will decrease as the number of species decreases.
  - D.** More diverse species will move into the area as biodiversity increases.

4. A cell model is shown. Students were instructed to review the types and number of structures that are present in this cell model.



Which three cell types could be represented by the model?

- M.** human stem cell
- P.** plant xylem cell
- R.** bacterial cell
- S.** sea urchin embryo cell
- T.** mammalian white blood cell

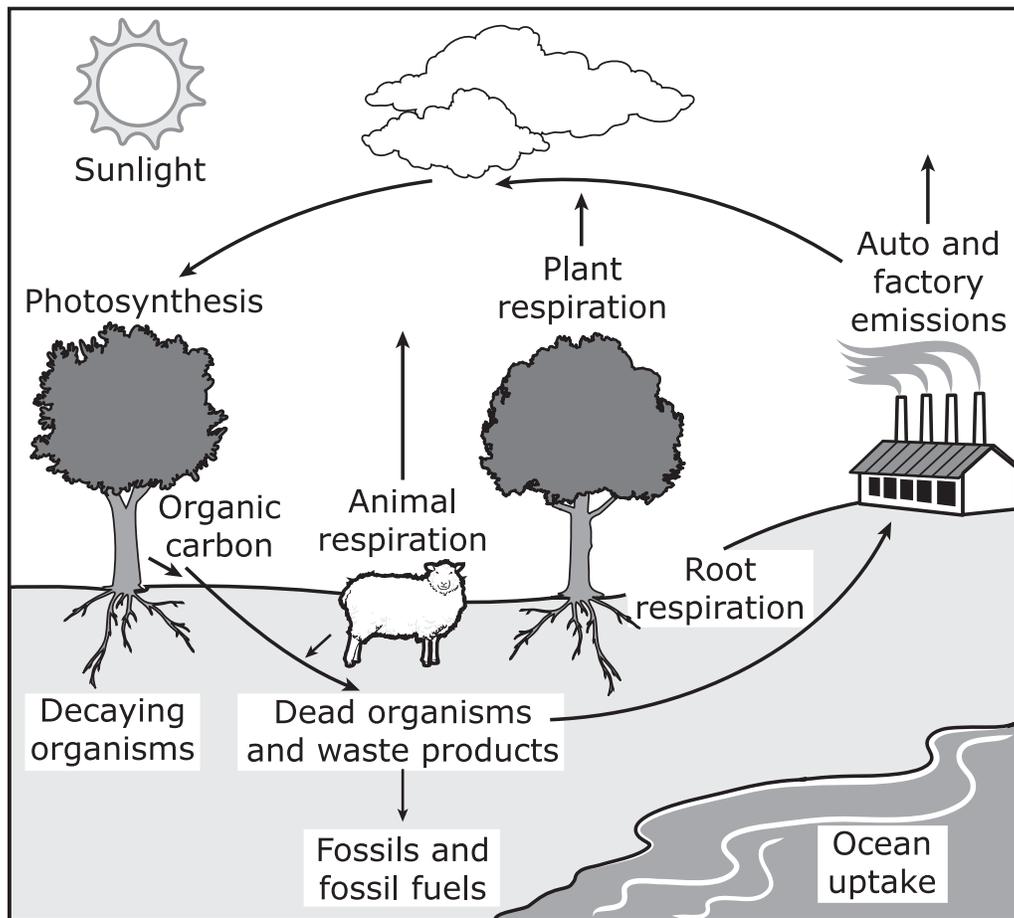
**5. Two dogs are shown.**

**Which claim about reproduction in dogs can best be supported using a valid argument?**

- A.** Offspring produced by sexual reproduction are genetically identical.
- B.** Gametes from both dogs are needed to maintain the correct number of chromosomes in the offspring.
- C.** Phenotypic variation will occur in the offspring as a result of mitosis in the gametes.
- D.** Binary fission is required for sexual and asexual reproduction in dogs.

6. This diagram illustrates the carbon cycle.

## Carbon Cycle



**Which change would lead to higher carbon dioxide levels in the atmosphere?**

- M.** an increase in photosynthesis
- P.** a decrease in animal respiration
- R.** an increase in the burning of fossil fuels
- S.** a decrease in the destruction of forests

Questions 7 – 10 refer to the passage(s) and image(s) shown.

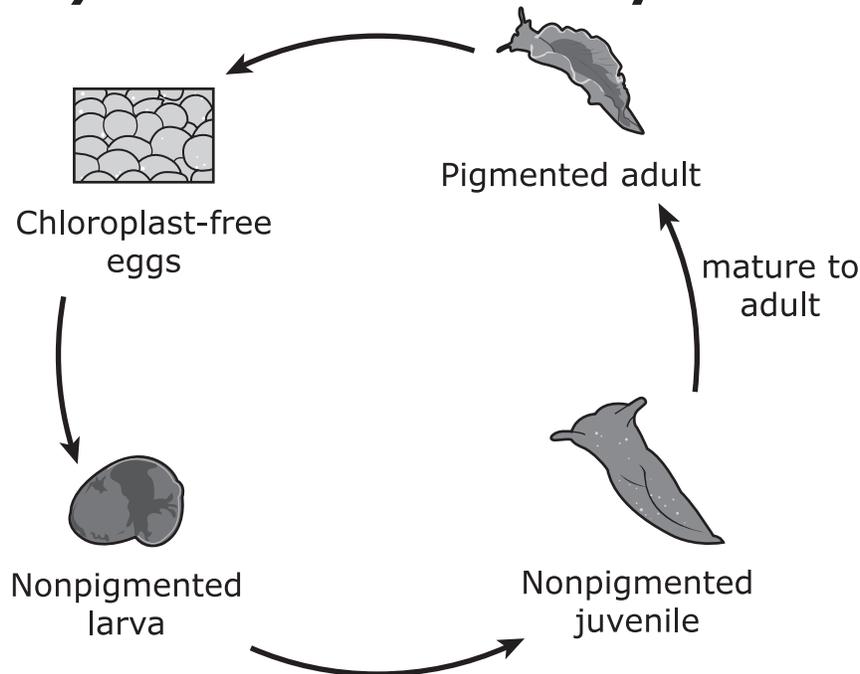
## Photosynthetic Slugs – Part 1

The green sea slug, *Elysia chlorotica*, is a soft-bodied marine animal that lives off the eastern coast of North America in the Atlantic Ocean. The green sea slug feeds on algae. It is able to use chloroplasts from the algae, *Vaucheria litorea*, to perform photosynthesis and produce its own food. A young green sea slug is able to survive for nine months after feeding one time on *V. litorea*.

It has been hypothesized that as the green sea slug feeds on *V. litorea*, it takes the chloroplasts from the algae. For the chloroplasts to continue working in the green sea slug, the green sea slug incorporates the algal genes that are needed to perform photosynthesis into its own DNA. This allows the green sea slug to produce the proteins needed for the chloroplasts to continue working due to common ancestry.

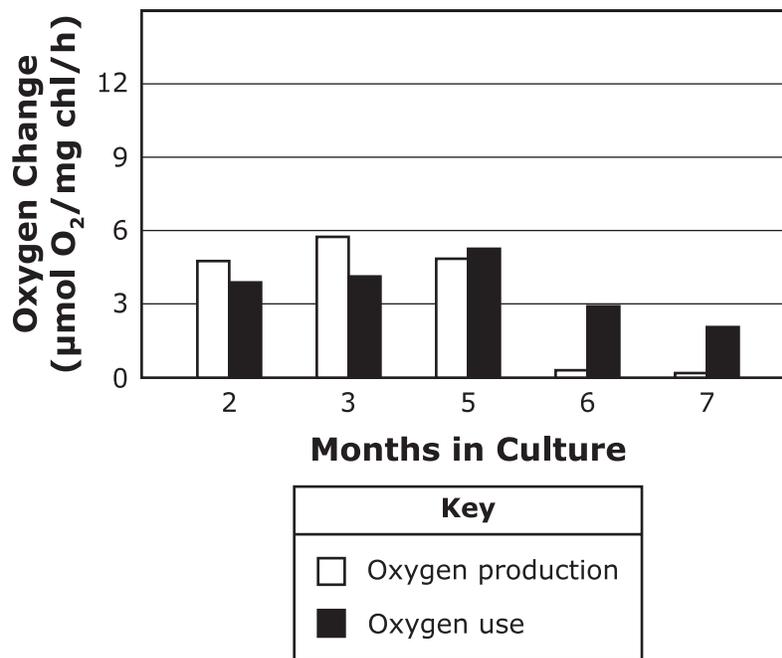
A diagram of the life cycle for *E. chlorotica* is shown.

### *Elysia chlorotica* Life Cycle



To investigate the slugs' ability to survive without food, researchers measured oxygen dynamics in mature *E. chlorotica* in culture after they had fed on *V. litorea*. The results of the investigation are shown in the graph.

## Oxygen Dynamics in Cultured *E. chlorotica*



**7. Which statement best explains how the green sea slug is able to produce its own food?**

- A.** The slug is able to convert the oxygen needed for cellular respiration into glucose in the chloroplasts.
- B.** The slug is able to store the algae within its body and use the glucose produced by the algae for cellular respiration.
- C.** The slug is able to use the chloroplasts to make glucose molecules that it then uses for cellular respiration.
- D.** The slug is able to perform cellular respiration to provide the carbon dioxide needed for photosynthesis.

**8. Which property would give the green sea slug the capability to incorporate the genes of *V. litorea* into its own DNA?**

- M.** The green sea slug has the ability to replicate the algal DNA.
- P.** The green sea slug has the ability to change its DNA to match the algal DNA.
- R.** They both have the same number of chromosomes in their DNA.
- S.** They both use the same nucleotides in their DNA.

9. In the investigation of oxygen dynamics in *E. chlorotica* cultures, gross photosynthesis is reported after seven months in culture, even in the apparent absence of oxygen production.

Which statement provides the best reasoning to explain this observation?

- A. The oxygen produced in photosynthesis is used in cellular respiration.
  - B. Photosynthesis can be sustained in the absence of oxygen production.
  - C. The plastids store oxygen for use in photosynthesis.
  - D. The ability to carry out photosynthesis is transferred from the chloroplast to the mitochondria.
10. Based on the model of the *E. chlorotica* life cycle, at which stage is the organism most likely capable of carrying out photosynthesis?
- M. throughout its entire life cycle
  - P. as a larva
  - R. as a nonpigmented juvenile
  - S. as a pigmented adult

Questions 11 and 12 refer to the passage(s) and image(s) shown.

## Photosynthetic Slugs – Part 2

The algae *Vaucheria litorea* are able to carry out photosynthesis; however, isolated chloroplasts from *V. litorea* are not. Researchers have determined that the DNA within the chloroplasts contains the genes required for photosynthesis. Many of the additional genes needed to sustain chloroplast function are located in the nucleus. To investigate the genetic requirements for chloroplast function in the green sea slug, *Elysia chlorotica*, researchers sequenced the *psbO* gene found in *V. litorea*. The *psbO* gene encodes for part of the water-splitting complex in the light-dependent reaction during photosynthesis. The researchers then determined which cells, cell parts, and developmental stage of the green sea slug, if any, also contain this gene. The data from their investigation are shown in the table.

### Presence of *psbO* Gene in *V. litorea* and *E. chlorotica* Cells

Organism	Area Studied	<i>psbO</i> DNA Sequence Present?
<i>V. litorea</i>	Whole cell	Yes
<i>V. litorea</i>	Nucleus	Yes
<i>V. litorea</i>	Chloroplast	No
<i>V. litorea</i>	Mitochondria	No
<i>E. chlorotica</i>	Eggs	Yes
<i>E. chlorotica</i>	Larvae	Yes
<i>E. chlorotica</i>	Mature adult	Yes
<i>E. chlorotica</i>	Nucleus	Yes
<i>E. chlorotica</i>	Mitochondria	No
<i>E. chlorotica</i>	Cytoplasm	No

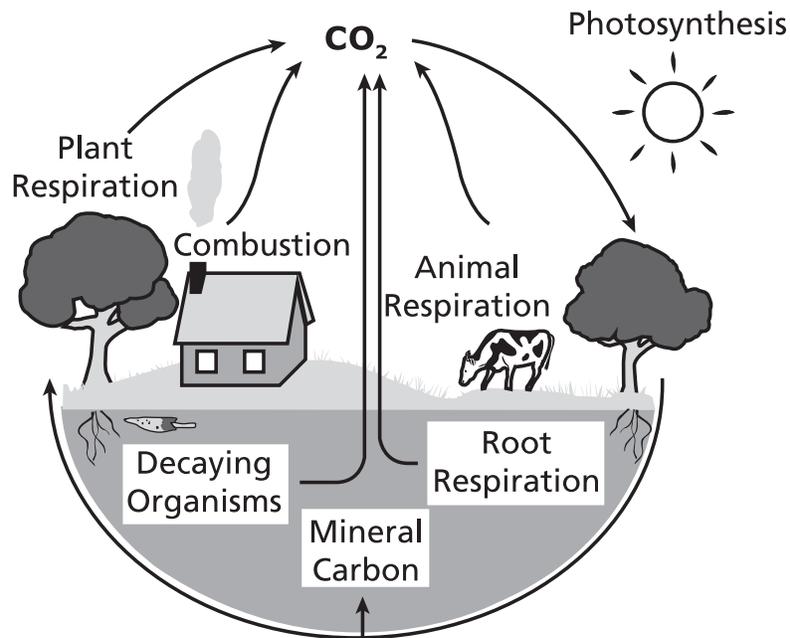
**11. Which claim is most consistent with the evidence that *psbO* DNA sequences are detected in *E. chlorotica* eggs?**

- A.** The *psbO* gene is transferred from *V. litorea* when it is consumed by *E. chlorotica*.
- B.** The *psbO* gene was transferred from *V. litorea* to a recent ancestor of *E. chlorotica*.
- C.** The *psbO* gene independently evolved in response to selective pressure in an ancestor of *E. chlorotica*.
- D.** The *psbO* gene is present in all organisms belonging to the same phylogenetic clade as *E. chlorotica*.

**12. Which statement correctly uses the data from the table to support a claim that nuclear genes support chloroplast function in *V. litorea*?**

- M.** *psbO* DNA sequences are detected in the nucleus but not in chloroplasts.
- P.** *psbO* mRNA is present in the cytoplasm.
- R.** *psbO* sequences are found in many photosynthetic organisms.
- S.** *psbO* sequences in *V. litorea* and *E. chlorotica* are very similar.

13. An image of the carbon cycle is shown.

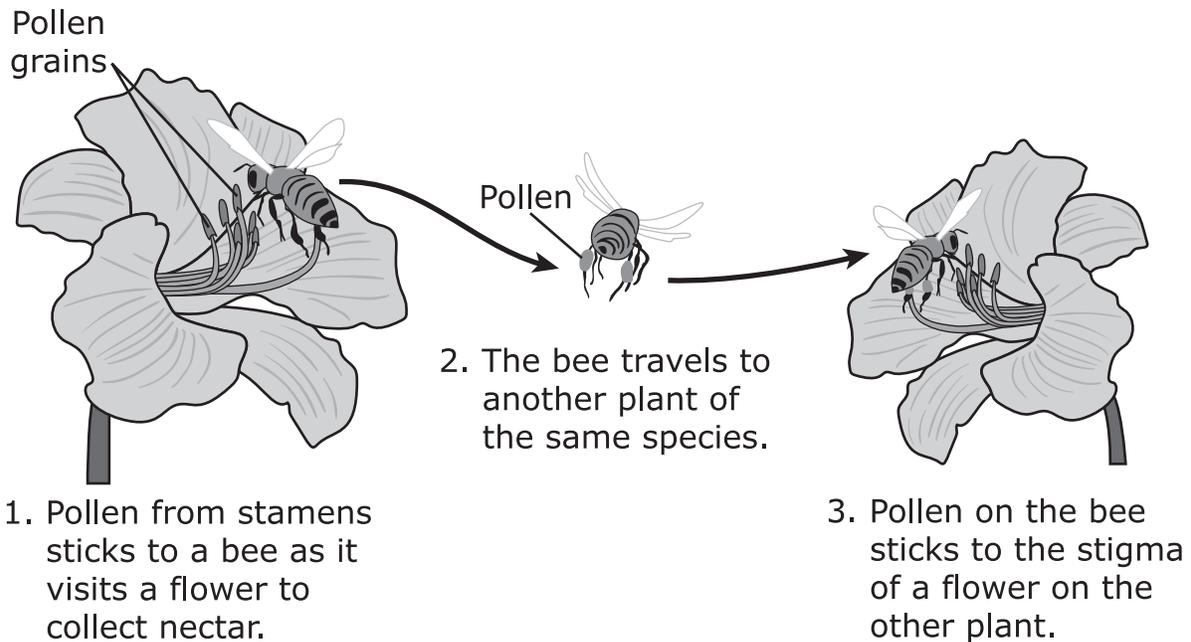


**Which action could lead to a reduction in atmospheric carbon?**

- A.** using coal to power a factory
- B.** burning logs in a fireplace
- C.** animals eating mushrooms in a field
- D.** humans planting trees in a forest

14. A model of a bee pollinating a flower is shown.

## Cross-Pollination

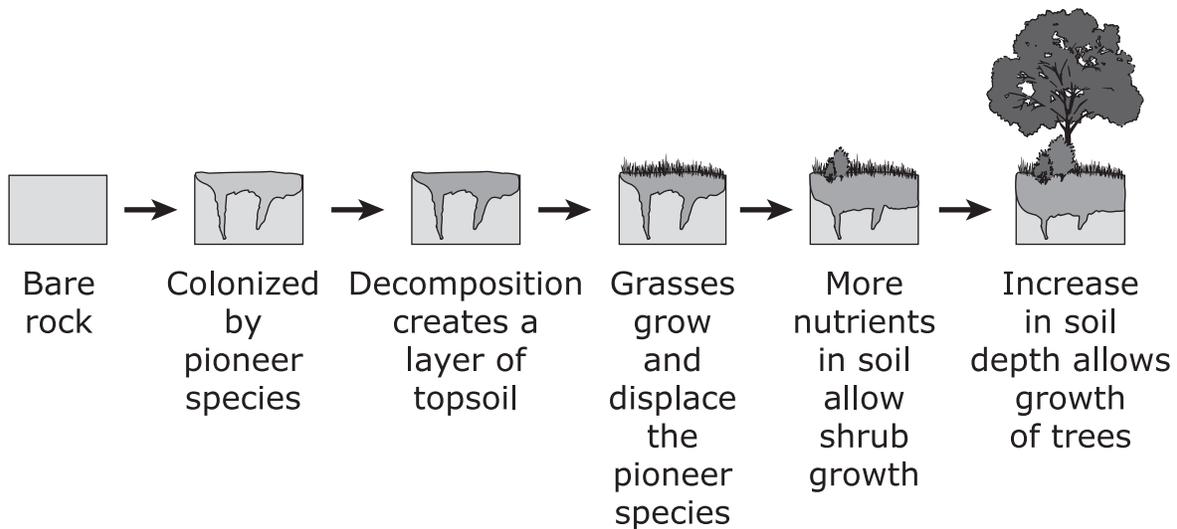


**Bees cross-pollinate flowers when moving from flower to flower to obtain nectar. Bees use the collected nectar to create honey. Which three ecosystem services are best represented by this model?**

- M.** provisioning services: goods provided by or produced by ecosystems
- P.** regulating services: benefits obtained from regulation of ecosystem services
- R.** cultural services: nonmaterial benefits from ecosystems
- S.** supporting services: services necessary for production of other ecosystem services
- T.** land use: clearing land for human housing development

15. A model of ecological succession is shown.

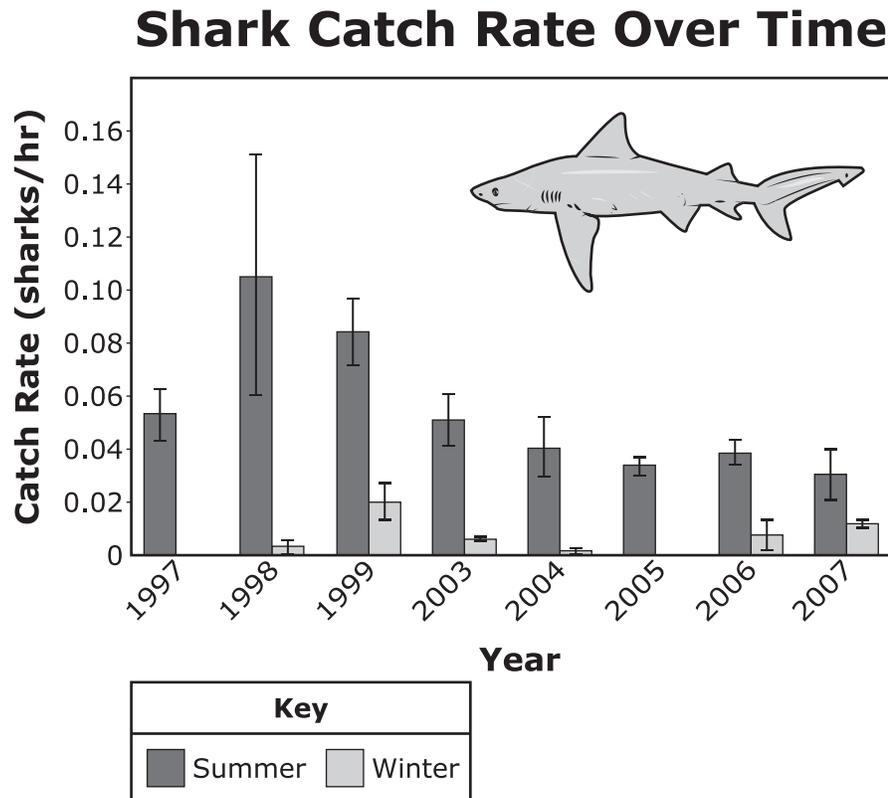
## Ecological Succession



Which two natural events would lead to this type of succession?

- A. clear-cutting of a forest
- B. wind damage from a tornado
- C. lava flow from a volcano
- D. flooding with soil erosion
- E. retreat of a glacier

16. The graph shows the average catch rates per hour of tiger sharks for various years between 1997 and 2007 in the Shark Bay ecosystem.



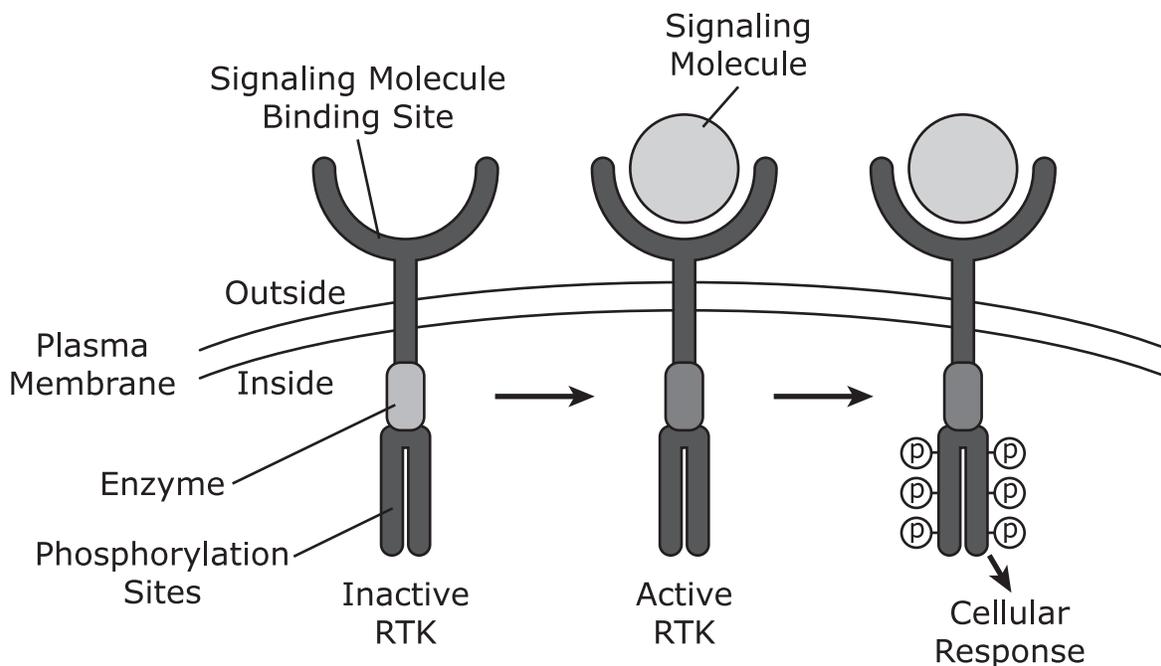
Which claim about the shark population is best supported using the data?

- M.** More people fish for sharks in the winter than in the summer.
- P.** Sharks have larger body sizes during the summer than during the winter.
- R.** Sharks migrate northward from Shark Bay during the summer to maintain a low body temperature.
- S.** The population of sharks in Shark Bay is larger in the summer than in the winter.

17. Which three processes occur during meiosis?

- A. crossing over
- B. asexual reproduction
- C. formation of gametes
- D. independent assortment
- E. production of diploid cells

18. Receptor tyrosine kinases (RTKs) are a class of membrane receptor that, when bound by a specific signaling molecule, will enzymatically phosphorylate itself and initiate a response in the cell. A model representing RTK activation is shown.



A researcher is planning an experiment to engineer a nonfunctional version of an RTK. Which engineered protein will most likely be a nonfunctional RTK?

- M. an RTK protein with a second enzyme region in the cytosolic portion of the protein
- P. an RTK protein that can phosphorylate itself even in the absence of the signaling molecule
- R. an RTK protein that is unable to bind to the signaling molecule
- S. an RTK protein that has multiple phosphorylation sites

19. A removal of a dam in a river has restored river flow and improved the water quality of the river. Which of these would most directly increase due to the enhanced water quality in the river ecosystem?
- A. pollution
  - B. biodiversity
  - C. death rates
  - D. global climate change

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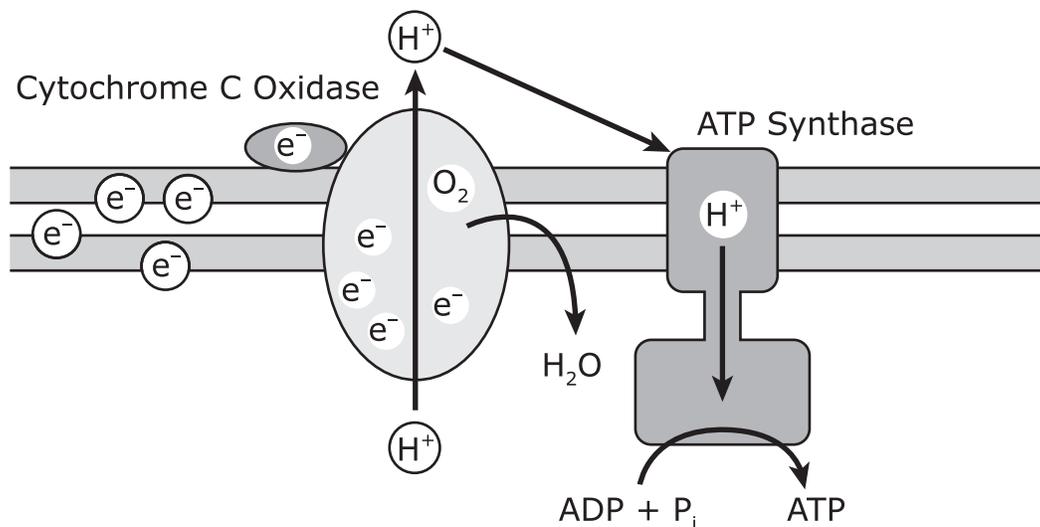
Questions 20 – 22 refer to the passage(s) and image(s) shown.

## Cyanogenic Clover – Part 1

White clover plants have the ability to produce the toxin cyanide under certain conditions. One hypothesis proposes that producing cyanide protects plants from herbivores such as insects, slugs, snails, and small mammals. When herbivores consume cyanide, it interferes with the ability of the mitochondrion to use oxygen during cellular respiration.

Cytochrome c oxidase is a protein that is embedded in the inner membrane of the mitochondrion. In the absence of cyanide, cytochrome c oxidase receives electrons in the electron transport chain. The electrons are joined with oxygen and hydrogen to make water. Some hydrogen ions are also pumped out to be used by the protein ATP synthase to create ATP. The diagram shows the movement of ions across the inner membrane of the mitochondrion.

### Inner Membrane of the Mitochondrion



20. Based on the inner membrane of the mitochondria, which model correctly represents the effect of cyanide on cellular respiration in herbivores that eat clover plants?

- M.** Sugars → Mitochondria → ~~X~~ Carbon Dioxide (CO<sub>2</sub>)  
 Oxygen (O<sub>2</sub>) → Mitochondria → Water (H<sub>2</sub>O)  
 ADP + (P<sub>i</sub>) → Mitochondria → ATP
- P.** Sugars → Mitochondria → Carbon Dioxide (CO<sub>2</sub>)  
 Oxygen (O<sub>2</sub>) → Mitochondria → ~~X~~ Water (H<sub>2</sub>O)  
 ADP + (P<sub>i</sub>) → Mitochondria → ~~X~~ ATP
- R.** Sugars → Mitochondria → Carbon Dioxide (CO<sub>2</sub>)  
 Oxygen (O<sub>2</sub>) → Mitochondria → ~~X~~ Water (H<sub>2</sub>O)  
 ADP + (P<sub>i</sub>) → Mitochondria → Decreased ATP Concentration
- S.** Sugars → Mitochondria → ~~X~~ Carbon Dioxide (CO<sub>2</sub>)  
 Oxygen (O<sub>2</sub>) → Mitochondria → Water (H<sub>2</sub>O)  
 ADP + (P<sub>i</sub>) → Mitochondria → Increased ATP Concentration

**21. Which statement best describes how sugars are metabolized in herbivores that eat clover containing high levels of cyanide?**

- A.** Fermentation and the Krebs cycle metabolize sugars and produce sufficient ATP to sustain life.
- B.** Aerobic respiration and photosynthesis partially metabolize sugars and store metabolic intermediates until the levels of cyanide are reduced.
- C.** Glycolysis metabolizes sugars more efficiently than it does in the absence of cyanide and produces the normal amount of ATP per sugar molecule.
- D.** Glycolysis and fermentation metabolize sugars but do not produce sufficient ATP to sustain life.

**22. Which statement describes the likely metabolic impact of cyanide production on clover plants?**

- M.** Cyanide is nontoxic to clover plants because they produce ATP without the electron transport in the mitochondria.
- P.** Cyanide is toxic to clover plants because they use cytochrome c oxidase for electron transport in the mitochondria.
- R.** Cyanide is toxic to clover plants because they use cytochrome c oxidase for ATP synthesis in the chloroplasts.
- S.** Cyanide is nontoxic to clover plants because they carry out electron transport in chloroplasts rather than in mitochondria.

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Questions 23 – 25 refer to the passage(s) and image(s) shown.

## Cyanogenic Clover – Part 2

In white clover plants, two different genes determine the ability to produce cyanide. Gene *A* determines whether the plant produces precursor molecules from which cyanide is produced. Cyanide precursors are stored in vacuoles in the cytoplasm of clover plant cells. Gene *L* determines whether the plant has the enzyme linamarase, which releases cyanide from precursor molecules. Linamarase is stored between the plasma membrane and the cell wall of clover plant cells. Plants must have dominant alleles of both genes (*A* and *L*) to produce cyanide.

When clover cells are damaged, cyanide precursors are released from the cytoplasm and come into contact with the linamarase outside of the cell membrane. This interaction results in the production of cyanide.

23. Clover plants that are heterozygous for both genes are crossed with clover plants that are homozygous recessive for both genes. They produce 300 seeds.

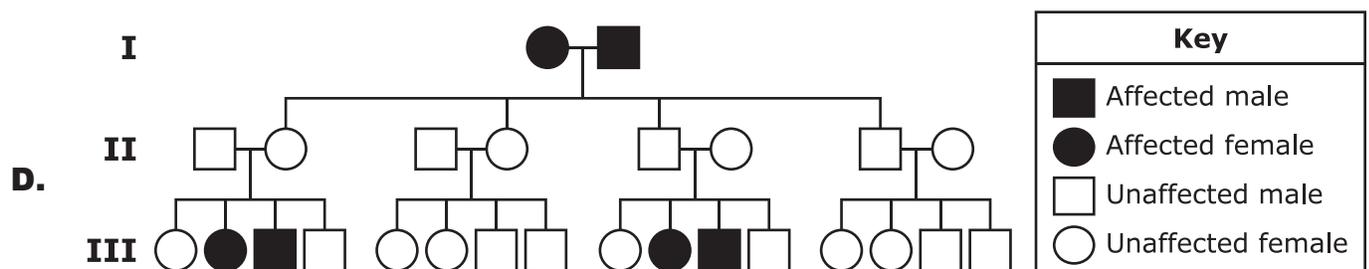
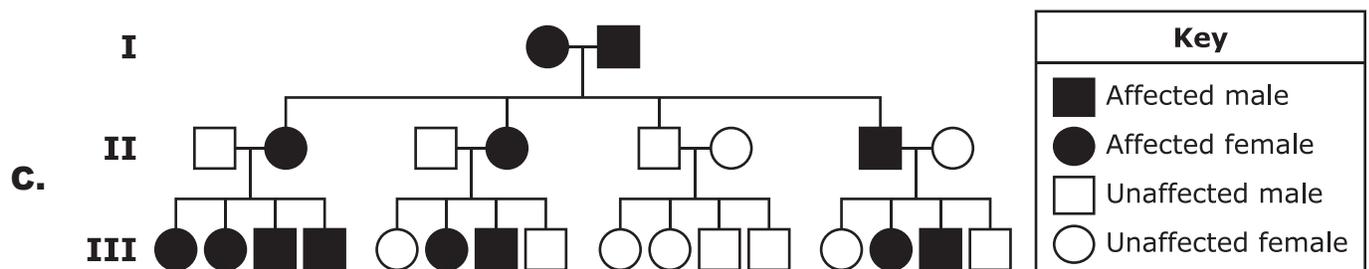
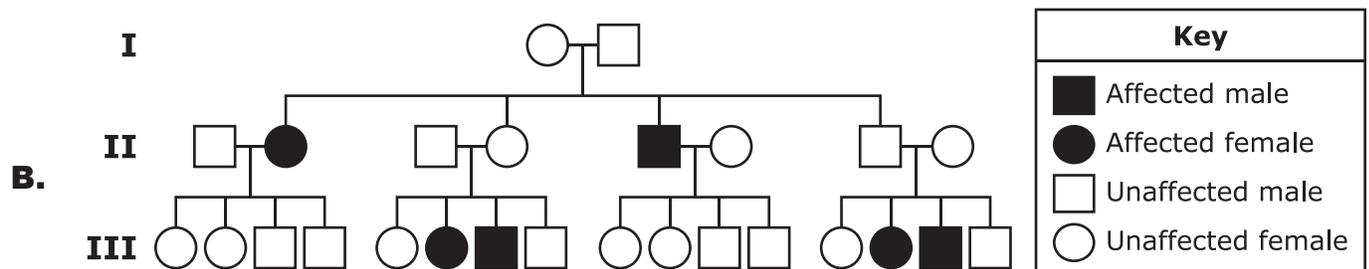
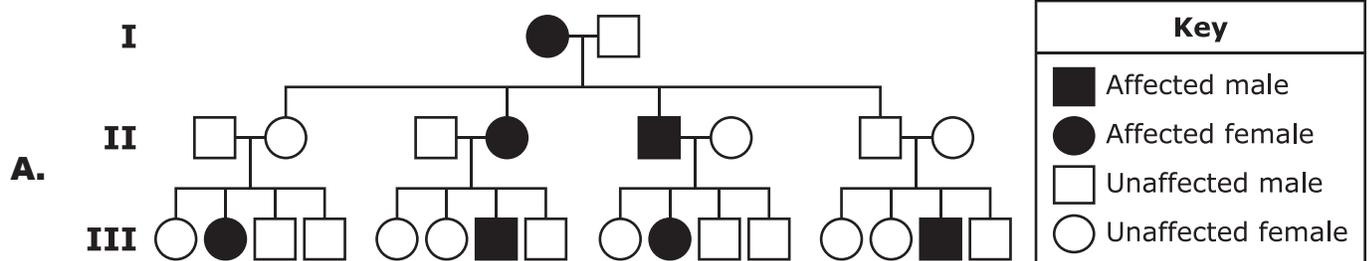
How many seeds can be expected to grow into plants that produce cyanide?

- A. 0
  - B. 75
  - C. 150
  - D. 225
24. In a controlled study, two parental plants are crossed and produce 240  $F_1$  plants. All of the  $F_1$  plants produce the cyanide precursor molecule, but only half of the  $F_1$  plants produce linamarase.

What are the most likely genotypes of the parental plants?

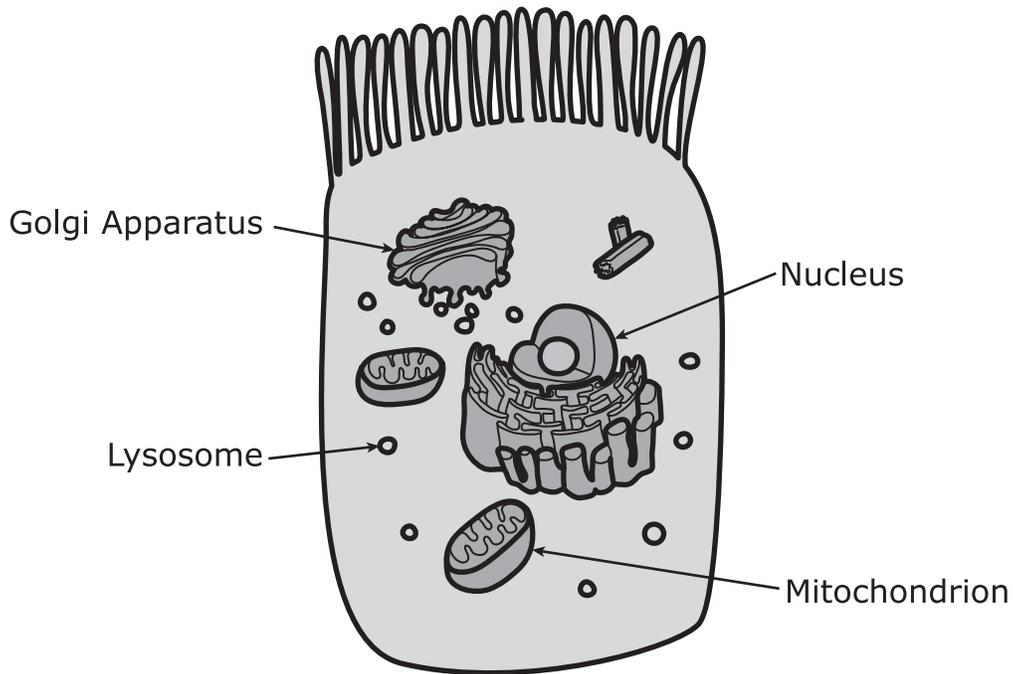
- M. *AALL* and *aall*
- P. *AaLl* and *AaLl*
- R. *Aall* and *aaLl*
- S. *AALl* and *Aall*

25. In the pedigrees shown, each symbol represents an individual clover plant. If the shaded symbols represent plants that produce the enzyme linamarase, which pedigree accurately represents inheritance in clover plants?



26. An intestinal cell is shown.

### Intestinal Cell

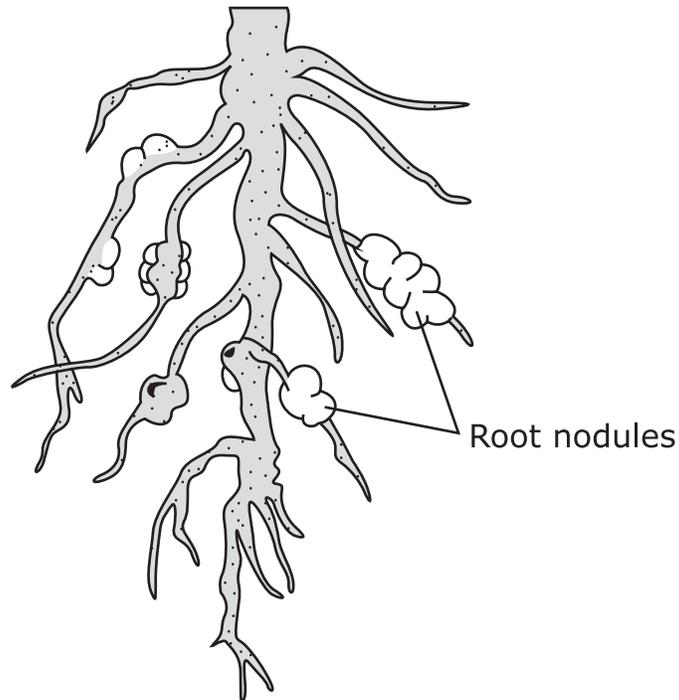


**Cells that line the intestines break down food and absorb nutrients. Which cellular organelle performs a similar function for cells?**

- M.** nucleus
- P.** Golgi apparatus
- R.** lysosome
- S.** mitochondrion

27. Which two viral characteristics provide evidence to support the argument that viruses are more similar to living components than to nonliving components of an ecosystem?
- A. Viruses contain genetic material.
  - B. Viruses are made of cells.
  - C. Viruses use and store energy to grow.
  - D. Viruses reproduce independently.
  - E. Viruses evolve through mutation and natural selection.

28. Legume plants such as beans have a symbiotic relationship with bacteria and form nodules in the roots of the plant that convert atmospheric nitrogen gas into nitrogen compounds the plant can use. The image shows root nodules on a legume plant.



**If root nodules were prevented from forming, which of these would be the most likely impact on the local community?**

- M.** The plants would no longer be able to perform photosynthesis.
- P.** The plants would increase water consumption to compensate for the loss of nitrogen.
- R.** The soil would become depleted of usable nitrogen compounds.
- S.** The concentration of atmospheric nitrogen gas would decrease.

**29. Which three statements correctly describe the roles of RNA molecules in the process of transcription and translation in animal cells?**

- A.** Small RNA molecules in the RNA polymerase catalyze the formation of phosphodiester bonds between nucleotides in the growing messenger RNA.
- B.** Messenger RNA molecules carry genetic information from the gene in the nucleus to the ribosome in the cytoplasm.
- C.** Transfer RNA molecules carry the appropriate amino acid to the growing polypeptide.
- D.** Genomic RNA molecules store genetic information and transmit it to an individual's offspring.
- E.** Ribosomal RNA molecules function in the assembly of the ribosome-mRNA complex and in the formation of peptide bonds between amino acids in the growing polypeptide.

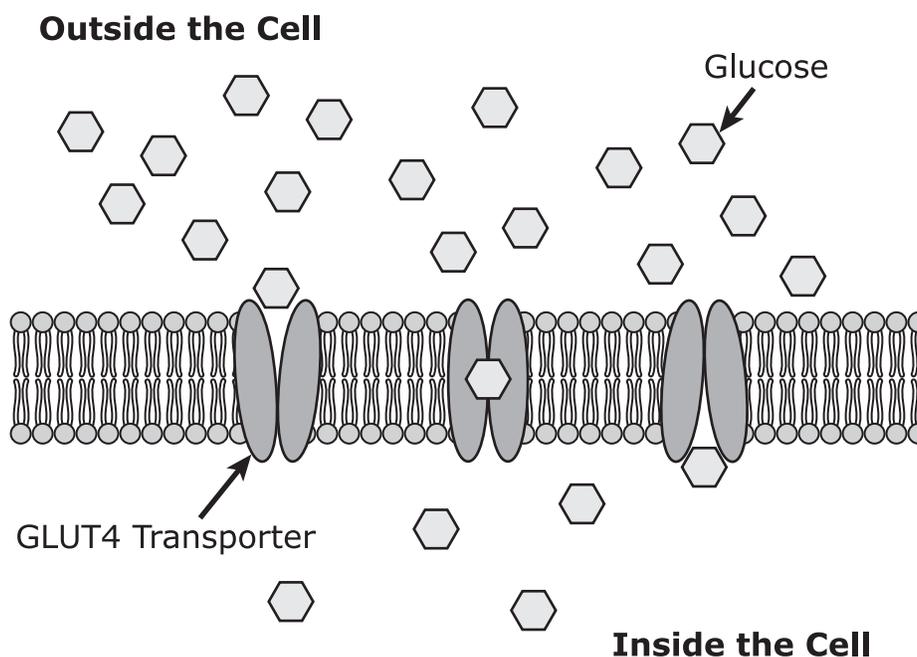
- 30. Scientists sink concrete blocks in oceans to create artificial coral reefs. Which successive event most likely occurs first on this type of coral reef?**
- M.** Algal colonies develop on the reef substrate.
  - P.** Coral polyps attach themselves to the surfaces to grow.
  - R.** Herbivorous fish arrive to graze on autotrophs on the reef.
  - S.** Carnivorous animals return to establish new habitats.

Questions 31 – 34 refer to the passage(s) and image(s) shown.

## Glucose Transport – Part 1

Deer mice rely on other organisms for many nutrients. The food deer mice consume is broken down into smaller particles, absorbed, and distributed throughout their bodies. One of these particles is glucose. Glucose requires specialized molecules such as the GLUT4 transporter to enter cells. Once glucose is in a cell, it can be broken down further to provide energy for the growth, metabolism, and maintenance of individual deer mice. Glucose entering a cell by way of GLUT4 is shown in the model.

### Glucose Transport Into a Cell



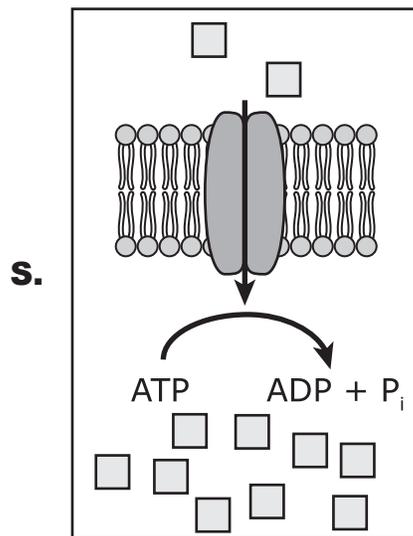
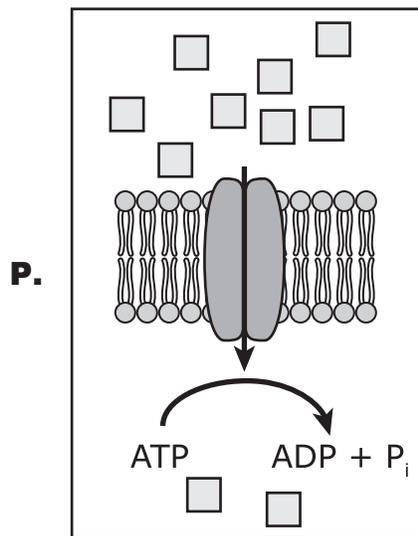
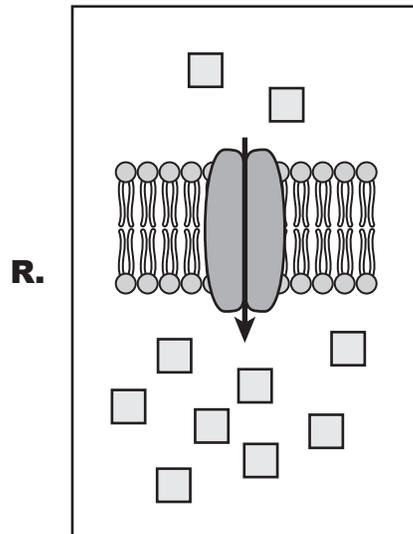
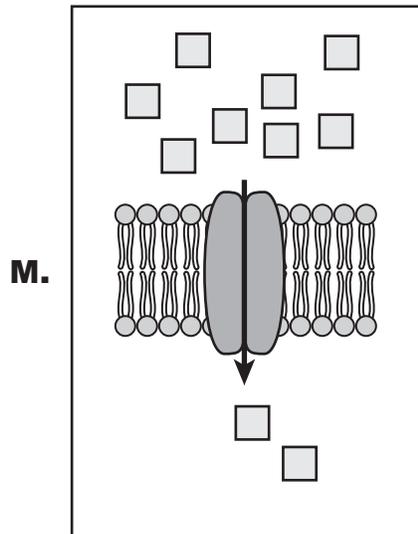
**31. A researcher claims that glucose is moved into cells by facilitated diffusion through the GLUT4 transporter.**

**Based on the model, which statement best supports the researcher's claim?**

- A.** The movement of glucose across the membrane does not require ATP.
- B.** Glucose moves from an area of low concentration to an area of high concentration.
- C.** The glucose molecules diffuse freely through the membrane without a protein channel.
- D.** Glucose provides energy for the protein channel to transport materials across the membrane.

32. Other particles consumed by deer mice, such as calcium, have to move into cells by active transport.

Which diagram correctly shows the movement of particles into the cell by active transport?



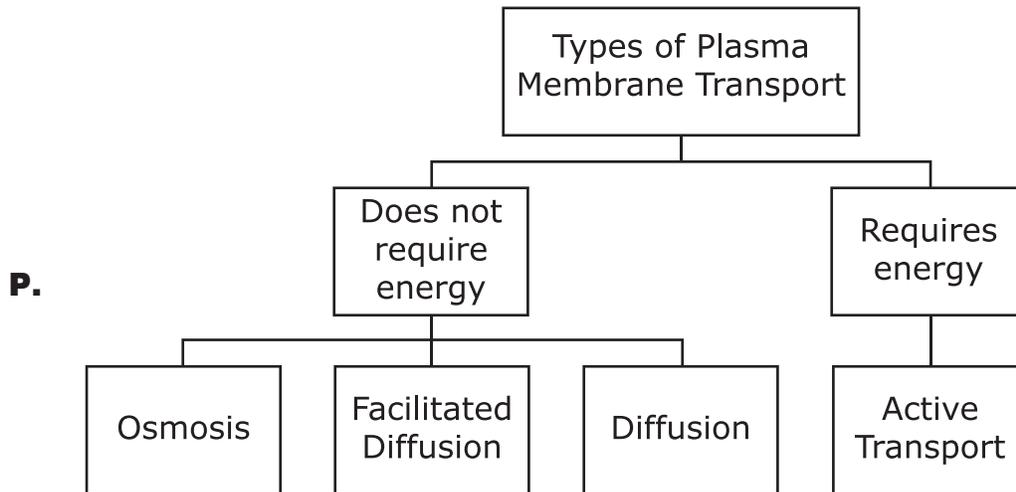
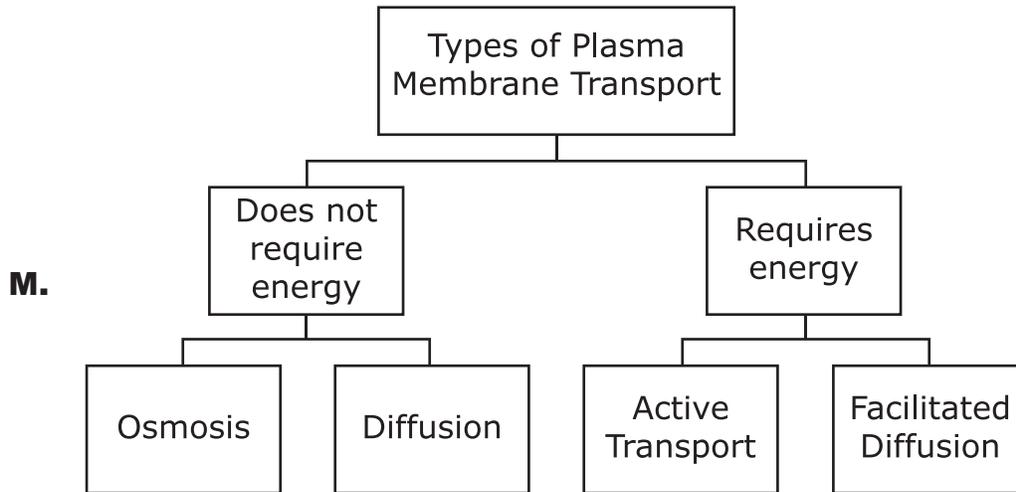
- 33. When glucose is broken down, carbon dioxide is produced, which results in more carbon dioxide inside the cell than outside the cell. The carbon dioxide then diffuses out of the cell.**

**Which statement best describes the movement of carbon dioxide by diffusion?**

- A.** The carbon dioxide can move through the plasma membrane by moving down the concentration gradient.
- B.** Water molecules are needed to move the carbon dioxide across the plasma membrane.
- C.** Peripheral proteins help move the carbon dioxide across the plasma membrane.
- D.** The transport of carbon dioxide through the plasma membrane requires energy from ATP.

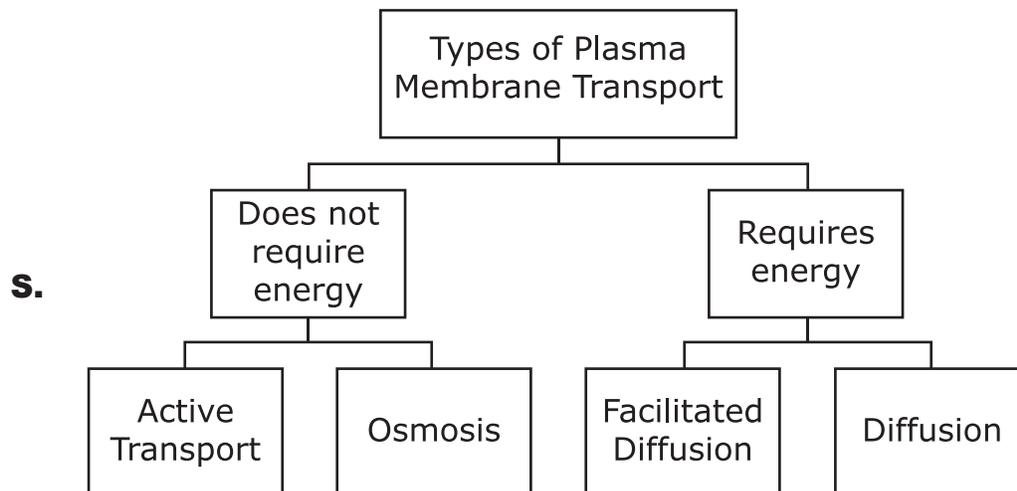
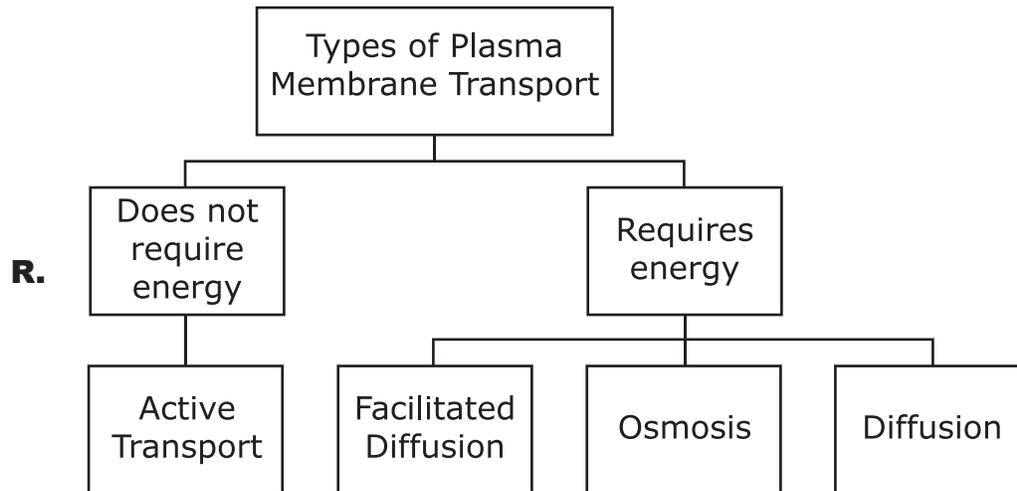
34. Students created flowcharts to show select types of transport that occur across the plasma membrane.

Which flowchart correctly shows the types of plasma membrane transport?



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(Item 34, continued from the previous page)



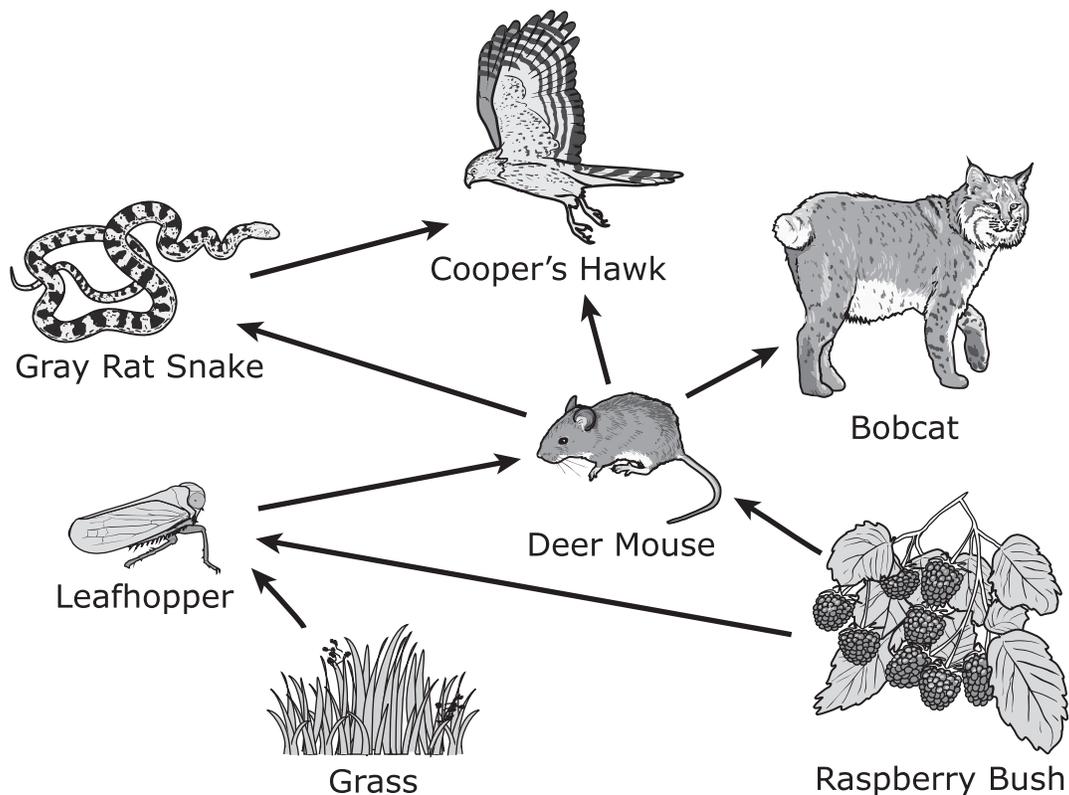
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Questions 35 and 36 refer to the passage(s) and image(s) shown.

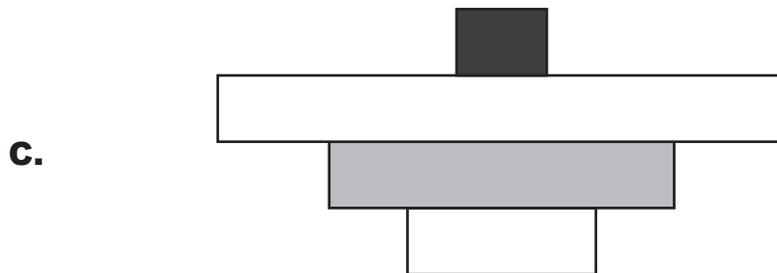
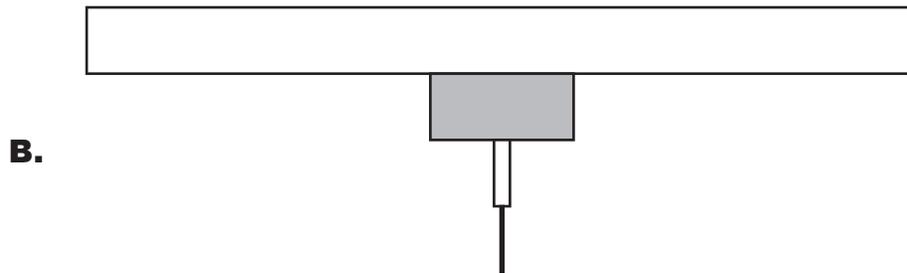
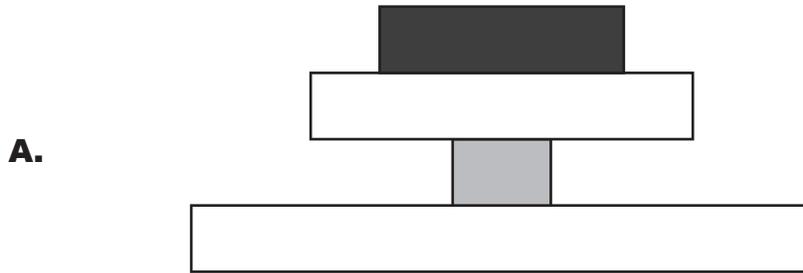
## Glucose Transport – Part 2

Deer mice consume autotrophs and other consumers to receive nutrients such as glucose to live. A group of students was interested in learning how energy is transferred between deer mice and other organisms in central Tennessee. The students created a food web of select organisms living with the deer mice in the same ecosystem. Their model food web is shown.

### Central Tennessee Food Web



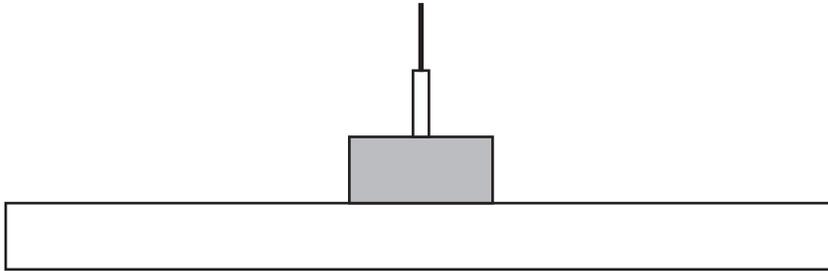
35. Which ecological pyramid best represents the approximate proportion of energy transferred from the grass to the bobcat?



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(Item 35, continued from the previous page)

D.



36. If the leafhopper receives 463,000 kJ of energy, which value best represents the approximate energy lost between the trophic levels occupied by the gray rat snake and the Cooper's hawk?

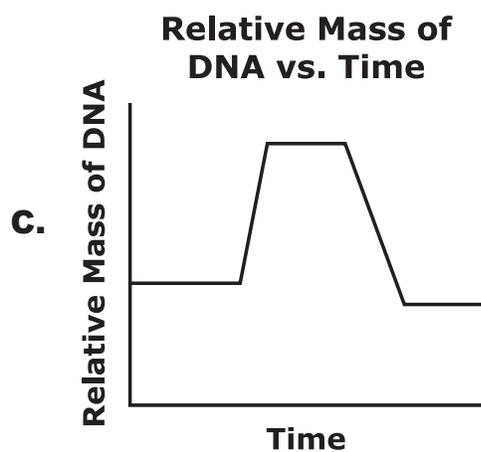
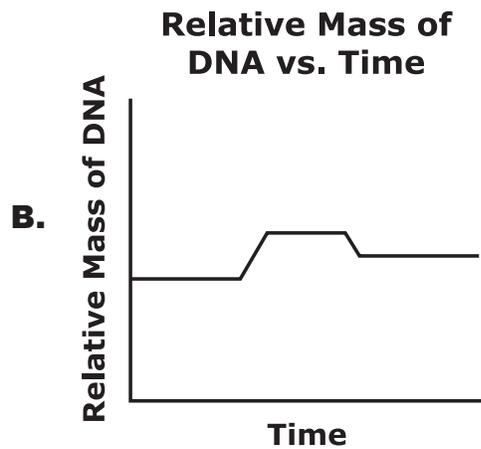
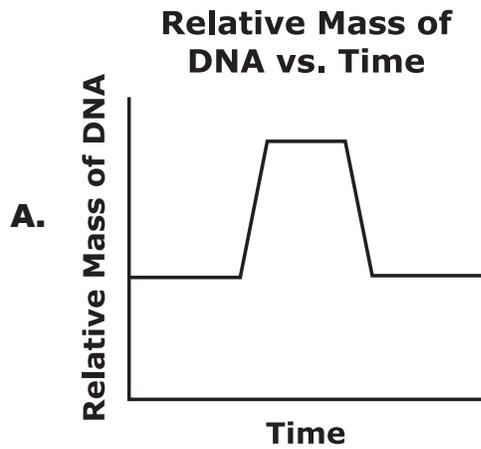
M. 46.3 kJ

P. 4,170 kJ

R. 463 kJ

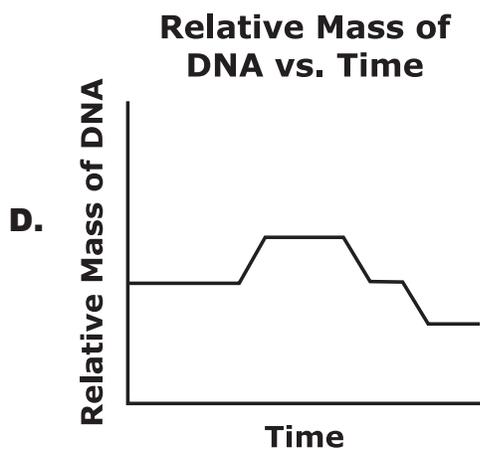
S. 41,700 kJ

37. Which graph most accurately represents the change in the mass of the DNA in a body cell during one cell cycle?



*(This item continues on the next page.)*

(Item 37, continued from the previous page)



38. Coat color in dogs is controlled in part by a gene that regulates the deposition of pigment. The patches of color in the dog shown in the figure are caused by a somatic mutation. The genotypes in the different patches are indicated.

### Dog and Genotype of Skin Patches

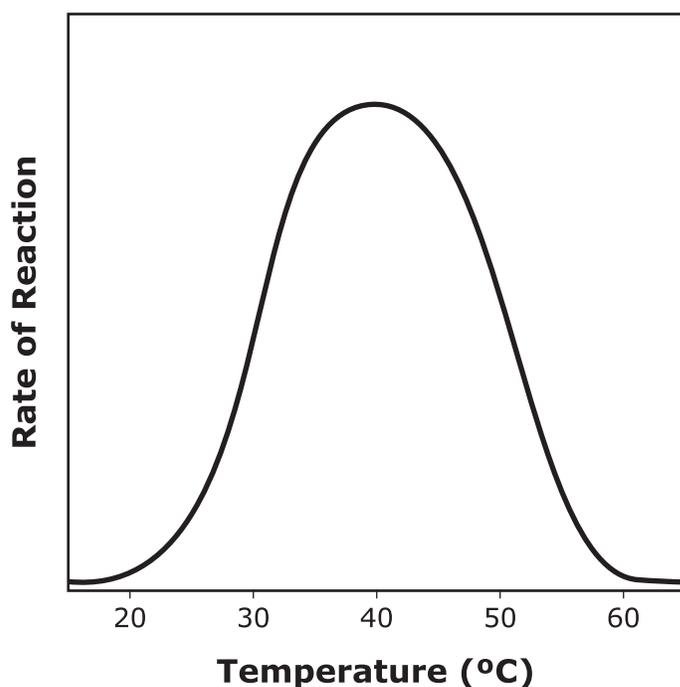


Which three statements are true about the mutation that caused the black coloring?

- M. The mutation did not affect the phenotype of the dog.
- P. The mutation will affect only this dog.
- R. The mutation occurred in a body cell after the formation of the embryo.
- S. The mutation was present in the gametes of the dog's parents.
- T. The mutation made a permanent change to the DNA of the affected cell.

39. The graph shows the effect of temperature on the rate of an enzyme-catalyzed reaction in the presence of excess substrate.

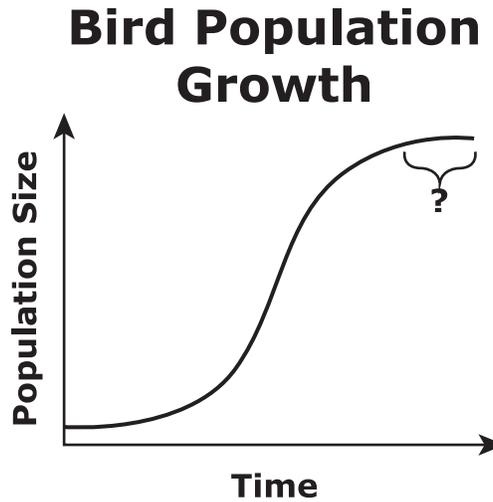
### Rate of an Enzyme-Catalyzed Reaction



If the reaction temperature were to increase from 40°C to 63°C, the reaction rate would likely

- A. decrease, because the enzyme would become denatured.
- B. increase, because the kinetic energy would increase.
- C. decrease, because the enzyme would be used up.
- D. stay the same, because the rate of enzyme-catalyzed reactions is constant.

40. The graph shows the change in the size of a bird population over time.



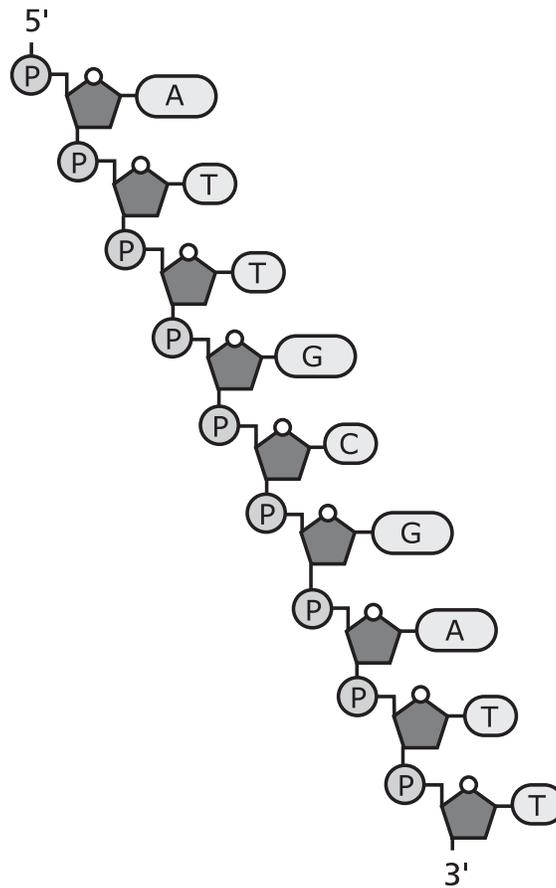
Which two factors can best explain the shape of the area labeled by a question mark on the population-growth curve?

- M.** The population immigrated to a different geographical location.
- P.** A treatment for a communicable disease was given to the birds.
- R.** There was competition among the birds for available resources.
- S.** Some birds were unable to find shelter from predators.
- T.** A new food source was introduced to the birds.

**41. Which two statements support the claim that viruses are nonliving?**

- A.** Viruses evolve.
- B.** Viruses contain a genetic code.
- C.** Viruses lack machinery for reproduction.
- D.** Viruses contain structures made of proteins.
- E.** Viruses cannot make their own chemical products.

42. A segment of DNA is shown.



Which strand is the complementary strand of DNA?

- M. 3'- TAA CGC TAA -5'
- P. 3'- AUU CGC AUU -5'
- R. 3'- ATT GCG ATT -5'
- S. 3'- AUU GCG AUU -5'

Questions 43 – 45 refer to the passage(s) and image(s) shown.

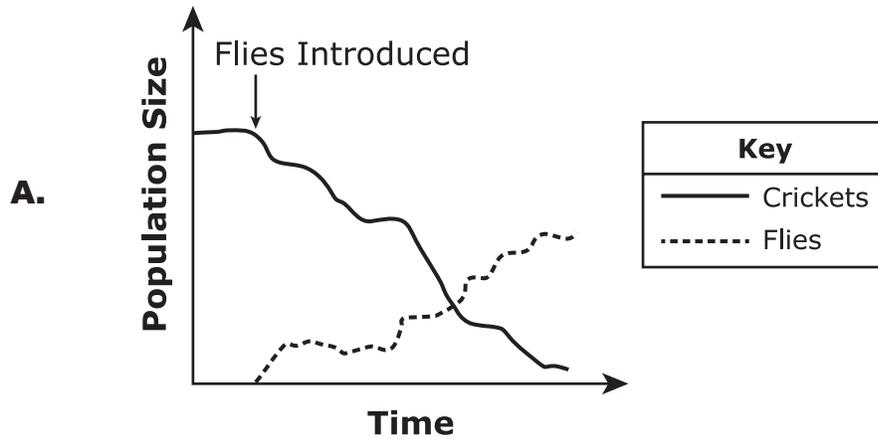
## Silent Crickets – Part 1

Crickets belong to a group of insects that use chirping sounds to locate mates. Male crickets have wings equipped with a scraper and teeth that produce a chirp when rubbed together. In 2012 researchers discovered that the majority of crickets on the island of Kauai in the Hawaiian Islands no longer chirped. The researchers identified the cause of this phenotype to be a new mutation named *flatwing* that affects wing morphology and results in wings that lack the teeth.

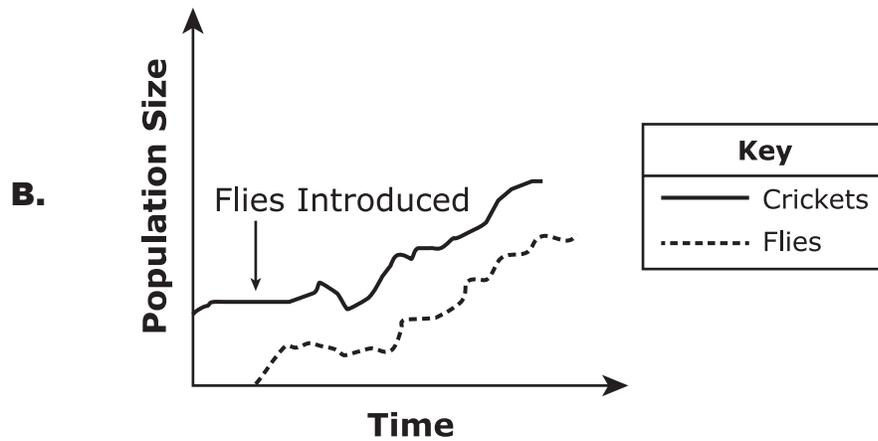
About ten years earlier, researchers identified an invasive species of parasitic flies whose larvae burrow into the body of the crickets and consume them from the inside. The flies use the chirps to locate crickets.

43. Which graph best illustrates the fly and cricket population changes that occurred in the years immediately following the introduction of the flies?

### Population Size vs. Time



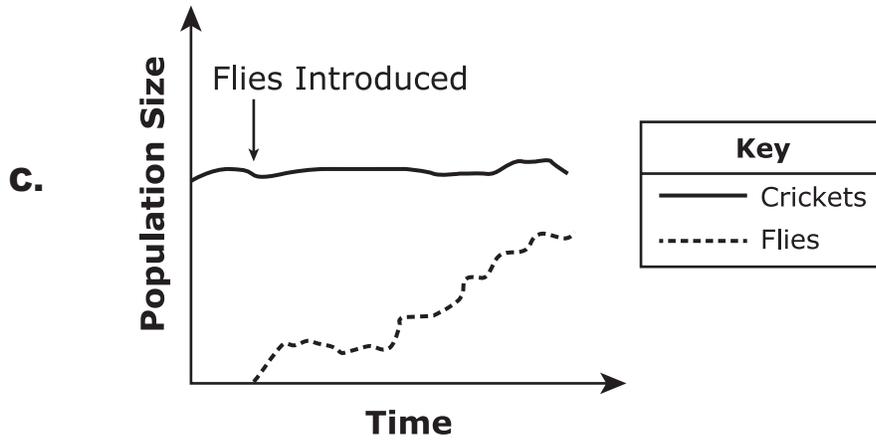
### Population Size vs. Time



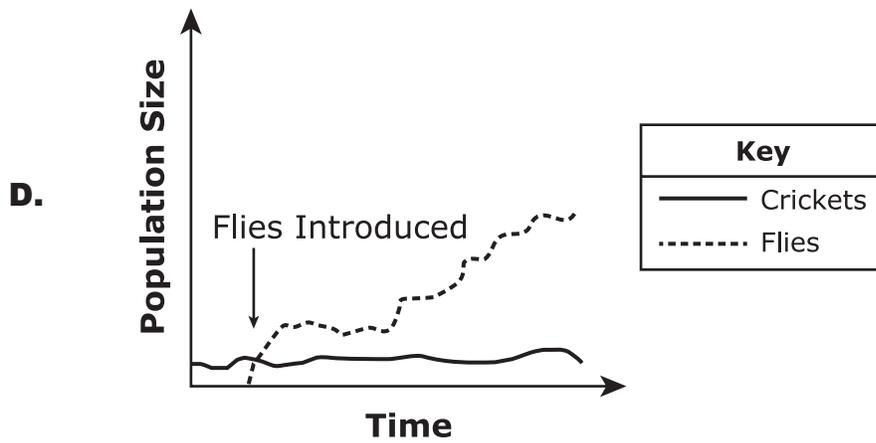
(This item continues on the next page.)

(Item 43, continued from the previous page)

### Population Size vs. Time



### Population Size vs. Time



**44. Which statement is the best explanation for the appearance of the flatwing phenotype among male crickets on Kauai?**

- M.** Crickets evolved the flatwing phenotype to escape detection by parasitic flies.
- P.** Infection by parasitic flies caused some crickets to mutate into the flatwing phenotype.
- R.** A change in female preference for mates resulted in the appearance of the flatwing phenotype.
- S.** A random mutation resulted in the appearance of the flatwing phenotype.

**45. Scientists set up an investigation to determine the effects of different variables on the fitness of crickets. Populations of 50 male and 50 female crickets were placed in three different habitats as listed in the data table shown. The populations were maintained for many generations.**

### Cricket and Fly Populations

Experimental Habitat	Wild Type Male Crickets	Flatwing Male Crickets	Female Crickets	Parasitic Flies
1	Present	Absent	Present	Absent
2	Present	Absent	Present	Present
3	Absent	Present	Present	Present

**Which prediction about the cricket population sizes at the end of the experiment is most likely correct?**

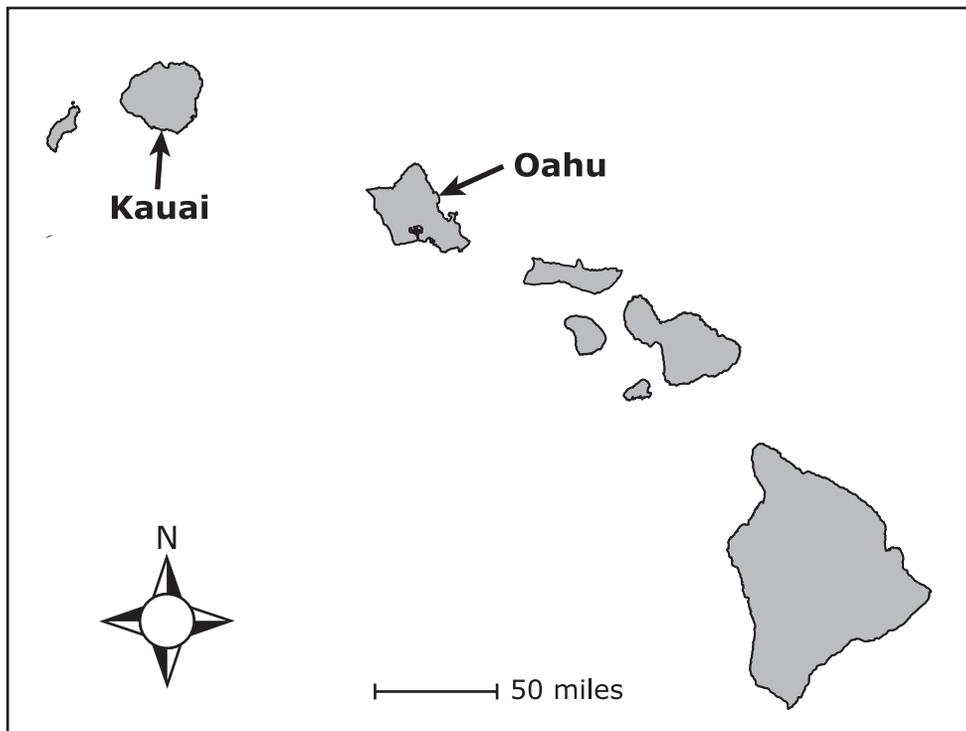
- A.** The population size will be larger in habitat 3 than in habitat 2.
- B.** The population size will be larger in habitat 2 than in habitat 1.
- C.** The population size will be larger in habitat 3 than in habitat 1.
- D.** The population size will be larger in habitat 2 than in habitat 3.

**No test material  
on this page**

Questions 46 – 48 refer to the passage(s) and image(s) shown.

## Silent Crickets – Part 2

Shortly after the discovery of flatwing crickets on the island of Kauai, silent crickets were discovered on the nearby island of Oahu. The map shows the location of the islands, and the table shows the year in which flatwing male crickets were first observed and the measured allele frequency in 2012.



### Initial Observation of the Flatwing Phenotype and Frequency of Flatwing Alleles

Island	Year of Initial Observation of Flatwing Phenotype	Frequency of Flatwing Alleles in 2012
Kauai	2003	0.96
Oahu	2005	0.45

The researchers performed a morphological analysis of wild type and flatwing flies from Kauai and Oahu and determined that the wing phenotypes are different between the two islands.

- 46. Which of these observations would provide the best support for a claim that the flatwing phenotype arose independently on Kauai and Oahu?**
- M.** The stomach contents of males from both islands contain the same plant material.
  - P.** Crickets are transported between the Hawaiian Islands by tourists.
  - R.** Males from each island have different genetic mutations affecting wing shape.
  - S.** The physical environment and climate on both islands are very similar.
- 47. Which piece of evidence would best help to explain the appearance of different mutations affecting wing structure over such a short period of time?**
- A.** Populations of crickets experience a high rate of mutation that produces many phenotypes.
  - B.** Populations of crickets introduce similar mutations to overcome similar selective pressures.
  - C.** Wing structure is an acquired trait that is established in every new generation.
  - D.** Individual crickets determine the wing structure to ensure maximum survival.

- 48. Scientists studying the cricket populations on Kauai and Oahu have also observed that flatwing males wander about more than wild type male crickets do.**

**Which hypothesis best explains the observed wandering behavior in a population consisting mostly of flatwing males?**

- M.** Wandering protects flatwing males from the parasitic fly.
- P.** Wandering helps flatwing males find mates in the absence of chirping.
- R.** Wandering allows flatwing males to access new food sources.
- S.** Wandering reduces competition with male crickets that chirp.

49. The rate of cell division varies greatly in different types of human cells. The data table shows the replacement rates of many types of human cells.

### Replacement Rates of Multiple Human Cell Types

Cell Type	Replacement Rate	Organ System
Stomach	2 – 9 days	Digestive
Tongue taste buds	10 days	Digestive
Skin epidermis	10 – 30 days	Integumentary
Red blood cell	4 months	Circulatory
Lungs, alveoli	8 days	Respiratory
Sperm	2 months	Reproductive
White blood cells	2 – 5 days	Immune
Small intestine epithelium	2 – 4 days	Digestive

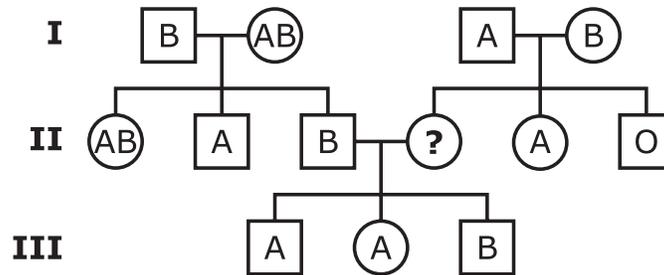
Which conclusion is most consistent with the data in the table?

- A. Cells in the integumentary system divide faster than any other type of cell in the body.
- B. Cells in the digestive system are among the most rapidly dividing cells in the body.
- C. Cells of the respiratory and circulatory systems have faster replacement rates than cells of the digestive system.
- D. Cells in the reproductive and nervous systems are never replaced.

**50. Which statement describes an advantage of sexual reproduction over asexual reproduction?**

- M.** Sexual reproduction results in more genetic variation in organisms than asexual reproduction.
- P.** Sexual reproduction requires more time to produce organisms than asexual reproduction.
- R.** Sexually produced offspring are more dependent on their parents for survival than offspring produced through asexual reproduction.
- S.** Sexually produced organisms are more dependent on other organisms for reproduction than offspring produced through asexual reproduction.

51. ABO blood type is controlled by three alleles of a single gene. Blood type O is associated with the recessive  $i$  allele. Blood types A, B, and AB are associated with the codominant  $I^A$  and  $I^B$  alleles. The pedigree shows the inheritance of ABO blood types in a family.



Which two genotypes are possible for the individual indicated with the question mark?

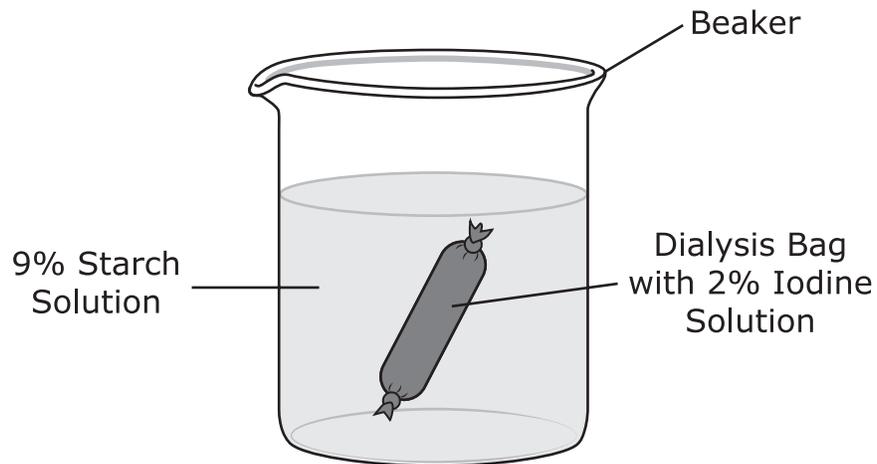
- A.  $ii$
- B.  $iI^A$
- C.  $I^A I^B$
- D.  $iI^B$
- E.  $I^B I^B$

**52. In an investigation into the role of plants in the cycling of matter, a researcher is designing an experiment in which plants will be grown under conditions that will limit the rate of photosynthesis. Which design would match the goal of the researcher?**

- M.** Grow the plants in a low oxygen environment and measure the rate of carbon dioxide production.
- P.** Grow the plants in a low carbon dioxide environment and measure the rate of oxygen production.
- R.** Grow the plants in soil containing excess water and measure the rate of transpiration.
- S.** Grow the plants in soil containing excess nitrogen and measure the rate of plant growth.

53. Dialysis bags can be used as models of cells to explore the movement of materials into and out of cells.

Students set up an investigation with a dialysis bag containing a 2% iodine solution in a beaker containing a 9% starch solution as shown in the figure. Starch turns blue-black in the presence of iodine. The dialysis bag is permeable to water and iodine but not to starch.

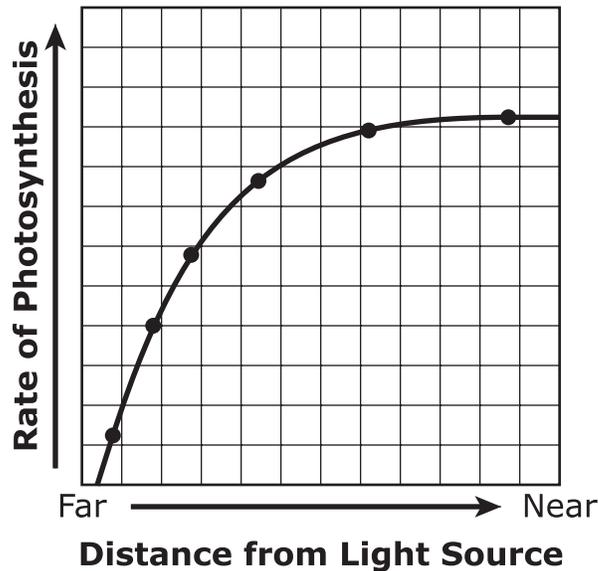


Which two observations most accurately predict what will occur in the investigation?

- A. The solution in the dialysis bag will turn blue-black.
- B. The solution in the beaker will turn blue-black.
- C. The concentration of starch in the dialysis bag will increase.
- D. The mass of the dialysis bag will decrease.
- E. The mass of the dialysis bag will increase.

54. The graph shows the results of an investigation into the effect of distance from a light source on the rate of photosynthesis.

### Photosynthesis Light Response



Based on the data represented in the graph, the rate of photosynthesis \_\_\_\_\_1\_\_\_\_\_ as the level of available \_\_\_\_\_2\_\_\_\_\_ increases. The greatest change in the rate of photosynthesis occurs when the light level is \_\_\_\_\_3\_\_\_\_\_.

Which table contains the numbers and terms that correctly complete the statements?

#### Numbers and Terms for the Statements

M.

Number	Term
1	increases
2	light
3	low

(This item continues on the next page.)

(Item 54, continued from the previous page)

### Numbers and Terms for the Statements

**P.**

Number	Term
1	decreases
2	oxygen
3	high

### Numbers and Terms for the Statements

**R.**

Number	Term
1	increases
2	oxygen
3	high

### Numbers and Terms for the Statements

**S.**

Number	Term
1	decreases
2	light
3	low



This is the end of the Biology test.

Name: \_\_\_\_\_

- 1.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 2.   Ⓜ   Ⓟ   Ⓡ   Ⓢ   Ⓣ   (select **three**)
- 3.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 4.   Ⓜ   Ⓟ   Ⓡ   Ⓢ   Ⓣ   (select **three**)
- 5.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 6.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 7.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 8.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 9.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 10.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 11.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 12.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 13.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 14.   Ⓜ   Ⓟ   Ⓡ   Ⓢ   Ⓣ   (select **three**)
- 15.   Ⓐ   Ⓑ   Ⓒ   Ⓓ   ⓔ   (select **two**)
- 16.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 17.   Ⓐ   Ⓑ   Ⓒ   Ⓓ   ⓔ   (select **three**)
- 18.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 19.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 20.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 21.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 22.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 23.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 24.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 25.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 26.   Ⓜ   Ⓟ   Ⓡ   Ⓢ

- 27.   Ⓐ   Ⓑ   Ⓒ   Ⓓ   Ⓔ   (select **two**)
- 28.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 29.   Ⓐ   Ⓑ   Ⓒ   Ⓓ   Ⓔ   (select **three**)
- 30.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 31.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 32.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 33.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 34.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 35.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 36.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 37.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 38.   Ⓜ   Ⓟ   Ⓡ   Ⓢ   Ⓣ   (select **three**)
- 39.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 40.   Ⓜ   Ⓟ   Ⓡ   Ⓢ   Ⓣ   (select **two**)
- 41.   Ⓐ   Ⓑ   Ⓒ   Ⓓ   Ⓔ   (select **two**)
- 42.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 43.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 44.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 45.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 46.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 47.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 48.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 49.   Ⓐ   Ⓑ   Ⓒ   Ⓓ
- 50.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 51.   Ⓐ   Ⓑ   Ⓒ   Ⓓ   Ⓔ   (select **two**)
- 52.   Ⓜ   Ⓟ   Ⓡ   Ⓢ
- 53.   Ⓐ   Ⓑ   Ⓒ   Ⓓ   Ⓔ   (select **two**)
- 54.   Ⓜ   Ⓟ   Ⓡ   Ⓢ



## Answer Key

1.  A  B  C  D
2.  A  B  R  S  T (select **three**)
3.  A  B  C  D
4.  A  P  R  S  T (select **three**)
5.  A  B  C  D
6.  M  P  R  S
7.  A  B  C  D
8.  M  P  R  S
9.  A  B  C  D
10.  M  P  R  S
11.  A  B  C  D
12.  A  P  R  S
13.  A  B  C  D
14.  A  B  R  S  T (select **three**)
15.  A  B  C  D  E (select **two**)
16.  M  P  R  S
17.  A  B  C  D  E (select **three**)
18.  M  P  R  S
19.  A  B  C  D
20.  M  P  R  S
21.  A  B  C  D
22.  M  P  R  S
23.  A  B  C  D
24.  M  P  R  S
25.  A  B  C  D
26.  M  P  R  S
27.  A  B  C  D  E (select **two**)

28.  M  P   S
29.  A    D  (select **three**)
30.  M   R  S
31.   B  C  D
32.  M  P  R
33.   B  C  D
34.  M   R  S
35.  A  B  C
36.  M   R  S
37.   B  C  D
38.  M    S  (select **three**)
39.   B  C  D
40.  M  P    T (select **two**)
41.  A  B   D  (select **two**)
42.   P  R  S
43.   B  C  D
44.  M  P  R
45.   B  C  D
46.  M  P   S
47.   B  C  D
48.  M   R  S
49.  A   C  D
50.   P  R  S
51.  A    D  E (select **two**)
52.  M   R  S
53.  A   C   E (select **two**)
54.   P  R  S

### TCAP Practice Test Standards Alignment and Key - Biology

Question No.	Key	Standard
1	C	BIO1.LS3.2
2	M, P, T	BIO1.LS1.5
3	C	BIO1.LS2.5
4	M, S, T	BIO1.LS1.2
5	B	BIO1.LS3.1
6	R	BIO1.LS2.2
7	C	BIO1.LS1.8
8	S	BIO1.LS4.1
9	A	BIO1.LS1.8
10	S	BIO1.LS1.8
11	B	BIO1.LS4.1
12	M	BIO1.LS4.1
13	D	BIO1.LS2.3
14	M, P, S	BIO1.LS4.3
15	C, E	BIO1.LS2.5
16	S	BIO1.LS2.1
17	A, C, D	BIO1.LS3.1
18	R	BIO1.LS1.5
19	B	BIO1.LS4.3
20	P	BIO1.LS1.9
21	D	BIO1.LS1.9
22	P	BIO1.LS1.9
23	B	BIO1.LS3.3
24	S	BIO1.LS3.3
25	C	BIO1.LS3.3
26	R	BIO1.LS1.2
27	A, E	BIO1.LS1.1
28	R	BIO1.LS2.3
29	B, C, E	BIO1.LS1.4
30	P	BIO1.LS2.5
31	A	BIO1.LS1.7

Question No.	Key	Standard
32	S	BIO1.LS1.7
33	A	BIO1.LS1.7
34	P	BIO1.LS1.7
35	D	BIO1.LS2.4
36	P	BIO1.LS2.4
37	A	BIO1.LS1.6
38	P, R, T	BIO1.LS3.2
39	A	BIO1.LS1.5
40	R, S	BIO1.LS2.1
41	C, E	BIO1.LS1.1
42	M	BIO1.LS1.3
43	A	BIO1.LS2.1
44	S	BIO1.LS4.2
45	A	BIO1.LS2.1
46	R	BIO1.LS4.2
47	A	BIO1.LS4.2
48	P	BIO1.LS4.2
49	B	BIO1.LS1.6
50	M	BIO1.LS3.1
51	B, C	BIO1.LS3.3
52	P	BIO1.LS2.3
53	B, D	BIO1.LS1.7
54	M	BIO1.LS1.8

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