MISSISSIPPI DEPARTMENT OF EDUCATION

Ensuring a bright future for every child

Mississippi Academic Assessment Program (MAAP)

Biology

PRACTICE TEST

2022-2023

The Biology Practice Test is a useful tool for Mississippi educators to use in preparing students for the format of the Mississippi Academic Assessment Program for Science. The items were written and aligned to the 2018 Mississippi College- and Career-Readiness Standards for the Science. **This document contains 25 Biology items**.

1. Adult somatic cell nuclear transfer, also known as cloning, may potentially be a method to recover populations of endangered species. Recently, cloning was used on the last surviving cow of a rare breed from New Zealand.

What is the strongest ethical and moral argument against continuing research and experiments in cloning endangered species?

A. lack of mate selection for the cloned animals to reproduce

B. likelihood that cloned organisms would introduce new diseases to native species

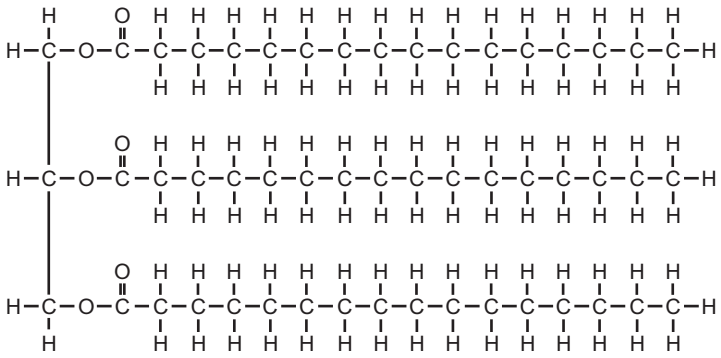
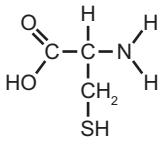
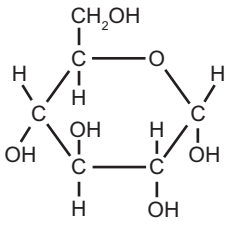
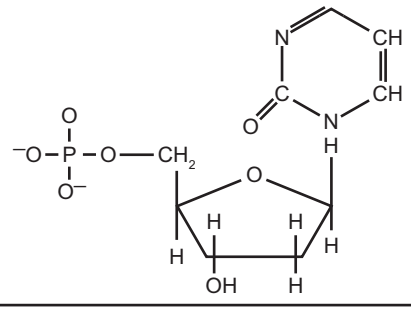
C. possibilities that the process could be used on organisms for personal preference

D. concern that it will disrupt the economic market for individuals selling uncloned animals

2. The chart shows the molecular structures of monomers associated with four common macromolecules.

Record the label of each macromolecule listed below in the box next to its monomer molecular structure.

Macromolecules and Their Monomer Structures

Name of Macromolecule	Monomer Molecular Structure
	
	
	
	

Labels

Ⓐ carbohydrate

Ⓑ lipid

Ⓒ nucleic acid

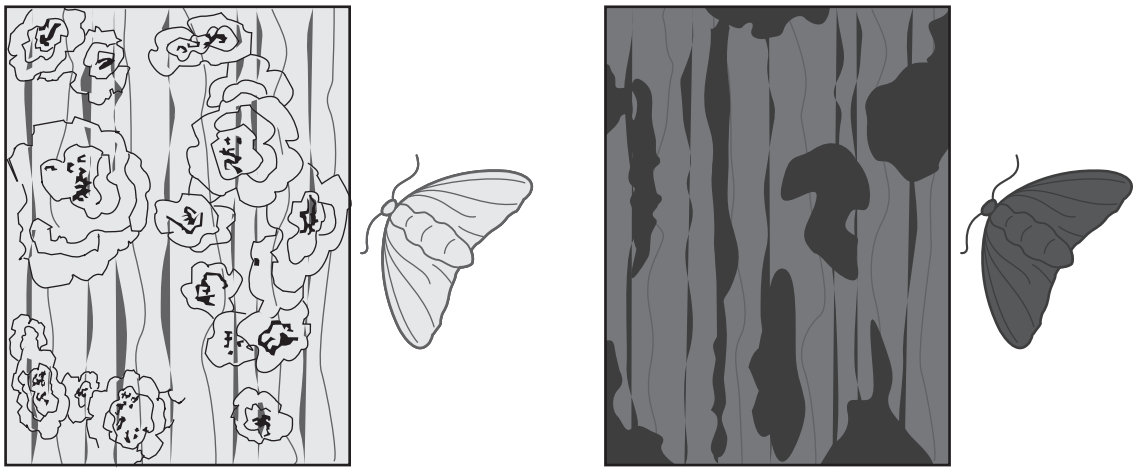
Ⓓ protein

Use the scenario to answer the next two questions.

Peppered Moths

Before the Industrial Revolution in Great Britain, birds fed primarily on dark-colored moths. The Industrial Revolution caused environmental changes. Coal fires caused dark soot to be released into the air. This soot was then deposited on trees, grasses, and buildings. This change to the existing environment caused a change in the genetic frequencies demonstrated by moths in Great Britain.

Change in Peppered Moths

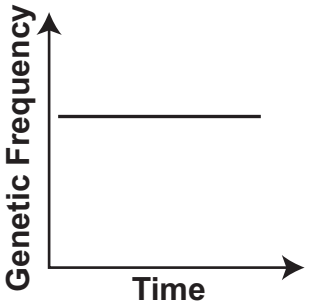


before Industrial Revolution

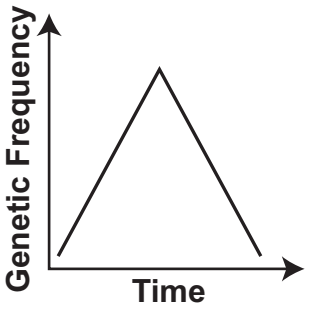
after Industrial Revolution

3. Which graph **best** represents the genetic frequency of the dark-colored moths during the Industrial Revolution in Great Britain?

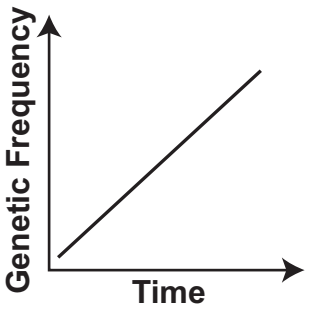
A.



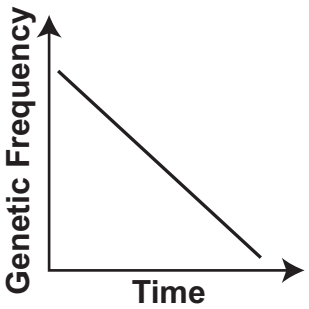
B.



C.



D.



4. Based on the information in the scenario, what caused the change in the genetic frequencies of the moths during the Industrial Revolution?

A. genetic mutations due to the soot

B. natural selection due to predation

C. chemical poisoning due to poor air quality

D. overproduction due to excess food sources

5. Which **two** options identify contributions to cell theory that are attributed to Robert Hooke?

A. discovered and named cells

B. stated all plants are made of cells

C. observed cork cell walls under a microscope

D. determined all cells come from other preexisting cells

E. stated all cells have the same basic chemical composition

F. discovered that hereditary information is passed on from cell to cell

6. All cells are either eukaryotic or prokaryotic.

Part A: Record the letter of an option in each box in the table to show whether the characteristic describes a eukaryotic cell, a prokaryotic cell, or both types of cell. The options may be used once, more than once, or not at all.

Characteristics of Eukaryotic and Prokaryotic Cells

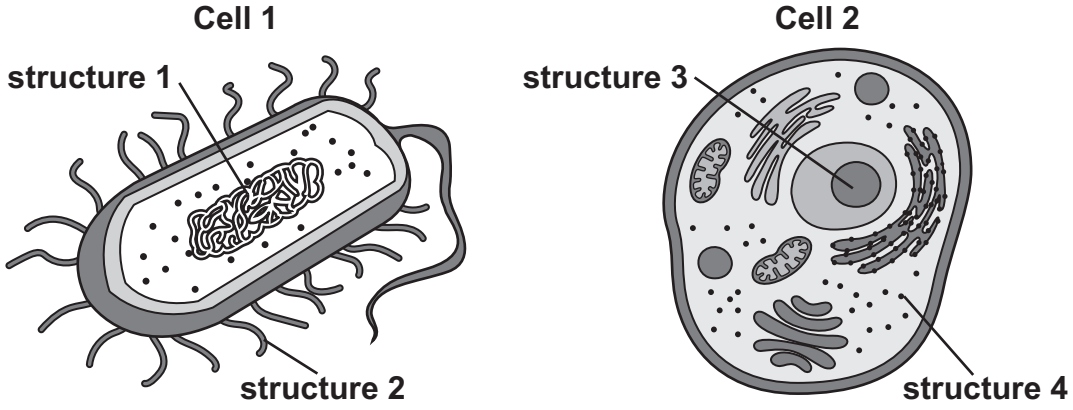
Characteristic	Type of Cell
has ribosomes	
has a cell membrane	
has DNA in the cytoplasm	
has membrane-bound organelles	

Options

1. **prokaryotic**
2. **eukaryotic**
3. **both**

Part B: The diagrams show a eukaryotic cell and a prokaryotic cell. On the diagram representing the eukaryotic cell, select the structure where the cellular DNA is stored.

Cellular Structures



7. Mitosis and meiosis are two processes that can produce new cells in an organism. Which statement correctly compares and contrasts the new cells produced by each process?

A. New cells produced by mitosis have unique genetic material, and new cells produced by meiosis have identical genetic material.

B. New cells produced by mitosis are responsible for reproduction, and new cells produced by meiosis are responsible for growth and repair.

C. New cells produced by mitosis are the result of two nuclear divisions, and new cells produced by meiosis are the result of one nuclear division.

D. New cells produced by mitosis maintain genetically identical offspring, and new cells produced by meiosis contribute to genetic diversity in offspring.

8. A student is comparing aerobic and anaerobic respiration in both animals and plants by constructing equations to represent these four general chemical reactions.

Record the letters of the missing substances from the list below into the equations where they belong. Some substances will be used more than once.

Aerobic Respiration in Animals

_____ + glucose ⟶ _____ + _____ + energy

Aerobic Respiration in Plants

_____ + glucose ⟶ _____ + _____ + energy

Anaerobic Respiration in Animals

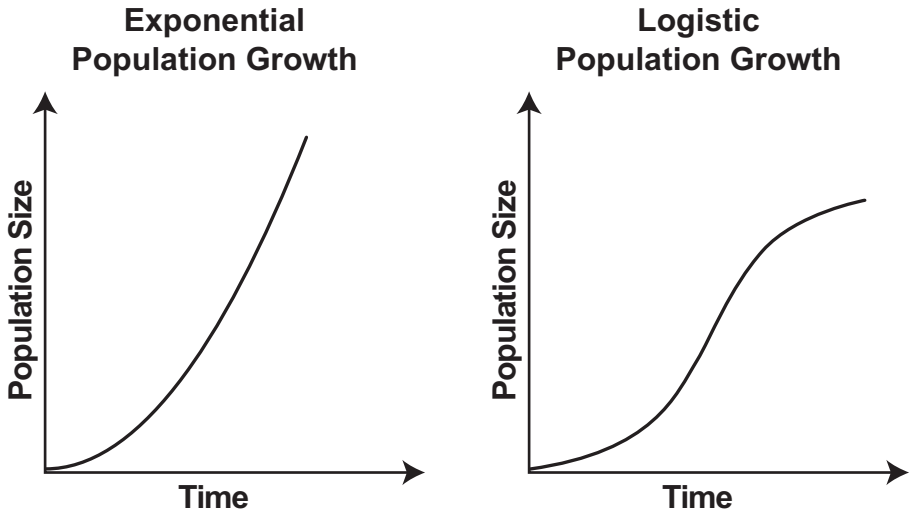
glucose ⟶ _____ + energy

Anaerobic Respiration in Plants

glucose ⟶ _____ + _____ + energy

Ⓐ ethanol
Ⓑ water
Ⓒ oxygen
Ⓓ lactic acid
Ⓔ carbon dioxide

9. Under ideal circumstances in an environment, a population will grow exponentially. However, in studies of actual populations in various environments, scientists have found that the exponential growth rate a population may experience for a while will slow down and may eventually level off at a constant rate. This is called logistic growth.



Which factor would **most likely** cause the growth rate of a population to shift from exponential to logistic growth?

A. Predators that hunt the population are eliminated due to disease.

B. The birth rate in the population exceeds the death rate in the population.

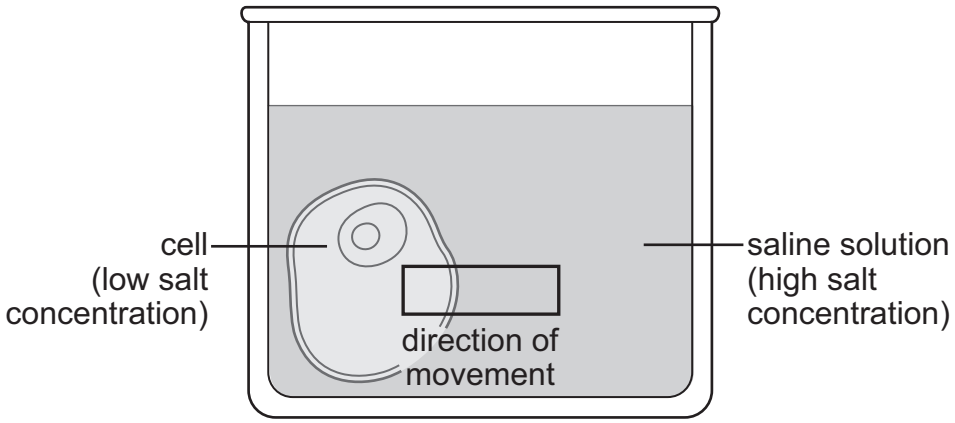
C. The population consumes food resources as fast as they can be produced.

D. A competing population migrates to another area, leaving an excess of food and space.

10. An incomplete diagram of a cell in a saline solution is shown. The concentrations of salt within the cell and the solution are given.

Draw an arrow in the box inside the beaker to show the **most likely** direction of water flow and record a label in the box below the beaker to **best** identify the type of movement occurring.

Cell in a Saline Solution



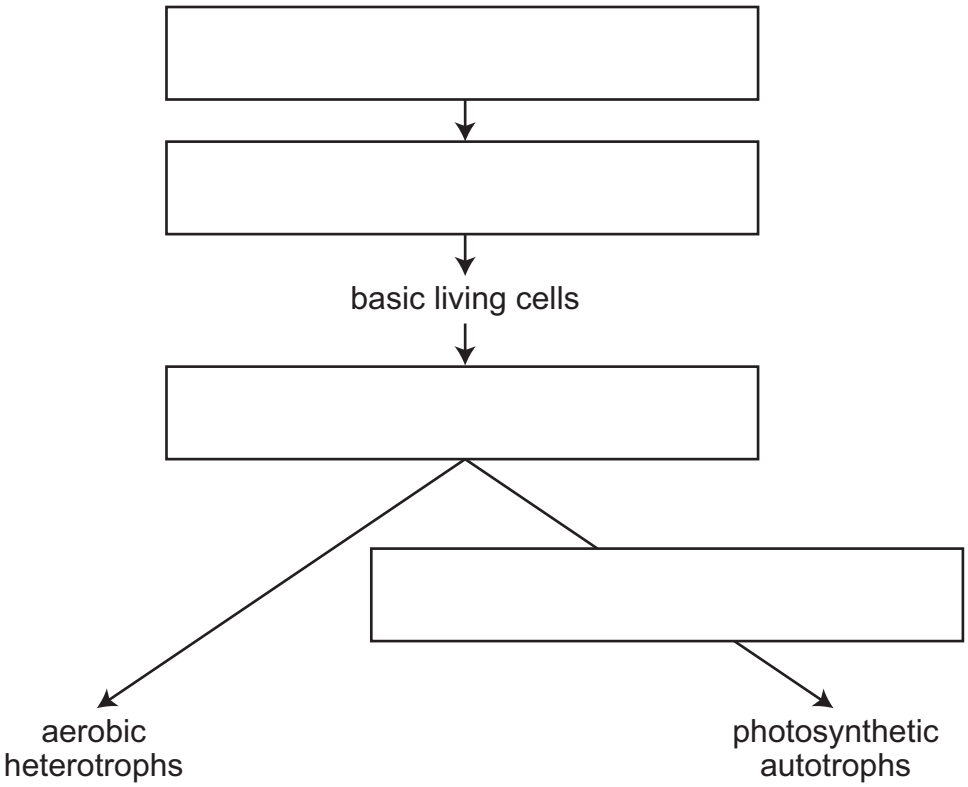
type of movement: ☐

Direction of Movement	Type of Movement
⟷	① **active transport**
→	② **endocytosis**
	③ **diffusion**
←	④ **osmosis**

11. The diagram shows an incomplete model of the evolution of heterotrophs and autotrophs.

Record the letter of a description in each box to correctly complete the model.

Evolution of Heterotrophs and Autotrophs



W **evolution of structures that use oxygen to break down sugars**

X **evolution of structures that use light energy to form sugars**

Y **formation of inorganic molecules**

Z **formation of organic molecules**

12. Which statement correctly compares viruses to bacteria?

A. Viruses are larger than bacteria, but both have a nucleus that contains genetic material.

B. Viruses are smaller than bacteria, but both have a nucleus that contains genetic material.

C. Viruses have a cell wall for protection, while bacteria are not surrounded by a cell wall.

D. Viruses have a protein capsule for protection, while bacteria are surrounded by a cell wall and a cell membrane.

13. Which step in cell division must occur first so that a young animal can grow into an adult?

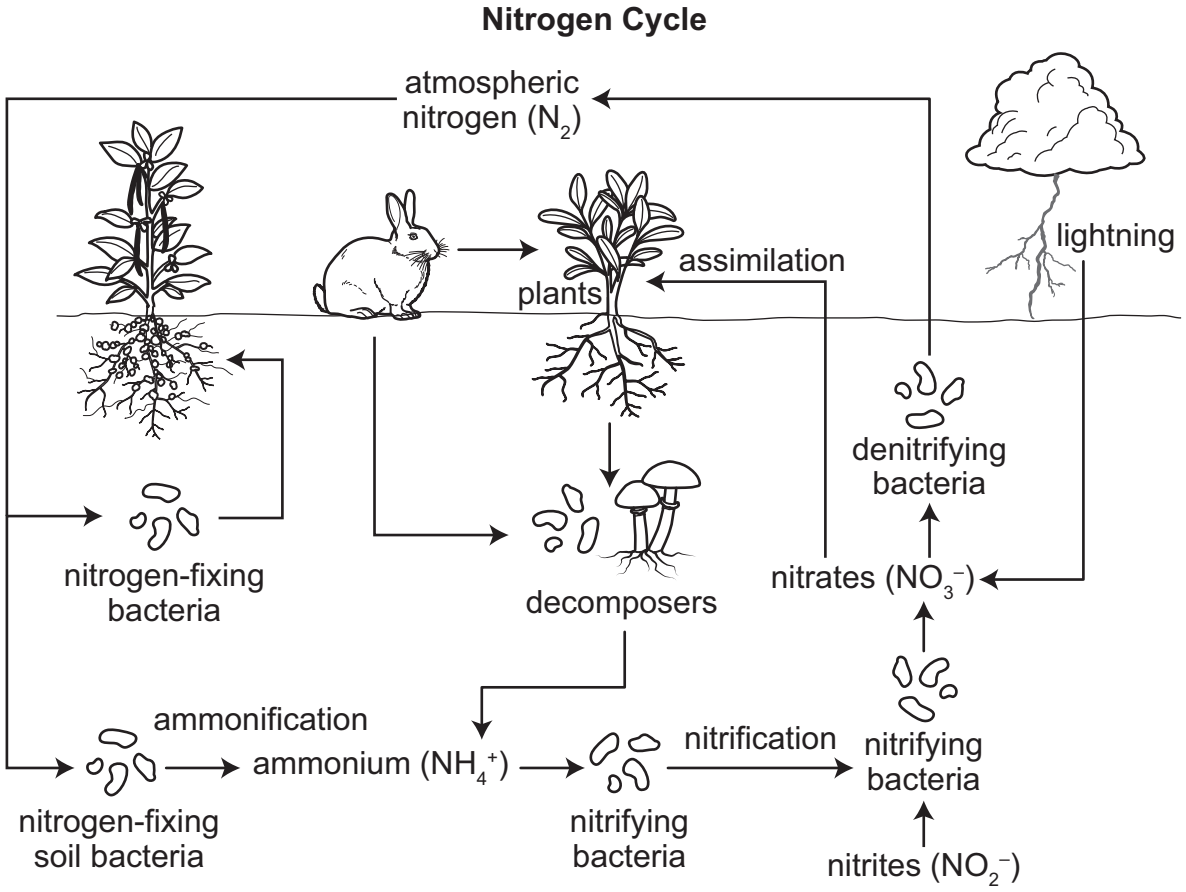
A. The chromosomes must duplicate.

B. The chromosomes must separate.

C. The cells must divide the cytoplasm.

D. The cells must produce spindle fibers.

14. The diagram models the flow of nitrogen through an ecosystem.



Part A: Based on the diagram, which component is a direct product of abiotic and biotic activities in this cycle?

A. nitrates

B. nitrites

C. ammonium

D. atmospheric nitrogen

Part B: What is the role of nitrogen-fixing bacteria in this cycle?

A. making atmospheric nitrogen available for plants

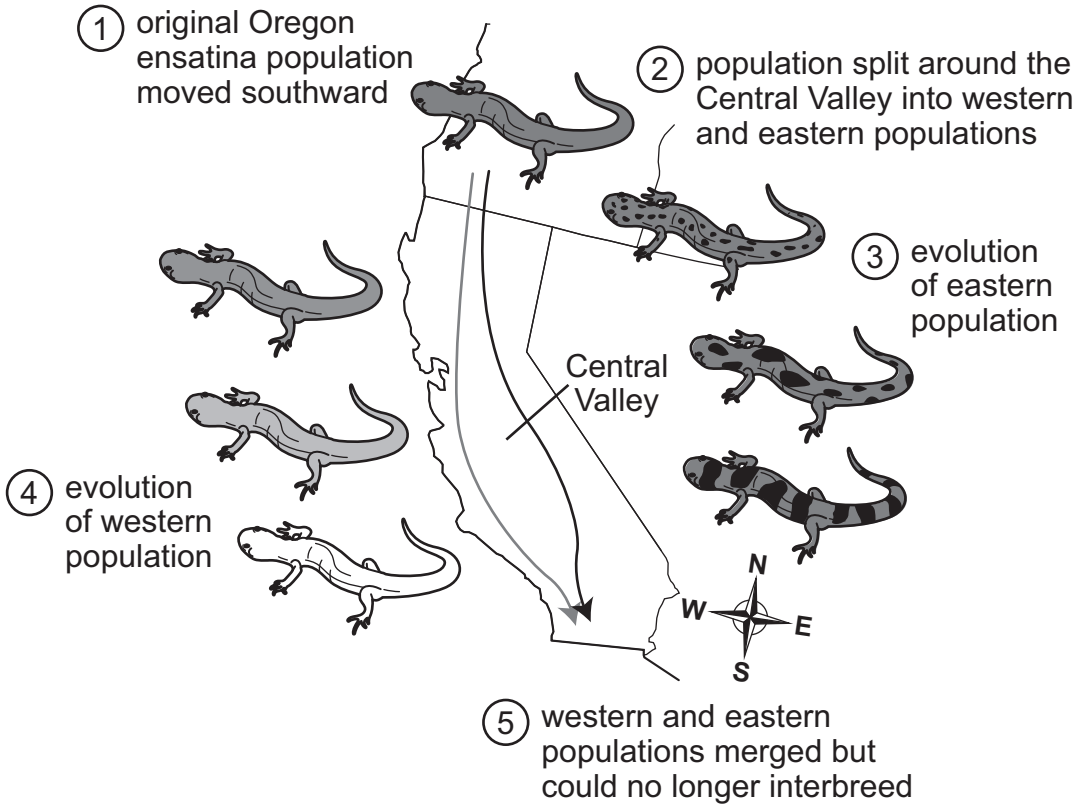
B. transforming sunlight energy into usable energy for plants

C. breaking down dead plant matter and releasing it as nitrogen into the atmosphere

D. increasing the amount of plant matter that decomposers can convert to ammonium

15. *Ensatina* is a genus of salamander present along the western coast of North America. This salamander is thought to have started in the wet environments of northern California and southern Oregon (Oregon ensatina). From this location, the salamanders moved northward into similar wet environments and southward into much drier environments. Over time, some of the salamanders reached northern Mexico. The map shows the locations of different subspecies of *Ensatina*.

Ensatina Salamanders over Time



Which statement **best** describes the ensatina salamanders?

A. The southern movement of ensatinas resulted in salamanders that became more similar, resulting in multiple subspecies becoming a single subspecies.

B. The northern movement of ensatinas resulted in a new subspecies of the salamander that was able to survive in new and different environments.

C. The northern movement of ensatinas resulted in salamanders that were less similar as their environments became drier and hotter.

D. The southern movement of ensatinas into drier, warmer environments that had less similar salamanders resulted in a single subspecies becoming at least two different subspecies.

16. Tapeworms attach themselves to the inner surface of the intestine in cows and consume some of the passing food material before the cow can obtain the material's nutrients. Which statement **best** explains the role the tapeworm plays in relation to the cow?

A. The tapeworm is a predator because it lives inside of and attacks the cow.

B. The tapeworm is a competitor because it consumes nutrients the cow consumes.

C. The tapeworm is a commensalist because it cannot survive without a cow host to protect it.

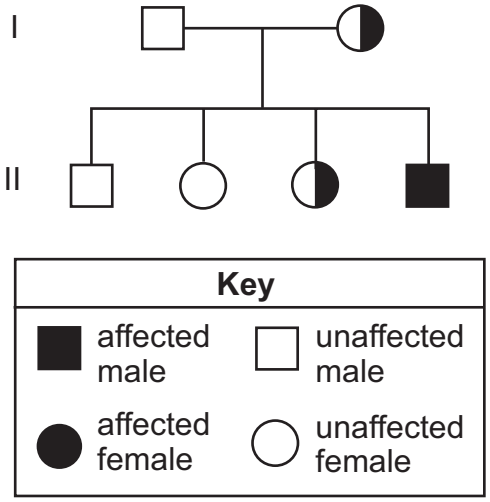
D. The tapeworm is a parasite because it benefits from living inside the cow and harms the cow.

Use the scenario to answer the next two questions.

Red-Green Color Blindness

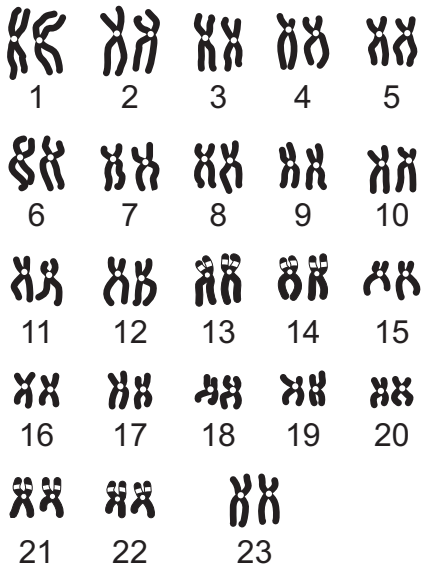
Red-green color blindness means that a person cannot distinguish shades of red and green. There are no significant complications to being color-blind, however, affected individuals may be prevented from holding certain occupations where color recognition is required. Males are affected more often than females because the gene is recessive and located on the X chromosome.

Color Blindness in Two Generations



17. Study the female karyotype.

Female Karyotype



On which numbered pair of chromosomes would the gene for red-green color blindness be located? Record the number on the line.

_____

18. Circle a number in each set of options to describe the possibilities for the offspring of a cross between a female who is a carrier for color blindness and a male who is not color-blind.

There is a (0% / 25% / 50% / 75% / 100%) chance the offspring will be a color-blind male.

There is a (0% / 25% / 50% / 75% / 100%) chance the offspring will be a color-blind female.

19. A student purchased a geranium plant from a greenhouse. The student uses the materials listed below to transfer the geranium plant to a new container.

Materials

- 4,000 grams potting soil
- 5 grams fertilizer (contains nitrogen, phosphorus, potassium)
- 1 large clay flowerpot
- 1 mature geranium plant
- 1,000 milliliters water
- 2 worms

Which criterion and reasoning work together to correctly classify a material from the list as living or nonliving?

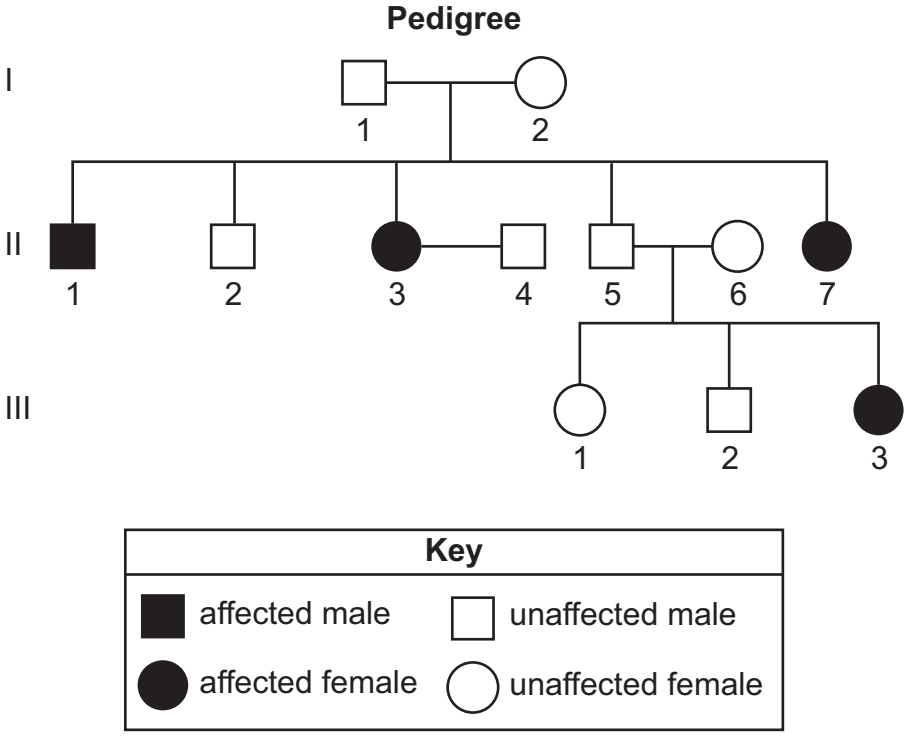
A. Criterion: Living things have mass and volume, and nonliving things do not.
Reasoning: Since the soil has mass and volume, the soil is living.

B. Criterion: Nonliving things absorb water, and living things do not.
Reasoning: Since the flowerpot cannot absorb water, the flowerpot is living.

C. Criterion: Nonliving things reproduce, and living things do not.
Reasoning: Since the worms can produce offspring, the worms are living.

D. Criterion: Living things require nutrients, and nonliving things do not.
Reasoning: Since the geranium plant uses the fertilizer to grow, the geranium plant is living.

20. A pedigree represents the inheritance of a particular trait through generations of individuals.



Part A: Circle the inheritance pattern of the trait shown in the pedigree.

Based on the pedigree, the trait is most likely (autosomal dominant / autosomal recessive / sex-linked dominant / sex-linked recessive).

Part B: What is the genotype of individual 3 in generation II?

A. AA

B. Aa

C. aa

D. X^AX^a

E. X^AY

21. Which statement **best** describes the ecological succession that takes place after a severe wildfire?

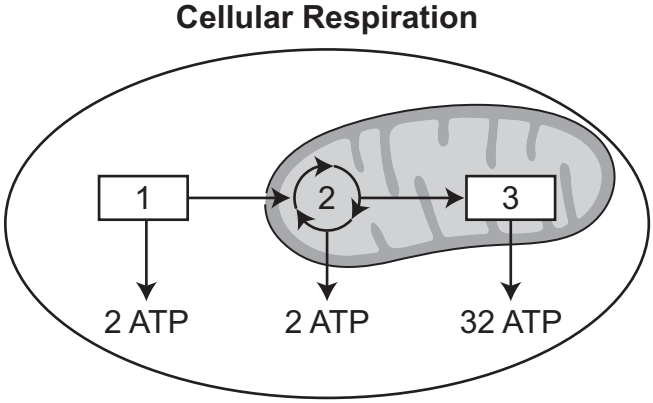
A. Secondary succession takes place after a forest fire because only bare rock is exposed.

B. Secondary succession takes place after a forest fire because the affected land once supported life.

C. Primary succession takes place after a forest fire because there is nothing living in or on the affected land.

D. Primary succession takes place after a forest fire because land that was not previously impacted by sunlight is exposed.

22. The model shows the overall process of cellular respiration in a typical animal cell.



Part A: Circle a process in each set of options to identify the stages of cellular respiration.

Stage 1 is (the citric acid cycle / the electron transport chain / glycolysis).

Stage 2 is (the citric acid cycle / the electron transport chain / glycolysis).

Stage 3 is (the citric acid cycle / the electron transport chain / glycolysis).

Part B: Circle a reactant or product in each set of options to describe the processes shown by the stages in the model.

Stage 1 uses (carbon dioxide / glucose / oxygen).

Stage 2 uses the products of stage 1

to produce 2 ATP and (carbon dioxide / glucose / oxygen).

Stage 3 uses the products of stage 2

and (carbon dioxide / glucose / oxygen) to produce 32 ATP and water.

23. A student is developing a model of energy conversion during photosynthesis. Which information must the student include in the model?

A. Light energy is transferred into glucose molecules as chemical energy.

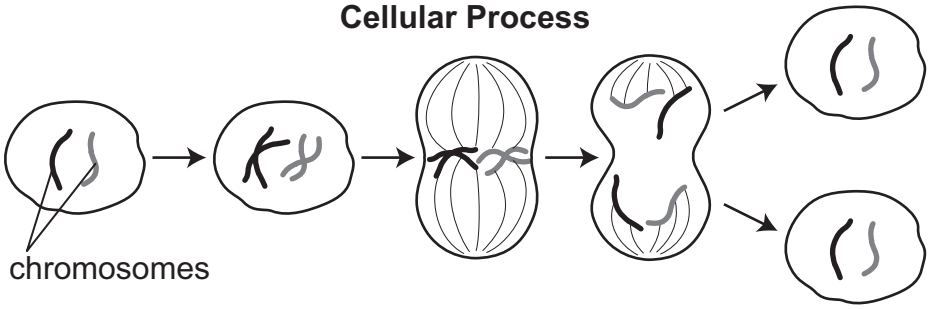
B. Chemical energy is produced when glucose molecules are broken down.

C. Chemical energy is used to open chloroplasts so that light energy is collected.

D. Light energy is transferred into molecules of water and ATP as chemical energy.

24. A cellular process is shown in the diagram.

Cellular Process



This process occurs in multicellular organisms and in single-celled organisms. The table describes three examples of the process in different organisms.

Examples of Cellular Process in Organisms

Organism	Use	Outcome
strawberry	vegetative propagation	produces two copies of the plant
sea anemone	budding	produces a smaller copy of sea anemone (polyp)
gecko	regeneration	grows new tail after previous tail has been removed

Using the information provided, which statement **best** describes the role of the cellular process in different types of organisms?

A. The process allows cells to make exact copies in order to reproduce sexually or grow.

B. The process allows cells to make new versions in order to reproduce asexually or grow.

C. The process allows cells to make new versions in order to reproduce sexually or repair cells.

D. The process allows cells to make exact copies in order to reproduce asexually or repair cells.

25. An original segment of DNA and a segment that has been mutated due to exposure to UV radiation are shown below.

Original and Mutated DNA Strands

original segment:	ATG	CCA	GGC	CCA
mutated segment:	ATG	CCA	CGC	CCA

Part A: Which sequence represents the mRNA produced during transcription of the mutated DNA segment?

A. UAC GGU GCG GGT

B. UAC GGU GCG GGU

C. AUC GGU GCG GGU

D. UAC CCU CCA GGU

Continued on Next Page

Part B: Refer to the mRNA codon chart below.

mRNA Codon Chart

First letter	Second letter: U	Second letter: C	Second letter: A	Second letter: G	Third letter
U	UUU, UUC: Phe UUA, UUG: Leu	UCU, UCC, UCA, UCG: Ser	UAU, UAC: Tyr **UAA stop** **UAG stop**	UGU, UGC: Cys **UGA stop** UGG Trp	U C A G
C	CUU, CUC, CUA, CUG: Leu	CCU, CCC, CCA, CCG: Pro	CAU, CAC: His CAA, CAG: Gln	CGU, CGC, CGA, CGG: Arg	U C A G
A	AUU, AUC, AUA: Ile AUG Met	ACU, ACC, ACA, ACG: Thr	AAU, AAC: Asn AAA, AAG: Lys	AGU, AGC: Ser AGA, AGG: Arg	U C A G
G	GUU, GUC, GUA, GUG: Val	GCU, GCC, GCA, GCG: Ala	GAU, GAC: Asp GAA, GAG: Glu	GGU, GGC, GGA, GGG: Gly	U C A G

Which statement **best** describes this mutation?

A. The protein will not be produced; the mutation is a nonsense mutation.

B. The protein produced will not change; the mutation is a silent mutation.

C. The third amino acid in the protein would change from PRO to ALA, which may affect the shape and function of the protein.

D. The third amino acid in the protein would change from ALA to PRO, which may affect the shape and function of the protein produced.

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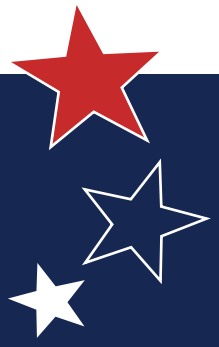
Biology Practice Test

END OF COURSE



DATA RECOGNITION
DRC
CORPORATION

Data Recognition Corporation
13490 Bass Lake Road
Maple Grove, MN 55311

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Fall 2022

The information for each item, including the objective, DOK level, item type, and correct answer, is located in this document. The items appear in the order as shown in the table.

Item Number	Objective	DOK Level	Item Type	Correct Answer
1	(BIO.3C.4) Research and identify how DNA technology benefits society. Engage in scientific argument from evidence over the ethical issues surrounding the use of DNA technology (e.g., cloning, transgenic organisms, stem cell research, and the Human Genome Project, gel electrophoresis).	2	Multiple Choice	C
2	(BIO.1B.1) Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA) in organisms.	2	Technology Enhanced	See Answer Key
3	(BIO.4.4) Design models and use simulations to investigate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations.	2	Multiple Choice	C
4	(BIO.4.5) Use Darwin's Theory to explain how genetic variation, competition, overproduction, and unequal reproductive success acts as driving forces of natural selection and evolution.	2	Multiple Choice	B
5	(BIO.1A.2) Describe the tenets of cell theory and the contributions of Schwann, Hooke, Schleiden, and Virchow.	2	Technology Enhanced	See Answer Key
6	(BIO.1C.2) Investigate to compare and contrast prokaryotic cells and eukaryotic cells, and plant, animal, and fungal cells.	2	Technology Enhanced	See Answer Key
7	(BIO.3A.2) Compare and contrast mitosis and meiosis in terms of reproduction.	2	Multiple Choice	D
8	(BIO.2.4) Conduct scientific investigations or computer simulations to compare aerobic and anaerobic cellular respiration in plants and animals, using real world examples.	2	Technology Enhanced	See Answer Key
9	(BIO.5.6) Analyze and interpret population data, both density-dependent and density-independent, to define limiting factors. Use graphical representations (growth curves) to illustrate the carrying capacity within ecosystems.	3	Multiple Choice	C
10	(BIO.1D.2) Develop and use models to explain how the cell deals with imbalances of solute concentration across the cell membrane (i.e., hypertonic, hypotonic, and isotonic conditions, sodium/potassium pump).	2	Technology Enhanced	See Answer Key
11	(BIO.4.1) Use models to differentiate between organic and chemical evolution, illustrating the steps leading to aerobic heterotrophs and photosynthetic autotrophs.	2	Technology Enhanced	See Answer Key
12	(BIO.1C.3) Contrast the structure of viruses with that of cells, and explain why viruses must use living cells to reproduce.	2	Multiple Choice	D

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Item Number	Objective	DOK Level	Item Type	Correct Answer
13	(BIO.1E.2) Identify and describe the changes that occur in a cell during replication. Explore problems that might occur if the cell does not progress through the cycle correctly (cancer).	2	Multiple Choice	A
14	(BIO.5.2) Analyze models of the cycling of matter (e.g., carbon, nitrogen, phosphorus, and water) between abiotic and biotic factors in an ecosystem and evaluate the ability of these cycles to maintain the health and sustainability of the ecosystem.	2	Technology Enhanced	See Answer Key
15	(BIO.4.6) Construct explanations for the mechanisms of speciation (e.g., geographic and reproductive isolation).	2	Multiple Choice	D
16	(BIO.5.5) Evaluate symbiotic relationships (e.g., mutualism, parasitism, and commensalism) and other co-evolutionary (e.g., predator-prey, cooperation, competition, and mimicry) relationships within specific environments.	2	Multiple Choice	D
17	(BIO.3B.3) Investigate traits that follow non-Mendelian inheritance patterns (e.g., incomplete dominance, codominance, multiple alleles in human blood types, and sex-linkage).	2	Technology Enhanced	See Answer Key
18	(BIO.3B.4) Analyze and interpret data (e.g., pedigrees, family, and population studies) regarding Mendelian and complex genetic traits (e.g., sickle-cell anemia, cystic fibrosis, muscular dystrophy, color-blindness, and hemophilia) to determine patterns of inheritance and disease risk.	2	Technology Enhanced	See Answer Key
19	(BIO.1A.1) Develop criteria to differentiate between living and non-living things.	2	Multiple Choice	D
20	(BIO.3B.4) Analyze and interpret data (e.g., pedigrees, family, and population studies) regarding Mendelian and complex genetic traits (e.g., sickle-cell anemia, cystic fibrosis, muscular dystrophy, color-blindness, and hemophilia) to determine patterns of inheritance and disease risk.	2	Technology Enhanced	See Answer Key
21	(BIO.5.7) Investigate and evaluate factors involved in primary and secondary ecological succession using local, real world examples.	2	Multiple Choice	B
22	(BIO.2.3) Develop models of the major reactants and products of cellular respiration (aerobic and anaerobic) to demonstrate the transformation of the chemical energy stored in food to the available energy of ATP. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored.	2	Technology Enhanced	See Answer Key

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Item Number	Objective	DOK Level	Item Type	Correct Answer
23	(BIO.2.2) Develop models of the major reactants and products of photosynthesis to demonstrate the transformation of light energy into stored chemical energy in cells. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored.	2	Multiple Choice	A
24	(BIO.1E.3) Relate the processes of cellular reproduction to asexual reproduction in simple organisms (i.e., budding, vegetative propagation, regeneration, binary fission). Explain why the DNA of the daughter cells is the same as the parent cell.	2	Multiple Choice	D
25	(BIO.3C.3) Use models to predict how various changes in the nucleotide sequence (e.g., point mutations, deletions, and additions) will affect the resulting protein product and the subsequent inherited trait.	2	Technology Enhanced	See Answer Key

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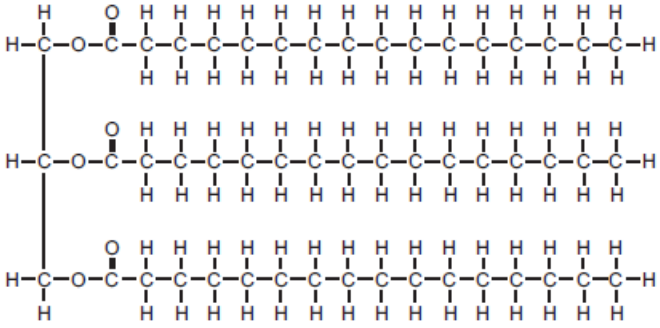
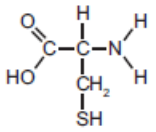
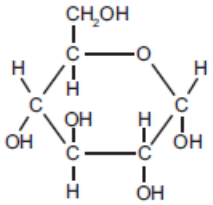
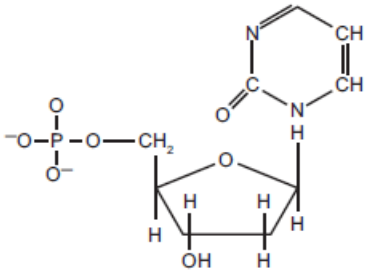
Technology Enhanced Items
Answer Key

Item #2

Macromolecules and Their Monomer Structures

Name of Macromolecule	Monomer Molecular Structure
B	
D	
A	
C	

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Technology Enhanced Items
Answer Key

Item #5

(A.) discovered and named cells

B. stated all plants are made of cells

(C.) observed cork cell walls under a microscope

D. determined all cells come from other preexisting cells

E. stated all cells have the same basic chemical composition

F. discovered that hereditary information is passed on from cell to cell

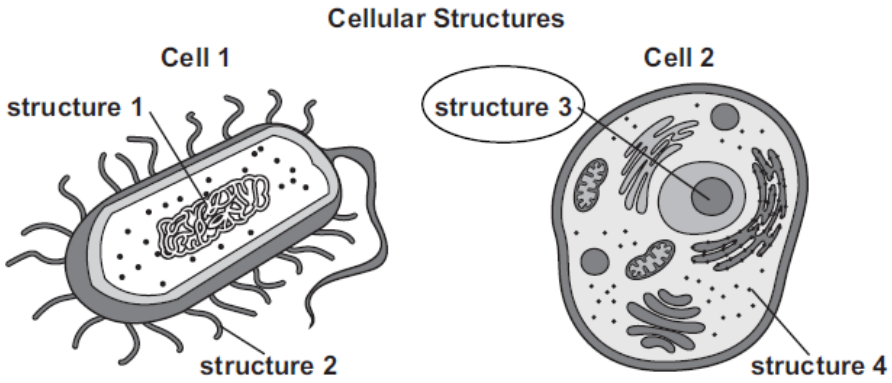
Item #6

Part A

Characteristics of Eukaryotic and Prokaryotic Cells

Characteristic	Type of Cell
has ribosomes	3
has a cell membrane	3
has DNA in the cytoplasm	1
has membrane-bound organelles	2

Part B



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Technology Enhanced Items
Answer Key

Item #8

Aerobic Respiration in Animals

C + glucose → B + E + energy

Aerobic Respiration in Plants

C + glucose → B + E + energy

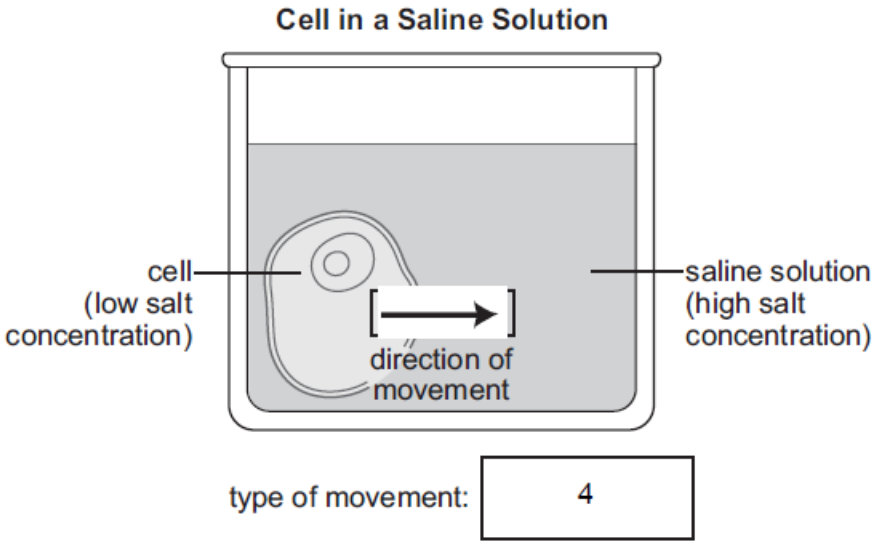
Anaerobic Respiration in Animals

glucose → D + energy

Anaerobic Respiration in Plants

glucose → A + E + energy

Item #10



type of movement: 4

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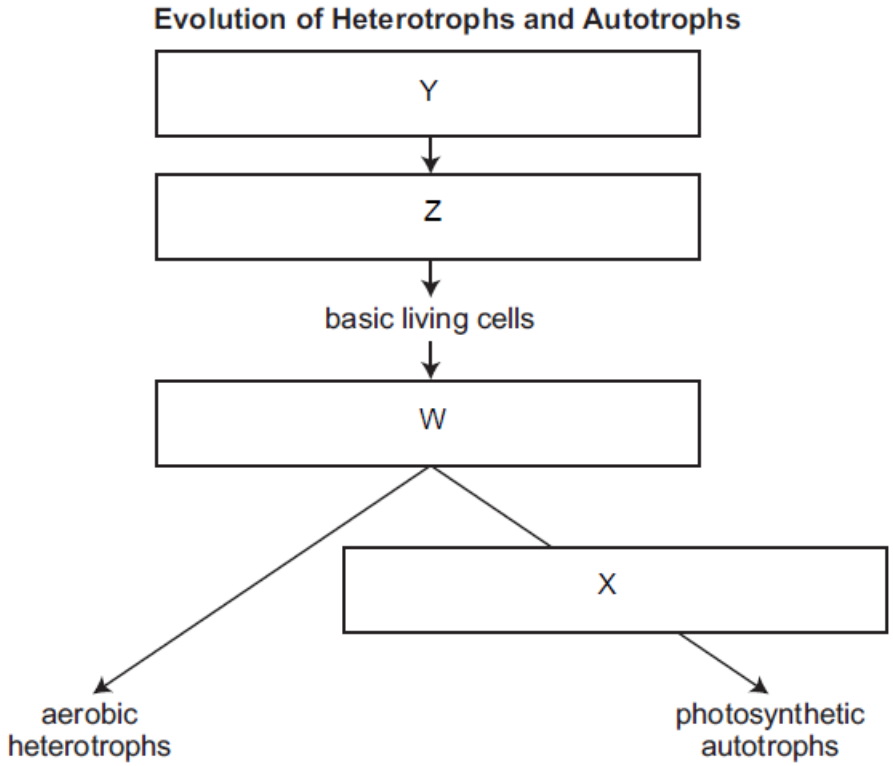
Technology Enhanced Items
Answer Key

Item #11



Item #14

Part A: Based on the diagram, which component is a direct product of abiotic and biotic activities in this cycle?

(A.) nitrates

B. nitrites

C. ammonium

D. atmospheric nitrogen

Part B: What is the role of nitrogen-fixing bacteria in this cycle?

(A.) making atmospheric nitrogen available for plants

B. transforming sunlight energy into usable energy for plants

C. breaking down dead plant matter and releasing it as nitrogen into the atmosphere

D. increasing the amount of plant matter that decomposers can convert to ammonium

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Technology Enhanced Items
Answer Key

Item #17

23

Item #18

There is a (0% / 25% / 50% / 75% / 100%) chance the offspring will be a color-blind male.

There is a (0% / 25% / 50% / 75% / 100%) chance the offspring will be a color-blind female.

Item #20

Part A: Circle the inheritance pattern of the trait shown in the pedigree.

Based on the pedigree, the trait is most likely (autosomal dominant / autosomal recessive / sex-linked dominant / sex-linked recessive).

Part B: What is the genotype of individual 3 in generation II?

A. AA

B. Aa

C. aa

D. X^AX^a

E. X^AY

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Technology Enhanced Items
Answer Key

Item #22

Part A: Circle a process in each set of options to identify the stages of cellular respiration.

Stage 1 is (the citric acid cycle / the electron transport chain / (glycolysis)).

Stage 2 is ((the citric acid cycle) / the electron transport chain / glycolysis).

Stage 3 is (the citric acid cycle / (the electron transport chain) / glycolysis).

Part B: Circle a reactant or product in each set of options to describe the processes shown by the stages in the model.

Stage 1 uses (carbon dioxide / (glucose) / oxygen).

Stage 2 uses the products of stage 1

to produce 2 ATP and ((carbon dioxide) / glucose / oxygen).

Stage 3 uses the products of stage 2

and (carbon dioxide / glucose / (oxygen)) to produce 32 ATP and water.

Item #25

Part A

A. UAC GGU GCG GGT

B. UAC GGU GCG GGU

C. AUC GGU GCG GGU

D. UAC CCU CCA GGU

Part B

A. The protein will not be produced; the mutation is a nonsense mutation.

B. The protein produced will not change; the mutation is a silent mutation.

C. The third amino acid in the protein would change from PRO to ALA, which may affect the shape and function of the protein.

D. The third amino acid in the protein would change from ALA to PRO, which may affect the shape and function of the protein produced.