VIRGINIA STANDARDS OF LEARNING

TEST ITEM SET

BIOLOGY

2010 Science Standards of Learning

Released Spring 2015

SAMPLE A

A teacher in a biology laboratory is using a chemical to dissolve an eggshell. Which picture shows the safest laboratory practice?

○ **A**

○ **C**

○ **B**

○ **D**

Directions: Click and drag a term into each box. Each term may be used more than once.

SAMPLE B

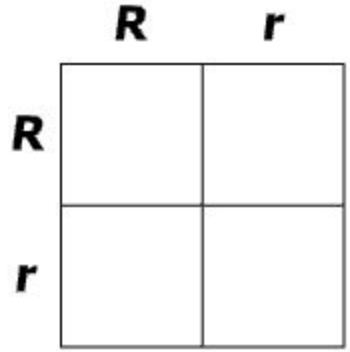
A student conducted an investigation to determine the effect of water temperature on the amount of sugar that dissolves in a beaker of water. Identify components for trial 1 of this investigation.

Trial 1

Beaker Number	Amount of Water (mL)	Temperature of Sugar (°C)	Temperature of Water (°C)	Amount of Sugar Dissolved (g)
1	100	20	5	185
2	100	20	10	189
3	100	20	15	194
4	100	20	20	204

Terms

- **Variable**
- **Constant**

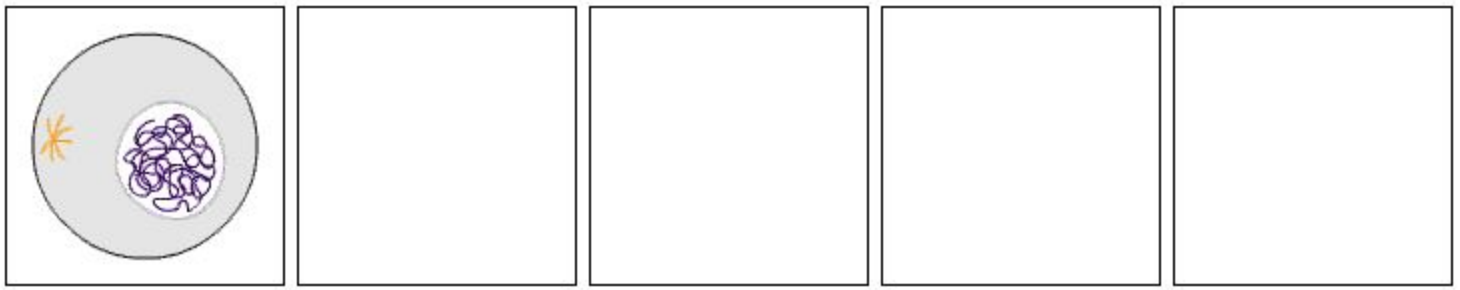


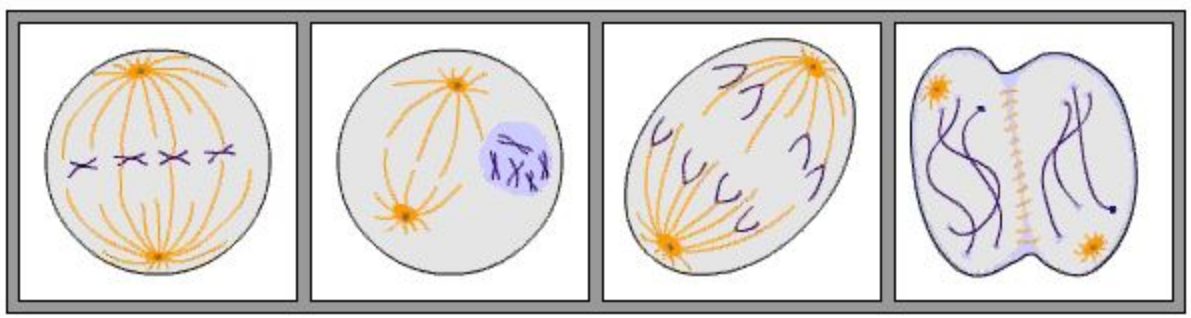
Red flower color is dominant to white flower color in rose plants. What is the expected result of a cross between two heterozygous rose plants?

- **A** 100% red
- **B** 75% red, 25% white
- **C** 50% red, 50% white
- **D** 25% red, 75% white

Directions: Click and drag the answers to the correct boxes.

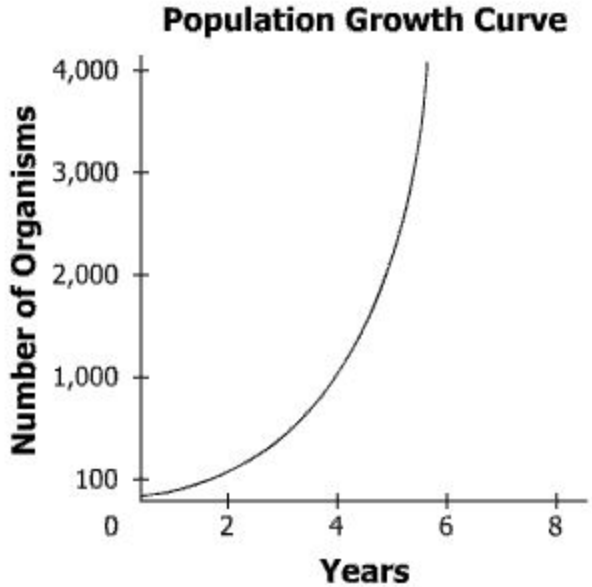
Place the phases of mitosis in the correct sequence.





To classify an organism a scientist finds in the field, which of these will the scientist first compare to other known organisms?

- **A** Dietary habits
- **B** Ecological niche
- **C** Physical structure
- **D** Reproductive method



For the growth curve to continue increasing, which of these must occur?

- **A** The organisms must adapt to a new habitat.
- **B** The organisms must migrate to a new environment.
- **C** The resources in the environment must be unlimited.
- **D** The environment must provide a habitat for a large variety of organisms.

What did Rosalind Franklin contribute to the understanding of DNA molecules?

- **A** An image indicating the shape of a DNA molecule
- **B** An analysis of the chemical makeup of a DNA molecule
- **C** A thought that DNA carries genetic information
- **D** A theory about how DNA conveys genetic information

Directions: Click and drag the answers to the correct boxes.

Some functions of several structures of a fish are listed in the chart. Complete the chart by placing the structures of a cell next to the function they perform.

Structure and Function Comparison

Function	Single-Cell Structure	Fish Structure
Control of Functions		Brain
Gas Exchange		Gills
Waste Storage		Bladder
Movement		Fins, Tail

Cell Membrane

Flagellum

Nucleus

Vacuole

Darwin's explanation for evolution was dependent on which scientific concept?

- **A** The ability of organisms to learn
- **B** The significance of social behaviors to survival
- **C** The existence of variations in a population
- **D** The relationship between size and survival

Which best helps scientists determine the age of fossils?

- **A** Physical traits
- **B** Genetic makeup
- **C** Reproductive strategy
- **D** Radioactive isotopes

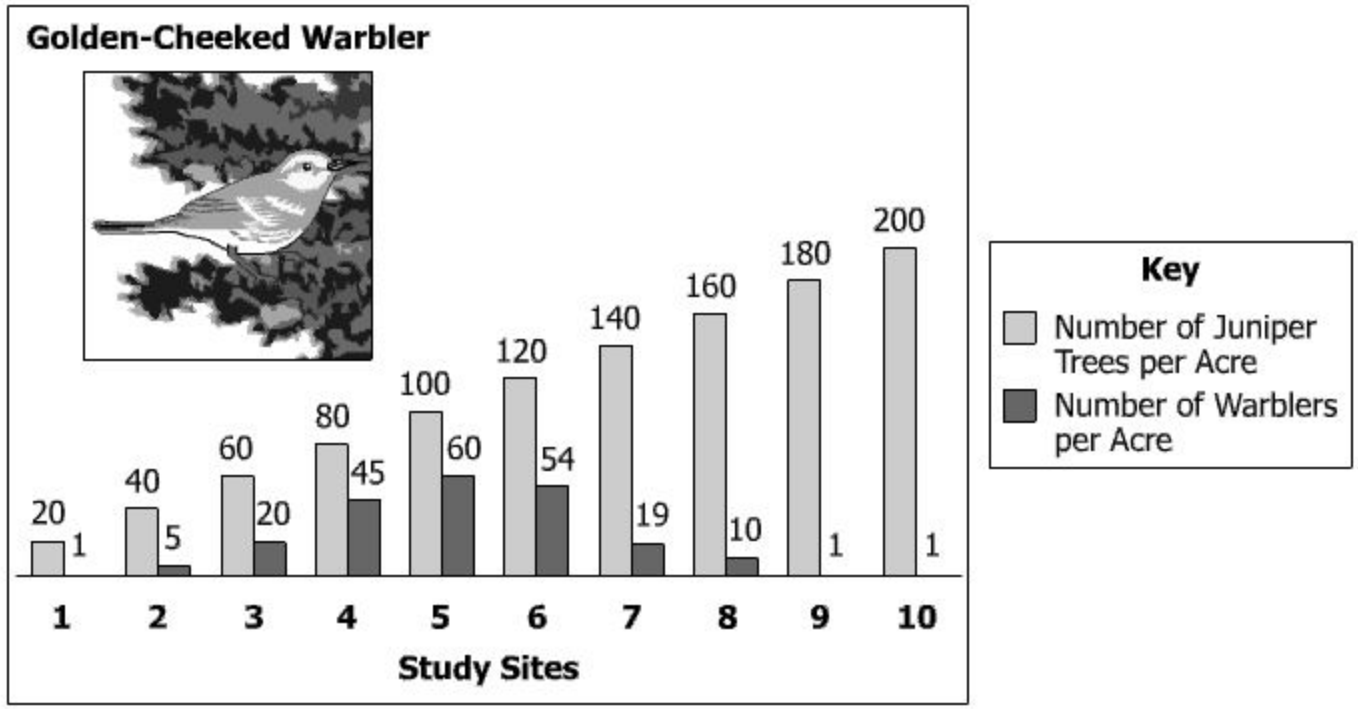
A student is investigating the effect of plants on indoor air quality and states, "If plants are added to an indoor environment, the air quality will improve." This statement is an example of —

- **A** a theory
- **B** a procedure
- **C** an observation
- **D** a hypothesis

Although controversial at first, the germ theory of disease proposed that microorganisms were the cause of many diseases. Which of these was a result of the general acceptance that microorganisms cause disease?

- **A** The development and use of antibiotics
- **B** The belief in spontaneous generation
- **C** The link between viruses and RNA
- **D** The proof of a supernatural cause for illnesses

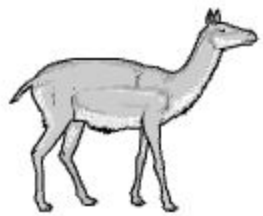
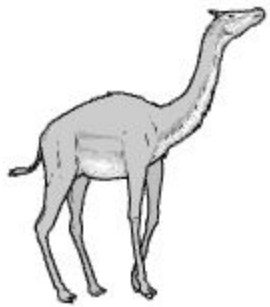
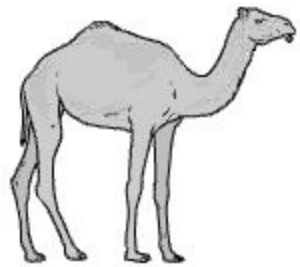
Golden-Cheeked Warbler/Juniper Tree Populations



A biologist gathered data to show the interaction of the golden-cheeked warbler and juniper tree populations. Which conclusion did the biologist most likely make from the data shown?

- **A** As the juniper tree population increases, the golden-cheeked warbler population increases.
- **B** The optimum habitat for the golden-cheeked warbler population is 100 juniper trees per acre.
- **C** The golden-cheeked warbler population stabilizes when the juniper tree population increases above 120 trees per acre.
- **D** A golden-cheeked warbler population is unable to survive if juniper trees are present.

History of the Camel

Oligocene Camel	Miocene Camel	Present Camel
		

Studying the differences between fossils and modern organisms helps scientists better understand the —

- **A** role of mutation in life functions
- **B** primary function of key macromolecules
- **C** adaptation of organisms through acquired traits
- **D** evolution of organisms over time

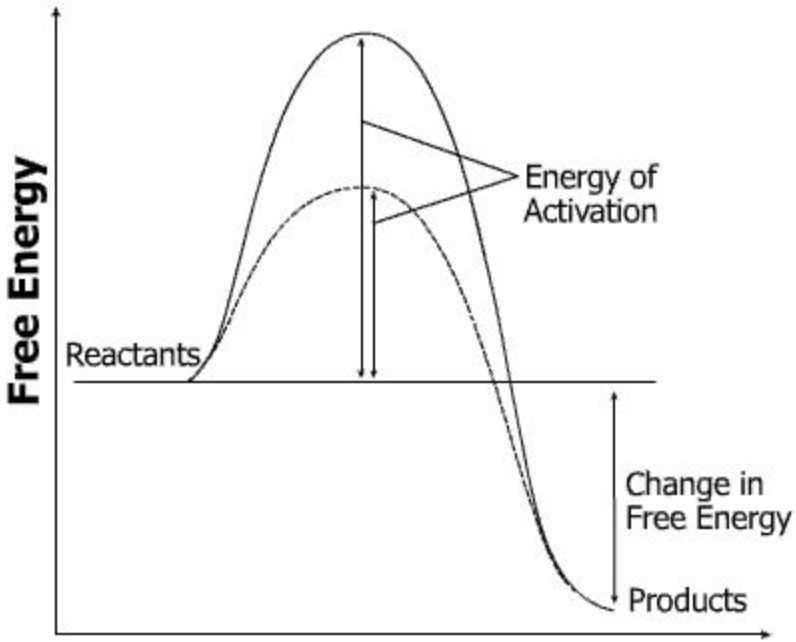
Unknown Organism

- Nucleus present
- Mitochondria present
- Multicellular
- Cells grow in columns
- Cell wall made of chitin
- Decomposer

This chart shows observations made of an unknown organism. Based on this information, the organism most likely belongs to the kingdom —

- **A** Fungi
- **B** Plantae
- **C** Eubacteria
- **D** Animalia

Energy Graph

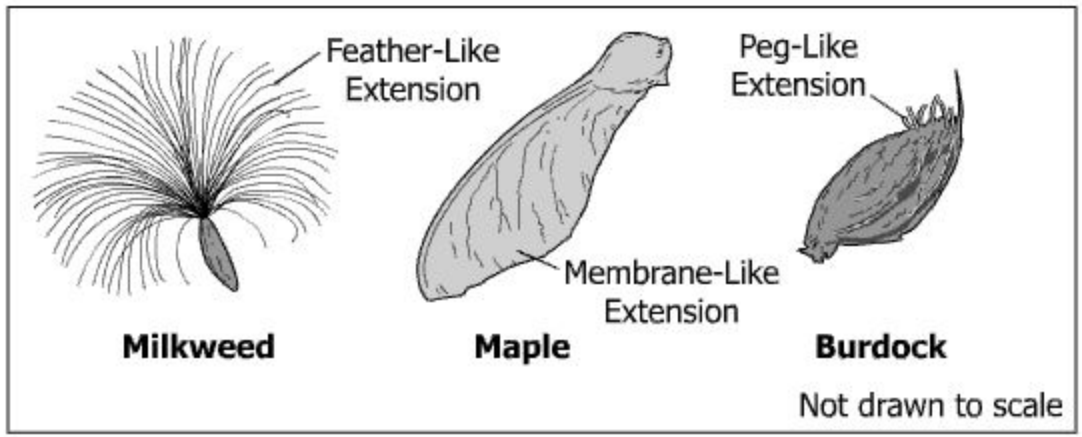


Key
——— reaction without enzyme
---------- reaction with enzyme

What can be concluded from this graph?

- **A** The reactants have less energy than the products.
- **B** The enzyme is consumed during the course of the reaction.
- **C** The enzyme lowers the energy of activation for the reaction.
- **D** The amount of free energy produced in the reaction increases with an enzyme.

Three Plant Seeds



Which statement is an inference based on this information?

- **A** Plant seeds have different shapes.
- **B** Milkweed seeds are dispersed by wind.
- **C** Maple seeds have a membrane-like extension.
- **D** Burdock seeds have short, peg-like extensions.

The weakness of hydrogen bonds between the bases of DNA allows —

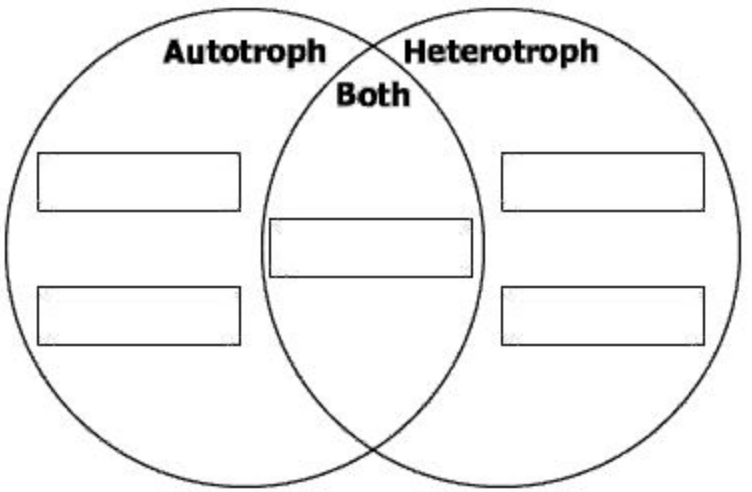
- **A** rearrangement of the sequence of bases to take place
- **B** base pairs to separate during transcription and replication
- **C** new bases to be incorporated into the DNA molecule
- **D** conversion of bases to amino acids in the event of cell starvation

Which of these would most likely result in a change to the current classification of an organism?

- **A** Discovering organisms with similar physical traits in the fossil record
- **B** Finding a related organism that was previously considered extinct
- **C** Linking the organism to different ancestors through DNA sequencing
- **D** Observing organisms that occupy the same ecological niche

Directions: Click and drag the answers to the correct boxes.

Classify the organisms by their metabolic strategies.



- Fern
- Euglena
- Grass
- Paramecium
- Yeast

Five species of frogs that live in separate habitats within 5 non-overlapping ranges along the Mississippi River share a common ancestor. Which process is most likely responsible for the formation of these five distinct species?

- **A** Physiological isolation
- **B** Geographic isolation
- **C** Behavioral isolation
- **D** Reproductive isolation

Chloroplast Process

$$\underline{X} + H_2O \longrightarrow \underline{Y} + O_2$$

The diagram shown represents the input and output of a process performed by the chloroplast of a cell. Which substance is most likely represented by Y?

- **A** Glucose
- **B** CO_2
- **C** ATP
- **D** Light

Investigation of Robins

1. A student notices fewer robins in her yard during the winter.
2. She thinks that some robins must migrate in the winter.
3. She counts the robins in her yard once a week for 2 years.
4. She finds that there are about half as many robins in her yard in the winter as in the summer.
5. Her research has shown that some robins are not in her yard during winter.

Which statement best describes her hypothesis?

- **A** A student notices fewer robins in her yard during the winter.
- **B** She thinks that some robins must migrate in the winter.
- **C** She counts the robins in her yard once a week for 2 years.
- **D** Her research has shown that some robins are not in her yard during winter.

Seaweeds occupy an important niche in the Chesapeake Bay ecosystem. Which question will best help a student identify the role of seaweeds in this ecosystem?

- **A** Which organisms depend on seaweeds as an energy source?
- **B** Which seaweed species produces the greatest amount of oxygen?
- **C** What wavelengths of light are photosynthesized by seaweed species?
- **D** What is the salinity in areas where seaweed is growing?

In 1950, Erwin Chargaff discovered that the percentage of adenine in DNA equals the percentage of thymine, and that the percentage of cytosine equals the percentage of guanine. This proved invaluable to the eventual discovery of which aspect of DNA?

- **A** Location
- **B** Solubility
- **C** Structure
- **D** Volume

The study of embryos and other early stages of development can help in the classification of living things, past and present, by providing clues about the —

- **A** prokaryotic species that are at risk for extinction
- **B** rate of appearances of new terrestrial organisms
- **C** barriers to mating among marine populations
- **D** common ancestry among vertebrate species

Directions: Click and drag the correct answer to each box.

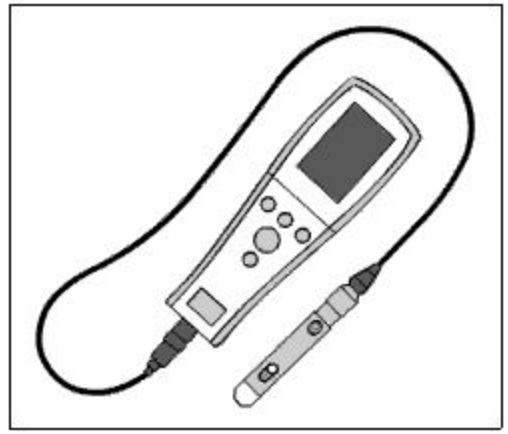
A water molecule is [ ]. It has a slightly [ ] charge on the [ ] atom and a slightly [ ] charge on the two [ ] atoms.

- polar
- nonpolar
- hydrogen
- oxygen
- positive
- negative

Which characteristic do most adult fungi and plants share?

- **A** They both are producers.
- **B** They both have cells with cell walls.
- **C** They both reproduce through binary fission.
- **D** They both have multiple nuclei in each cell.

Dissolved Oxygen Probe



Students use a dissolved oxygen probe during a laboratory activity involving 1,000 mL samples of pond water. The function of the probe is to —

- **A** create a model
- **B** test a hypothesis
- **C** gather accurate data
- **D** analyze investigation conditions

Directions: Type your answer in the box.

In a population of 120 oak trees, 25% of the population has oak wilt disease. What is the number of trees in this population that have oak wilt?

_____ **trees with oak wilt**

An insect called the hemlock woolly adelgid was introduced to a Virginia forest ecosystem. This pest feeds on the nutrients stored inside a hemlock tree, resulting in the death of the tree. Which kind of data would best help a student evaluate the effect of this insect?

- **A** A comparison of the adelgid with native pest species
- **B** An account of how the adelgid was introduced into Virginia ecosystems
- **C** A list of the foreign ecosystems infiltrated by the hemlock woolly adelgid
- **D** Information about the ecosystem's characteristics before the adelgid infestation

Comparison of Transpiration Rates Over a 60 Hour Period

Humidity (%)	Plant Species Group (10 plants each)	Type of Soil (200 g)	Average Transpiration Rate ($g/dm^2/hr$)
35	Species 1	Sand	23.5
	Species 2		21.6
46	Species 1	Sand	20.4
	Species 2		23.8
58	Species 1	Clay	18.8
	Species 2		22.9
70	Species 1	Clay	14.4
	Species 2		16.5

A student wanted to compare the transpiration rates of two different plant species at varying levels of humidity. The results are recorded in the table shown. Each plant group was given the same amount of water and light throughout the investigation. Which procedure should have been performed to prevent error in this investigation?

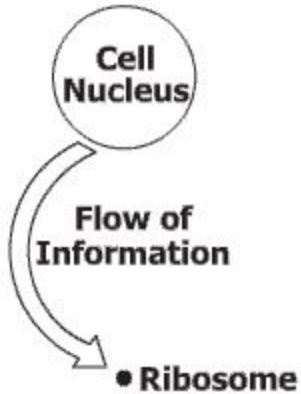
- **A** One type of plant should have been tested.
- **B** Fewer plants should have been included in each group.
- **C** The percentage of humidity should have been kept constant.
- **D** Both groups should have been tested in the same soil type at each humidity level.

In an ecosystem, a sudden decrease in the number of bacteria in the soil would most likely result in —

- **A** increased water pollution in the soil
- **B** increased precipitation and flooding of the soil
- **C** a reduction in the amount of nitrogen available to the ecosystem
- **D** a decrease in the number of fossils formed in the soil

Medicines are being produced using recombinant DNA technology. For veterinarians, the use of this DNA technology will result in —

- **A** decreasing the number of antibodies produced by pets
- **B** altering the chromosomes of healthy pets
- **C** making more treatments available for pets
- **D** identifying new diseases spread by pets



The arrow in the diagram represents the movement of which molecular structure?

- **A** DNA molecule
- **B** mRNA molecule
- **C** Base pair
- **D** Protein

Classification Key for Insects

1. a. Antennae with rounded tips ..... go to 2
   b. Antennae with pointed tips ..... go to 3

2. a. Wings with stripes ..... go to 4
   b. Wings without stripes ..... *Papilio polyxenes*

3. a. Wings fringed with visible hairs ..... *Lymantria dispar*
   b. Wings lacking hairs ..... *Malacosoma americanum*

4. a. Wings with tail-like extensions shorter than antennae ..... *Papilio palamedes*
   b. Wings with tail-like extensions longer than antennae ..... *Eurytides marcellus*

According to the classification key, what is the genus and species of this organism?

- **A** *Papilio polyxenes*
- **B** *Malacosoma americanum*
- **C** *Papilio palamedes*
- **D** *Eurytides marcellus*

Jackrabbit

© Heather Craig/iStockphoto #1622597

The jackrabbit is a desert mammal. The jackrabbit's circulatory system increases blood flow to the ears during hot days. The blood flow to the ears decreases during cool or cold nights. This circulation pattern is most directly related to —

- **A** detoxification
- **B** excretion
- **C** osmosis
- **D** homeostasis

Proteins are among the most diverse group of macromolecules because of the —

- **A** different amino acids that can be connected in many sequences
- **B** different types of bonds linking amino acids together
- **C** energy phosphate groups that the amino acids contain
- **D** link between each DNA base and an amino acid in a protein

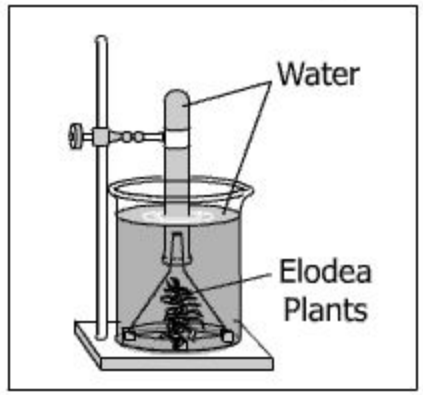
Which is an activity that increases the genetic variation within a population of earthworms?

- **A** Binary fission
- **B** Sexual reproduction
- **C** Budding
- **D** Fragmentation

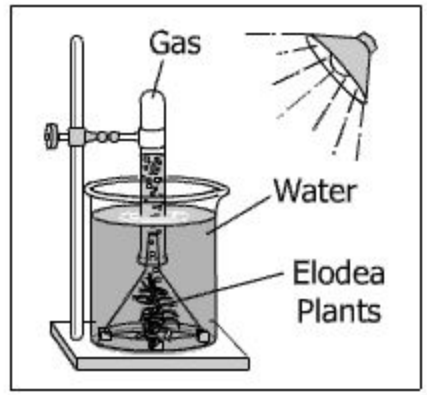
The structural differences between a tadpole and an adult frog are due to the —

- **A** availability of food sources at different stages
- **B** type of DNA present at each developmental stage
- **C** combination of genetic material inherited during fertilization
- **D** different sets of genes expressed at each stage of development

Student Experiment With Elodea Plants



24-Hour Setup Without Light



24-Hour Setup With Light

After 24 hours, the amount of gas that accumulated at the top of the inverted test tube is measured. The students conclude that the light source is causing the water to evaporate, causing water vapor to fill the top of the tube. The best alternative explanation of the differences between the setups is that the —

- **A** gravity increased the downward flow of the trapped water
- **B** metabolism of the elodea plants absorbed CO_2 from the water
- **C** heat from the light source caused the escape of dissolved gas
- **D** light caused the elodea plants to photosynthesize, releasing O_2 gas

Directions: From the table headings, click and drag the answers to the correct boxes.

This table was found in a journal of student research. What are the components found in these experimental data?

Effect of Temperature on Enzyme Activity

Test Group	Water (mL)	Starch Solution (mL)	Enzyme: Amylase (mL)	Incubation Temperature (°C)	Fractional Activity (%)
Control	9	2	0	37	0
1	8	2	1	37	74
2	8	2	1	38	76
3	8	2	1	39	78
4	8	2	1	40	80

Independent Variable	Dependent Variable	Constants		

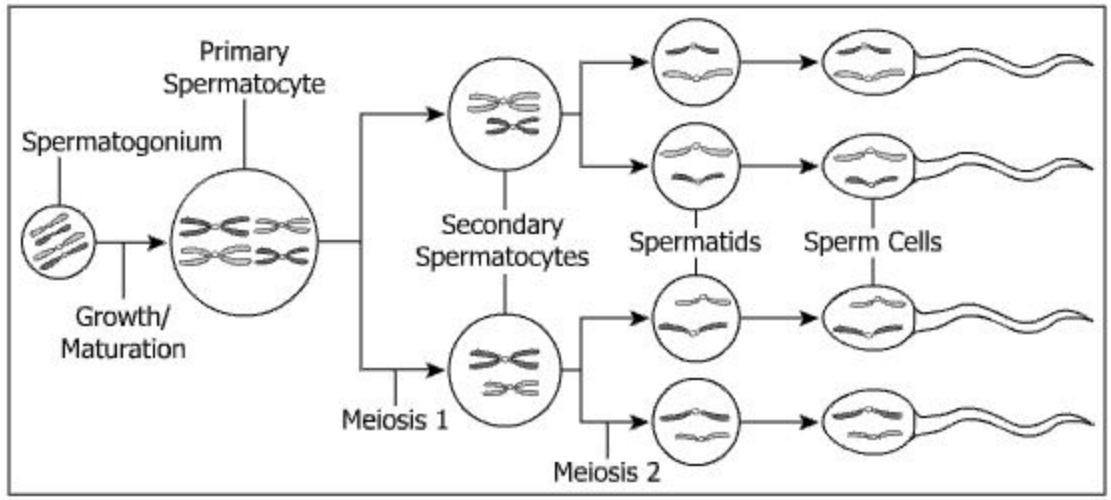
Scientists classifying modern animals are most likely to compare the —

- **A** structure of the animals' ATP
- **B** function of the animals' limbs
- **C** composition of the animals' bones
- **D** sequence of the animals' DNA

Which feature do viruses have in common with animal cells?

- **A** Ability to form proteins at the ribosomes
- **B** Existence of lipids in cell membranes
- **C** Presence of a genetic code in nucleic acid
- **D** Production of energy by a mitochondrion

Model of Spermatogenesis



According to this diagram, the result of spermatogenesis is four sperm cells, each with —

- **A** strands of DNA that resulted from crossing over
- **B** half of the original number of chromosomes
- **C** genetically identical strands of DNA
- **D** complete copies of all the original chromosomes

A group of ponies lives in the Chincoteague National Wildlife Reserve in Virginia. The development of longer legs over time would be selected for if —

- **A** it increased the survival rate of the long-legged ponies
- **B** it decreased the rate of reproduction of the long-legged ponies
- **C** it prohibited the long-legged ponies from using available food sources
- **D** it made the long-legged ponies run more slowly

One parent is heterozygous for a certain trait (*Dd*). The other parent is homozygous dominant (*DD*) for that trait. What is the percent chance that an offspring from this cross will be heterozygous?

- **A** 0%
- **B** 25%
- **C** 50%
- **D** 100%

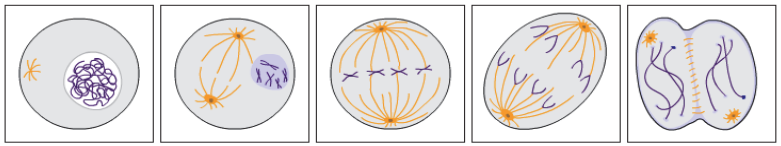
Length of Elodea Stems (cm)

Trial	Day 1	Day 8	Day 15	Day 22
W	3	6	10	14
X	5	7	10	14
Y	2	4	9	12
Z	4	7	17	13

Which trial in the table of data shown has questionable data?

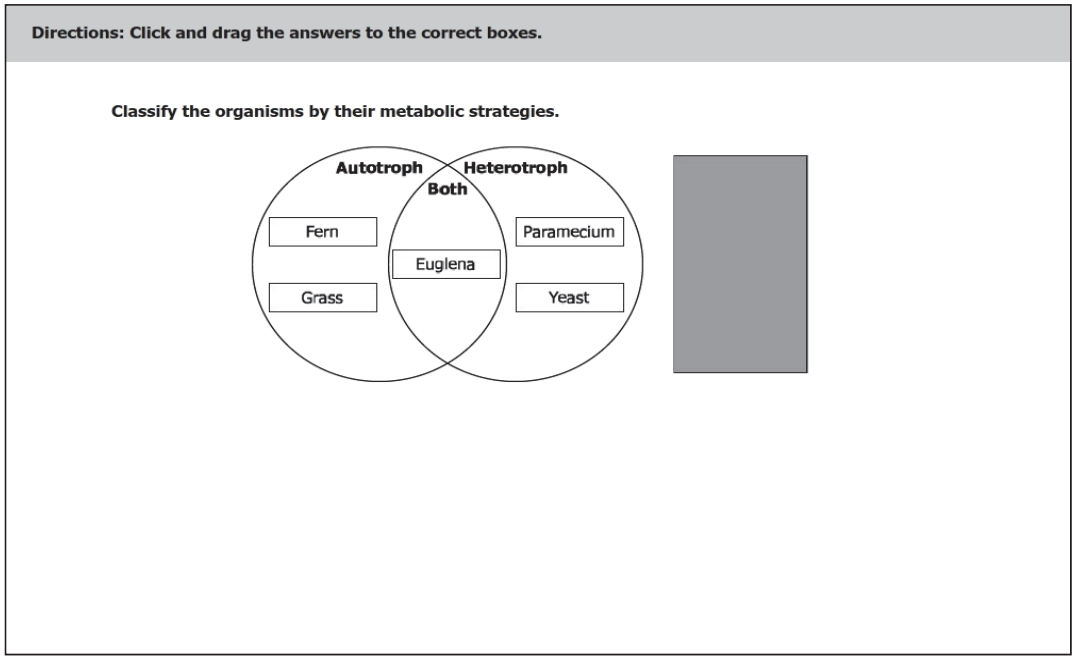
- **A** W
- **B** X
- **C** Y
- **D** Z

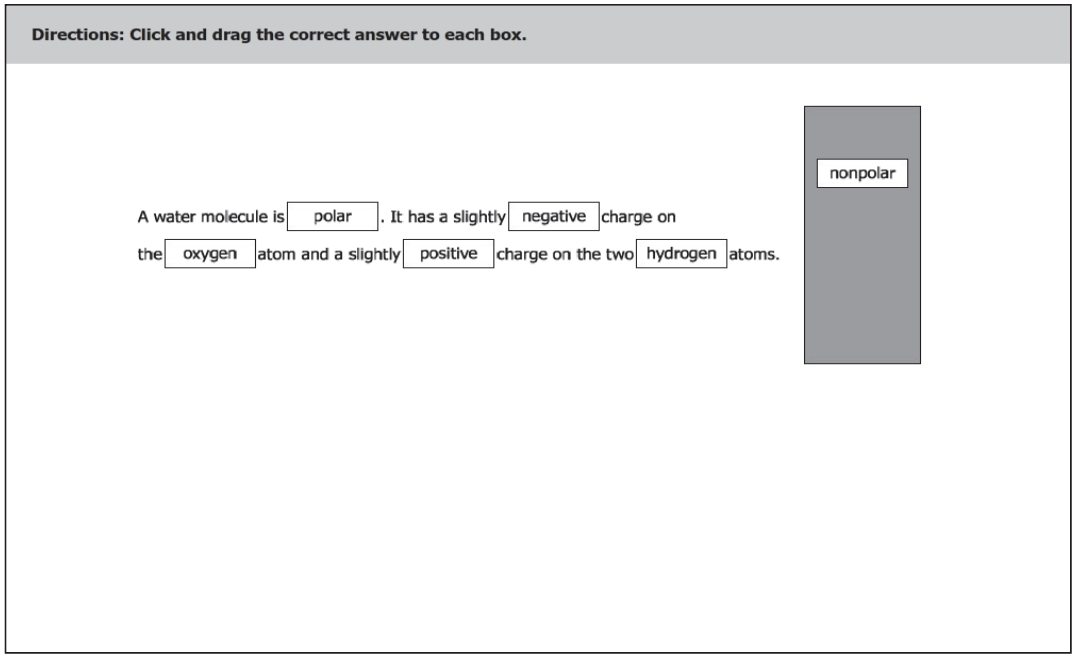
Biology
Released Test Item Set Spring 2015
Answer Key

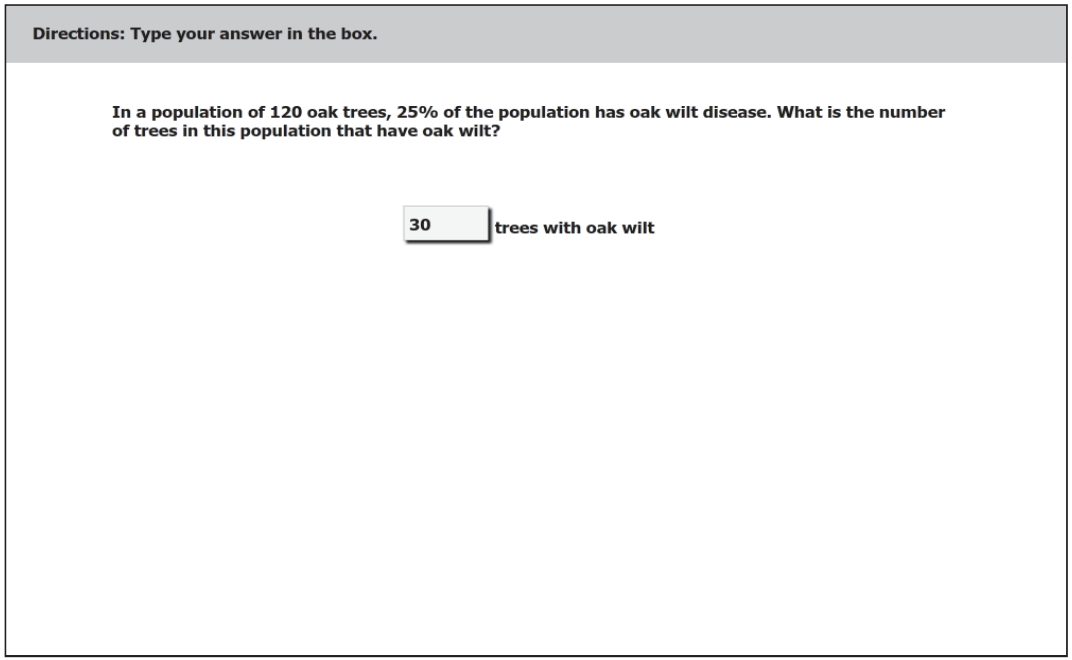
Sequence Number	Item Type: Multiple Choice (MC) or Technology-Enhanced Item (TEI)	Correct Answer	Reporting Category	Reporting Category Description
1	MC	B	003	Life at the Systems and Organisms Level
2	TEI	Phases must be placed in the correct order from left to right as shown:  Directions: Click and drag the answers to the correct boxes. Place the phases of mitosis in the correct sequence. 	002	Life at the Molecular and Cellular Level
3	MC	C	003	Life at the Systems and Organisms Level

<table>
<tr><th>Sequence Number</th><th>Item Type: Multiple Choice (MC) or Technology-Enhanced Item (TEI)</th><th>Correct Answer</th><th>Reporting Category</th><th>Reporting Category Description</th></tr>
<tr><td>4</td><td>MC</td><td>C</td><td>004</td><td>Interaction of Life Forms</td></tr>
<tr><td>5</td><td>MC</td><td>A</td><td>002</td><td>Life at the Molecular and Cellular Level</td></tr>
<tr><td>6</td><td>TEI</td><td>Answers must be placed in the correct order from top to bottom:
Nucleus; Cell Membrane; Vacuole; Flagellum
Directions: Click and drag the answers to the correct boxes.
Some functions of several structures of a fish are listed in the chart. Complete the chart by placing the structures of a cell next to the function they perform.
Structure and Function Comparison<table><tr><th>Function</th><th>Single-Cell Structure</th><th>Fish Structure</th></tr><tr><td>Control of Functions</td><td>Nucleus</td><td>Brain</td></tr><tr><td>Gas Exchange</td><td>Cell Membrane</td><td>Gills</td></tr><tr><td>Waste Storage</td><td>Vacuole</td><td>Bladder</td></tr><tr><td>Movement</td><td>Flagellum</td><td>Fins, Tail</td></tr></table></td><td>002</td><td>Life at the Molecular and Cellular Level</td></tr>
<tr><td>7</td><td>MC</td><td>C</td><td>004</td><td>Interaction of Life Forms</td></tr>
<tr><td>8</td><td>MC</td><td>D</td><td>004</td><td>Interaction of Life Forms</td></tr>
<tr><td>9</td><td>MC</td><td>D</td><td>001</td><td>Scientific Investigation</td></tr>
<tr><td>10</td><td>MC</td><td>A</td><td>004</td><td>Interaction of Life Forms</td></tr>
<tr><td>11</td><td>MC</td><td>B</td><td>001</td><td>Scientific Investigation</td></tr>
</table>

Sequence Number	Item Type: Multiple Choice (MC) or Technology-Enhanced Item (TEI)	Correct Answer	Reporting Category	Reporting Category Description
12	MC	D	004	Interaction of Life Forms
13	MC	A	003	Life at the Systems and Organisms Level
14	MC	C	002	Life at the Molecular and Cellular Level
15	MC	B	001	Scientific Investigation
16	MC	B	002	Life at the Molecular and Cellular Level
17	MC	C	003	Life at the Systems and Organisms Level

Sequence Number	Item Type: Multiple Choice (MC) or Technology-Enhanced Item (TEI)	Correct Answer	Reporting Category	Reporting Category Description
18	TEI	Answers must be placed in the correct locations: Autotroph (the two boxes on the left): Fern and Grass (order does not matter) Both (the center box): Euglena Heterotroph (the two boxes on the right): Paramecium and Yeast (order does not matter) 	003	Life at the Systems and Organisms Level
19	MC	B	004	Interaction of Life Forms
20	MC	A	002	Life at the Molecular and Cellular Level
21	MC	B	001	Scientific Investigation
22	MC	A	004	Interaction of Life Forms

Sequence Number	Item Type: Multiple Choice (MC) or Technology-Enhanced Item (TEI)	Correct Answer	Reporting Category	Reporting Category Description
23	MC	C	002	Life at the Molecular and Cellular Level
24	MC	D	003	Life at the Systems and Organisms Level
25	TEI	Answers must be placed in the correct locations, from left to right: First line: polar; negative Second line: oxygen; positive; hydrogen 	002	Life at the Molecular and Cellular Level
26	MC	B	003	Life at the Systems and Organisms Level
27	MC	C	001	Scientific Investigation

Sequence Number	Item Type: Multiple Choice (MC) or Technology-Enhanced Item (TEI)	Correct Answer	Reporting Category	Reporting Category Description
28	TEI	Typed response: 30 	001	Scientific Investigation
29	MC	D	001	Scientific Investigation
30	MC	D	001	Scientific Investigation
31	MC	C	004	Interaction of Life Forms
32	MC	C	002	Life at the Molecular and Cellular Level
33	MC	B	002	Life at the Molecular and Cellular Level
34	MC	D	003	Life at the Systems and Organisms Level
35	MC	D	003	Life at the Systems and Organisms Level
36	MC	A	002	Life at the Molecular and Cellular Level

<table>
<tr><th>Sequence Number</th><th>Item Type: Multiple Choice (MC) or Technology-Enhanced Item (TEI)</th><th>Correct Answer</th><th>Reporting Category</th><th>Reporting Category Description</th></tr>
<tr><td>37</td><td>MC</td><td>B</td><td>004</td><td>Interaction of Life Forms</td></tr>
<tr><td>38</td><td>MC</td><td>D</td><td>002</td><td>Life at the Molecular and Cellular Level</td></tr>
<tr><td>39</td><td>MC</td><td>D</td><td>001</td><td>Scientific Investigation</td></tr>
<tr><td>40</td><td>TEI</td><td>Answers must be placed in the correct order from left to right:
Incubation Temperature (°C); Fractional Activity (%); Water (mL); Starch Solution (mL); Enzyme: Amylase (mL)

Directions: From the table headings, click and drag the answers to the correct boxes.

This table was found in a journal of student research. What are the components found in these experimental data?

Effect of Temperature on Enzyme Activity
<table><tr><th>Test Group</th><th>Water (mL)</th><th>Starch Solution (mL)</th><th>Enzyme: Amylase (mL)</th><th>Incubation Temperature (°C)</th><th>Fractional Activity (%)</th></tr><tr><td>Control</td><td>9</td><td>2</td><td>0</td><td>37</td><td>0</td></tr><tr><td>1</td><td>8</td><td>2</td><td>1</td><td>37</td><td>74</td></tr><tr><td>2</td><td>8</td><td>2</td><td>1</td><td>38</td><td>76</td></tr><tr><td>3</td><td>8</td><td>2</td><td>1</td><td>39</td><td>78</td></tr><tr><td>4</td><td>8</td><td>2</td><td>1</td><td>40</td><td>80</td></tr></table>
Independent Variable: Incubation Temperature (°C)
Dependent Variable: Fractional Activity (%)
Constants: Water (mL); Starch Solution (mL); Enzyme: Amylase (mL)</td><td>001</td><td>Scientific Investigation</td></tr>
</table>

Sequence Number	Item Type: Multiple Choice (MC) or Technology-Enhanced Item (TEI)	Correct Answer	Reporting Category	Reporting Category Description
41	MC	D	002	Life at the Molecular and Cellular Level
42	MC	C	002	Life at the Molecular and Cellular Level
43	MC	B	002	Life at the Molecular and Cellular Level
44	MC	A	004	Interaction of Life Forms
45	MC	C	003	Life at the Systems and Organisms Level
46	MC	D	001	Scientific Investigation

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