

Biology

Administered May 2014

RELEASED

Biology

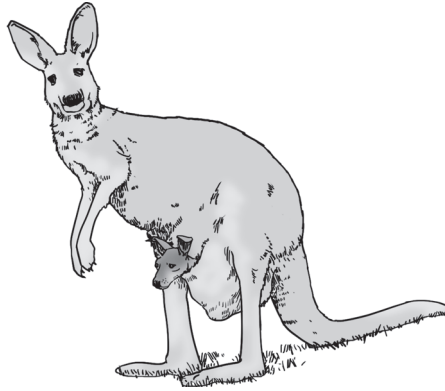
DIRECTIONS

Read each question carefully. Determine the best answer to the question from the four answer choices provided. Then fill in the answer on your answer document.

- 1 The opossum, which is native to North America, and the kangaroo, which is native to Australia, are marsupials.



Opossum



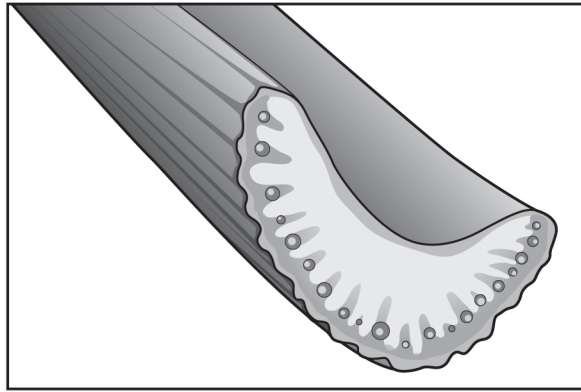
Kangaroo

The fact that both these mammals incubate their immature offspring in a pouch provides evidence that they —

- A belong to the same species
- B must range great distances to eat
- C have very similar skeletal structures
- D are descended from a common ancestor

- 2** Some students are instructed to put a celery stalk in a red dye solution for a lab activity. First the students carefully cut the bottom of the stalk with a scalpel. Then they put the stalk in the beaker with the solution and place the beaker on a shelf in the lab room. The next day they check the stalk and make observations. The students note that the leaves at the end of the stalk have changed color from green to red. The students cut across the celery stalk and use a hand lens to see that the small tube openings along the edge of the celery stalk are also red. The cross section is shown below.

Cross Section of a Celery Stalk



How do the plant systems work together to make this movement of liquid possible?

- F** The roots absorb water and minerals and move them up to the stem, while the stem moves food produced in the leaves down to the roots in tiny tubes.
- G** The roots anchor the plant in the soil, and the stem holds the leaves up.
- H** The roots absorb their own water and minerals, while the stem absorbs its water and minerals through the leaves.
- J** The roots lose water vapor to the soil, and the stem loses water vapor through the leaves.

- 3 The table below provides some information about the feeding methods of the five rhinoceros species.

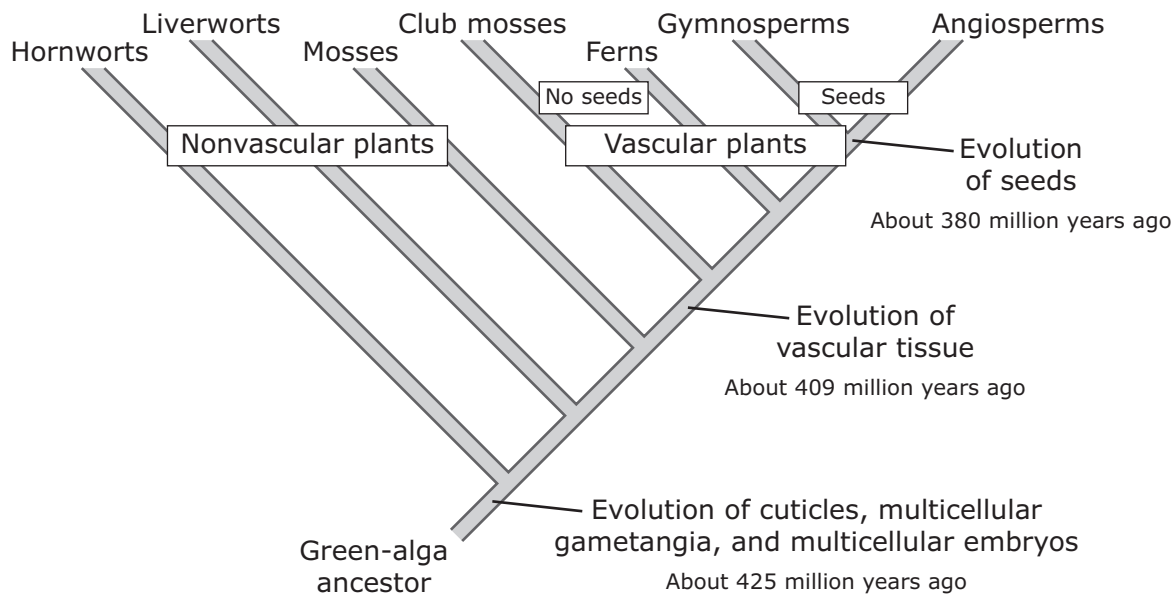
Rhinoceros Species	Method of Feeding
Black rhinoceros	Browses on woody plants and shrubs and eats some fallen fruits; rarely eats grass
White rhinoceros	Grazes on short grasses most of the year but will eat tall grasses when shorter grasses are depleted
Indian rhinoceros	Mainly grazes on tall grasses; will eat short grasses, shrubs, woody plants, and fruits
Javan rhinoceros	Browses the leaves and shoots of small trees and eats some fallen fruits
Sumatran rhinoceros	Browses the leaves and shoots of small trees and eats some fallen fruits

Which rhinoceros species is best adapted for feeding in the large open grasslands of Africa's Serengeti ecosystem?

- A Black rhinoceros
- B White rhinoceros
- C Sumatran rhinoceros
- D Javan rhinoceros

- 4 Early-onset Alzheimer’s disease affects people under the age of 65. Less than five percent of people who are diagnosed with Alzheimer’s disease have this type. Many cases of early-onset Alzheimer’s disease are inherited, a type known as familial Alzheimer’s disease (FAD). Which statement is best supported by this information?
- F FAD is the result of a genetic change in one or more chromosomes.
- G Natural selection will continue to reduce the incidence of FAD.
- H FAD affects only the genes of middle-aged people.
- J Deletion of one amino acid causes FAD.

- 5 The cladogram shows the evolution of land plants as indicated by fossil records.



Which discovery would challenge the validity of this cladogram?

- A A large aquatic vascular plant about 200 million years old
- B A species of algae that has existed for less than one million years
- C A moss species that has existed for less than 380 million years
- D A fossil of a fern more than 425 million years old

6 Atherosclerosis is a disease that obstructs blood flow and, therefore, oxygen supply to target organs. A major component of atherosclerosis is the excessive reproduction of smooth muscle cells of the blood vessels. Certain drugs may have the potential to reverse or prevent the unregulated reproduction of the diseased blood-vessel cells. Which of these processes is the most likely target of these drugs?

- F** Cell division
 - G** Erythroblast differentiation
 - H** DNA transcription
 - J** Cellular respiration
-

7 The outermost layer of plant stems in dicotyledons consists of epidermal cells and guard cells that surround openings called stomata. The epidermal cells are usually covered with a waterproof layer that provides protection from injury and water loss. The stomata allow gas exchange. The epidermal cells and stomata have functions similar to those of which two human body systems?

- A** Skeletal and respiratory
 - B** Cardiovascular and skeletal
 - C** Integumentary and respiratory
 - D** Cardiovascular and integumentary
-

8 Carbohydrates are more easily metabolized than lipids. However, on a gram-for-gram basis lipids provide cells with more —

- F** nitrogen
- G** proteins
- H** structure
- J** energy

9 Lord Howe Island is a volcanic island in the Tasman Sea that is about 11 km long and 2.8 km wide. The island has two species of palm trees, *Howea forsteriana* and the more abundant *Howea belmoreana*. The two species do not interbreed even when they grow very close to each other. Which evolutionary process fails to occur?

- A** Genetic drift of *Howea forsteriana*
- B** Natural selection of adaptive traits in both species
- C** Gene flow between the two species
- D** Mutations in *Howea belmoreana*

10 Dead zones are low-oxygen areas that develop on the seafloor. Scientists hypothesize that phytoplankton blooms cause these dead zones. Phytoplankton blooms occur when excess nutrients are introduced by pollution from fertilizers, sewage plants, and the burning of fossil fuels. Which of the following would most likely cause an increase in these contributors to dead zones?

- F** Rainfall patterns that increase freshwater runoff from terrestrial ecosystems
- G** Replacing coal-fired power plants with windmills
- H** Farming practices that reduce nitrate and phosphate applications
- J** Constructing efficient water-recovery and treatment plants

- 11** Using a light microscope, a student identified the following characteristics of four organisms found in a sample of pond water.

Pond-Water Organisms

Organism 1	Single-celled, nucleus, large vacuole
Organism 2	Single-celled, no nucleus, cell wall
Organism 3	Single-celled, no nucleus
Organism 4	Single-celled, nucleus

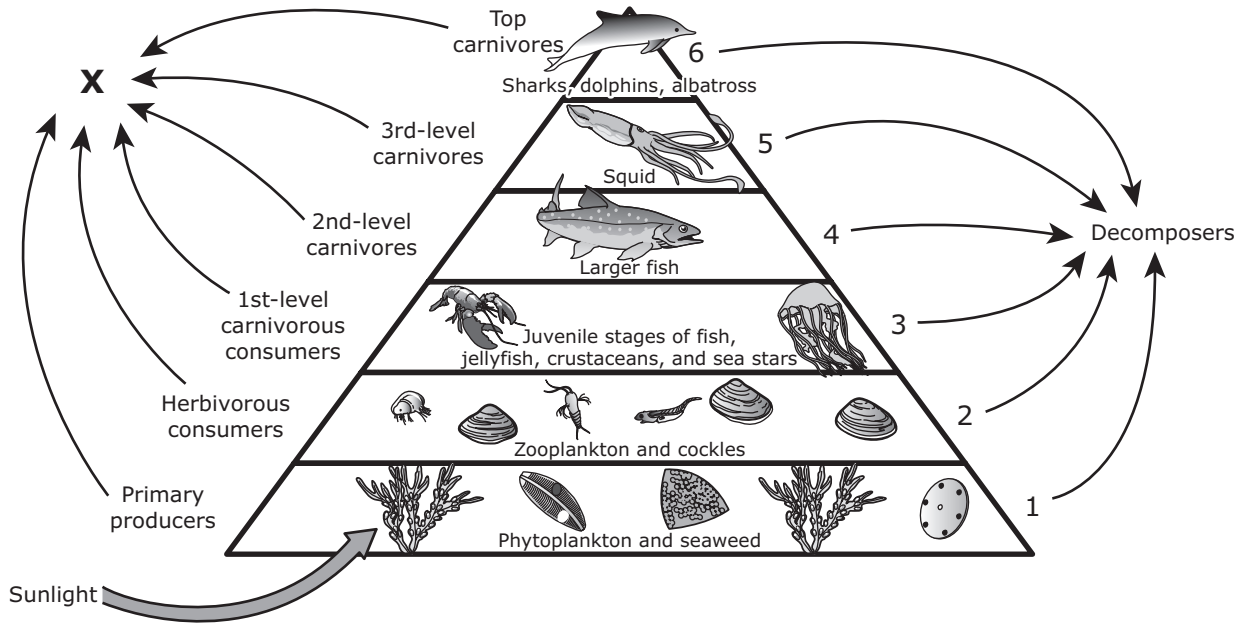
Based on the observations of the student, which organisms most likely belong to the taxonomic group for bacteria?

- A** Organisms 1 and 2
- B** Organisms 3 and 4
- C** Organisms 1 and 4
- D** Organisms 2 and 3
-
- 12** Sexual reproduction in animals depends on the production of gametes. Which of these processes produces gametes in animals?
- F** Mitosis
- G** Fertilization
- H** Meiosis
- J** Binary fission
-
- 13** What two human systems work together to provide body cells with a constant supply of oxygen while removing carbon dioxide waste products?
- A** Nervous and endocrine
- B** Muscular and skeletal
- C** Respiratory and circulatory
- D** Excretory and integumentary

- 14** Some fungi secrete substances that are toxic to bacteria that compete with them for food. Scientists have used their knowledge of this ability of fungi in order to produce which of the following substances?
- F** Yogurt
 - G** Fertilizers
 - H** Plastic
 - J** Antibiotics

-
- 15** A person infected with the human immunodeficiency virus (HIV) may not have any symptoms for a period of time. During this period the virus affects the body by doing which of the following?
- A** The virus produces toxins that weaken immune cells and prevent them from reproducing.
 - B** The virus damages immune cells while using their machinery to produce copies of itself.
 - C** The virus uses nutrients meant for immune cells to fuel its own cellular respiration.
 - D** The virus changes the identity of the nucleotides of immune cells to prevent the immune system from functioning normally.

16 A marine ecosystem is represented below.



What is lost to the environment at each of the trophic levels of this ecosystem?

- F Nutrients from the soil
- G Living space for the organisms
- H Food sources
- J Heat

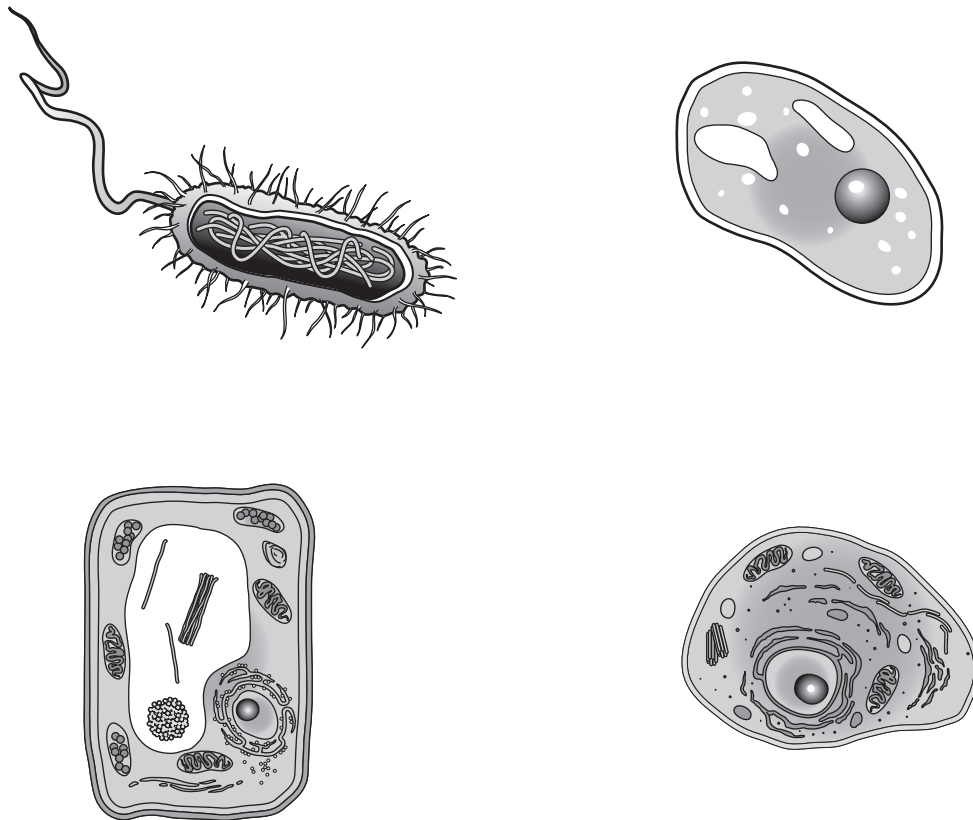
17 The sequence of nitrogenous bases in DNA varies widely. The sequence of the bases in DNA is most important for which of the following?

- A Providing the instructions for the traits of an organism
- B Preventing mutations from occurring during DNA replication
- C Allowing the DNA to have the shape necessary for replication
- D Helping form the sugar-phosphate backbone of DNA molecules

18 Which of the following functions at the same organizational level as the kidney in the human excretory system?

- F** Skeleton
- G** Epithelial tissue
- H** Urinary bladder
- J** A squamous cell

19 Four different types of cells are shown below.

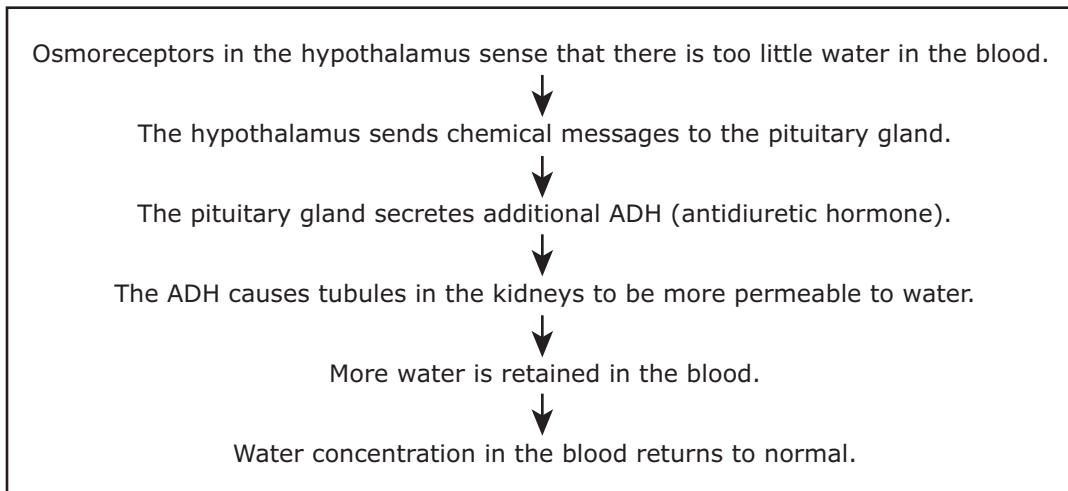


Which characteristic is shared by all four cells?

- A** A mechanism for transforming sunlight into energy
- B** Self-locomotion
- C** Membrane-bound organelles that transport substances
- D** Genetic material composed of DNA

- 20** Scientists estimate that there are more than 20,000 species of ants. The species range in size from 1 mm long to 38 mm long and live in most environments. The diets of ants range from flowers and seeds to fluids from their own larvae. Ants have been able to successfully inhabit so many different environments because their populations have been able to —
- F** hybridize with other species of insects
 - G** adapt to a variety of habitats and food sources
 - H** fill niches usually occupied by mammals
 - J** occupy habitats that have no other life-forms

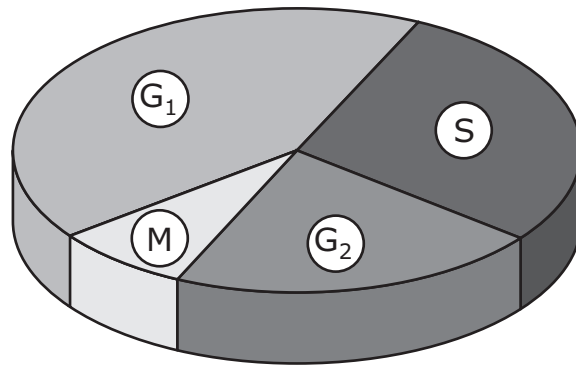
21 The osmoregulation process is shown below.



This process is an example of which of the following?

- A The role of the endocrine system in increasing the oxygen content of red blood cells
- B Control of urine production by the parasympathetic nervous system
- C Maintenance of homeostasis by a feedback mechanism
- D Disruption of homeostasis by exercise

- 22** Checkpoints occur between the stages of the cell cycle. If a cell does not meet certain criteria at the end of a stage, it will not move to the next stage.



Which of these occurs just before the cell enters the G₂ stage of the cell cycle?

- F** The nuclear membrane disintegrates.
- G** DNA replicates.
- H** Centrioles form.
- J** The nucleolus divides.

- 23** In any environment or ecosystem, organisms can have several different types of relationships. Three types of relationships are described below.

Ecological Relationships

Relationship	Description
X	Barnacles (small crustaceans) adhere to the skin of a whale in order to be deposited in a new location that is abundant in resources. The whale does not appear to be affected.
Y	Fleas attach to the skin of warm-blooded animals, feed on their blood, and make the animals itch.
Z	Fungal mycorrhizae live on plant roots and increase the plant's ability to absorb nutrients. The mycorrhizae are provided with carbohydrates from the plant.

Which of these correctly describes the relationships between the organisms?

- A** X: mutualism
Y: parasitism
Z: commensalism
- B** X: commensalism
Y: mutualism
Z: parasitism
- C** X: parasitism
Y: commensalism
Z: mutualism
- D** X: commensalism
Y: parasitism
Z: mutualism

-
- 24** In the 1860s Gregor Mendel performed numerous dihybrid crosses between pea plants. Dihybrid crosses involve the study of the inheritance patterns related to two different traits. In guinea pigs the allele for black fur (B) is dominant over the allele for brown fur (b), and the allele for short fur (F) is dominant over the allele for long fur (f). What percentage of the offspring from a BbFf x bbff cross would be expected to be heterozygous for both traits?

- F** 0%
- G** 25%
- H** 50%
- J** 100%

- 25** Hydrothermal vents form deep in the ocean when iron-rich magma is released from openings on the seafloor. These vents spew extremely hot water (400°C) mixed with methane and sulfur. Bacteria that thrive in this hostile environment form the base of a food chain that leads to colonization by tube worms, mussels, and many other life-forms. When a hydrothermal vent becomes inactive and cold, the bacterial community that lives in the hot fluid methane and sulfur dies out. Which organisms most likely succeed the original community in this ecosystem?
- A** Cold-tolerant bacteria that feed on sulfur and iron in the vents
 - B** Giant kelp that use sulfur in photosynthesis
 - C** Fish that do not need oxygen for cellular respiration
 - D** Ocean mammals that tolerate cold and act as top predators in the food chain
-
- 26** When a person is suddenly cut by a sharp object, a nervous impulse is sent along a sensory neuron to the spinal cord. The impulse is immediately transmitted through motor neurons to produce a response. Which of the following correctly identifies and describes this response?
- F** It is a conditioned response that occurs only to prevent injury.
 - G** It is a learned response that does not occur in infants and small children.
 - H** It is a reflex response that causes various muscles to contract in order to move away from the object.
 - J** It is a voluntary response that is initiated only after the impulse has been carried to the relevant area in the brain.
-
- 27** Which group of organelles is directly responsible for the production of new molecules within a cell?
- A** Ribosomes, the endoplasmic reticulum, and Golgi apparatuses
 - B** Golgi apparatuses, lysosomes, and the plasma membrane
 - C** The endoplasmic reticulum, plastids, and vacuoles
 - D** The nucleolus, vacuoles, and ribosomes

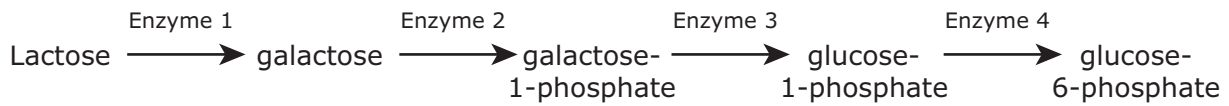
28 In 1917 the biologist Thomas Hunt Morgan conducted studies in which he kept some caterpillars in the dark and placed some others under red, green, or blue lights. Exposure to red light produced butterflies with brightly colored wings. Exposure to green light resulted in dark-colored wings. Exposure to blue light or no light resulted in pale-colored wings. What was the most likely conclusion of Morgan's research?

- F** The pigment in butterfly wings absorbs light from the environment.
- G** The phenotypic expression of wing shape depends on color pigmentation in butterflies.
- H** The genes regulating wing color in butterflies are influenced by environmental factors.
- J** Caterpillars exposed to red and green light are healthier than caterpillars exposed to no light or blue light.

29 Severe acute respiratory syndrome (SARS) is an illness caused by a coronavirus. Symptoms including a high fever, headaches, and body aches typically occur two to seven days after infection by the virus. SARS is more serious in elderly patients. This information suggests that the reproductive cycle of the SARS virus is —

- A** lysogenic, because the virus is a coronavirus
- B** lytic, because the virus causes respiratory illness
- C** lysogenic, because the virus primarily affects older people
- D** lytic, because of the quick onset of symptoms after infection

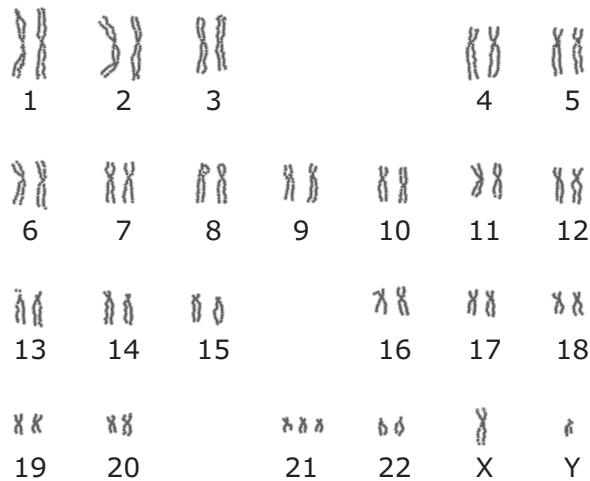
- 30** Lactose is found in milk products. It is converted by the body into a usable form in a series of chemical reactions. The diagram shows the series of reactions that convert lactose into a usable form.



If Enzyme 2 is denatured, the levels of which substance will increase?

- F** Lactose
- G** Galactose
- H** Galactose-1-phosphate
- J** Glucose-6-phosphate

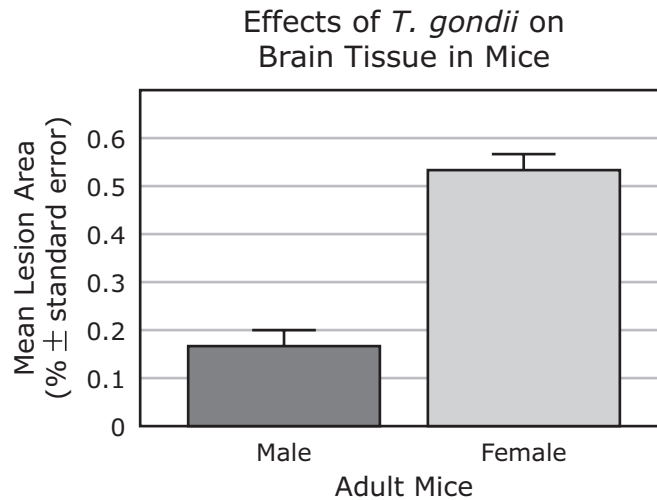
- 31** The picture below shows a person's karyotype.



Which of the following can best be determined by examining this karyotype?

- A** The presence of an additional chromosome
- B** The presence of a homozygous genotype
- C** The person's genome
- D** The person's phenotype

- 32** Toxoplasmosis is an infection producing brain lesions caused by the parasitic protozoan *Toxoplasma gondii*. Mice with their gonads removed are more resistant to *T. gondii* and develop very few lesions on their brain tissue. The graph shows the results of a scientific study of normal adult mice infected with *T. gondii*.



Which systems most likely interact and cause the severity of infections to vary?

- F** Muscular and skeletal
- G** Immune and endocrine
- H** Excretory and respiratory
- J** Nervous and integumentary

-
- 33** The cellular process known as the sodium-potassium pump was discovered in the 1950s by Jens Christian Skou, a Danish scientist. This process is a form of active transport that moves three sodium ions to the outside of a cell for every two potassium ions that it moves into the cell. Which of these best explains why energy is needed for active transport?

- A** Ions are negatively charged.
- B** Ions are attached to large proteins.
- C** Ions are trapped inside the plasma membrane.
- D** Ions are moved against the concentration gradient.

- 34** Brazil nuts (*Bertholletia excelsa*) are tall canopy trees that make up a large portion of the Amazon rain forest. They produce large grapefruit-sized seedpods. The agouti, a ground-dwelling rodent, has teeth strong enough to open the tough seedpods. While the agouti eats some of the tree's seeds, it also buries caches in various spots on the rain forest floor.



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© Fernanda Preto/Alamy



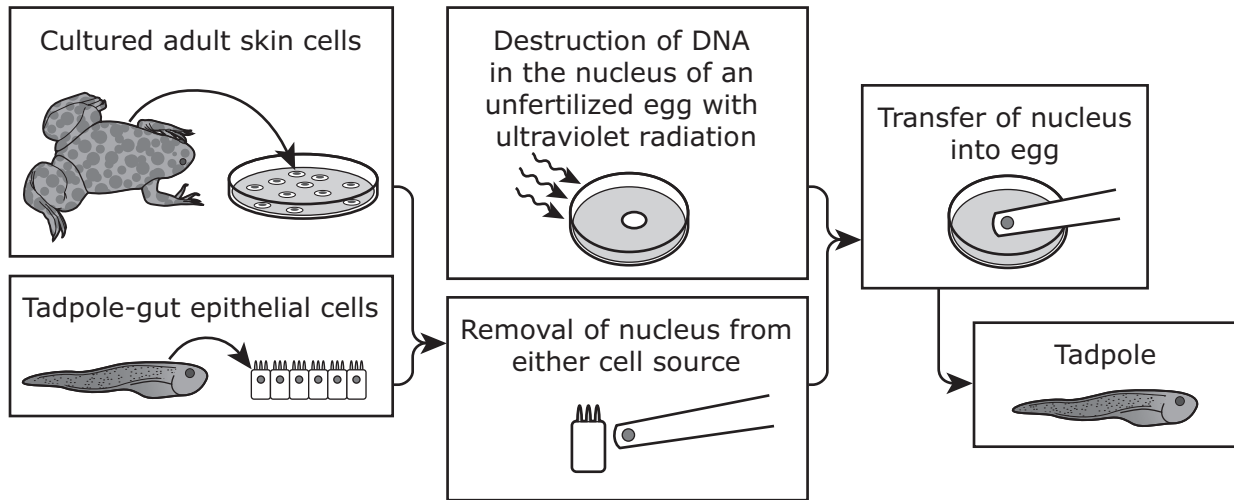
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Why is the agouti important to the rain forest ecosystem?

- F** It eats and disperses the trees' seeds.
- G** It eats the trees' excess seeds and prevents other animals from doing so.
- H** It cleans the rain forest floor of debris, allowing for easier motility.
- J** It prevents the trees' seeds from rotting on the rain forest floor.

- 35** Researchers Robert Briggs and Thomas King used ultraviolet radiation to destroy the nuclear DNA of frog eggs. Nuclei from adult skin cells and from tadpole-gut epithelial cells were cultured and then injected into eggs that had their nuclei destroyed. The results were tadpoles.

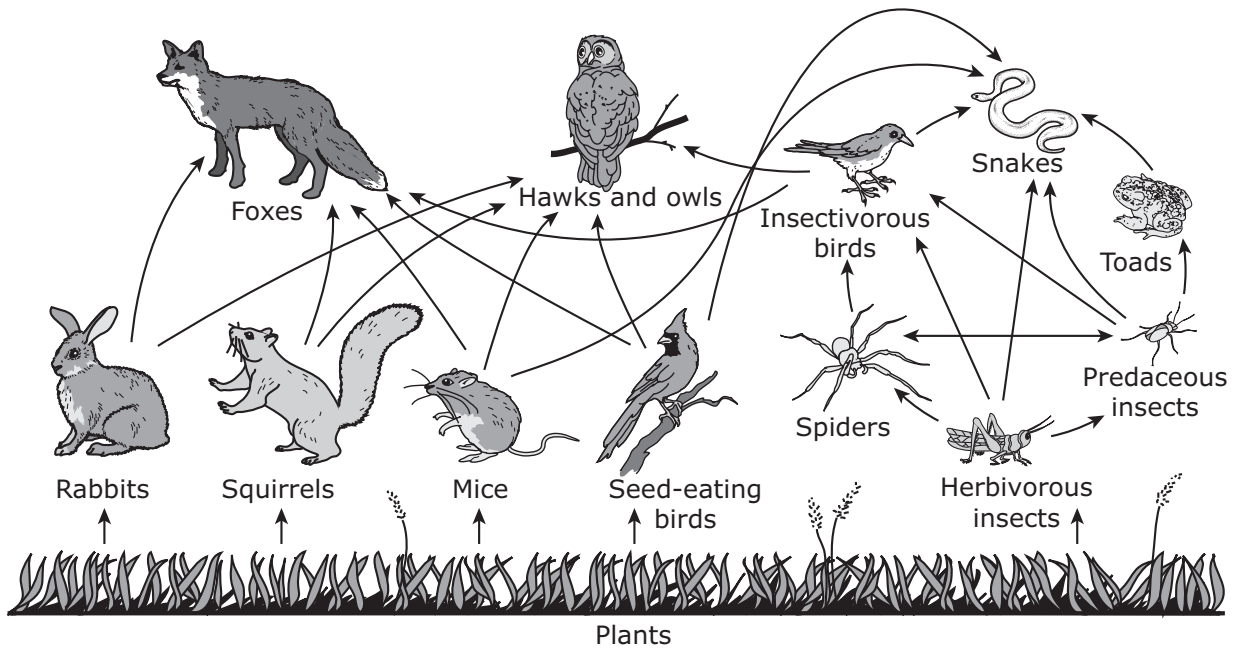
Briggs and King Investigation



Which conclusion is supported by the data from this investigation?

- A** The DNA information for development was silenced in differentiated cells.
- B** The transplanted DNA functioned as the original nuclear DNA of the egg cell would have.
- C** The DNA from skin cells and epithelial cells was not transcribed.
- D** The transplanted DNA mutated during culturing.

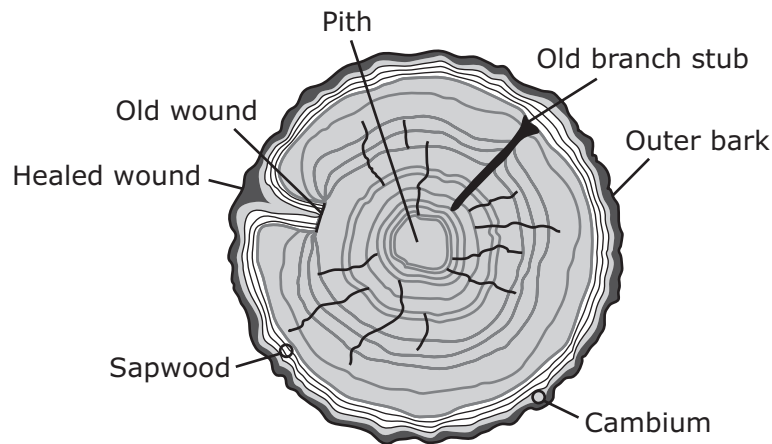
36 A terrestrial food web is shown below.



Which of the following lists only organisms that are secondary consumers in this food web?

- F** Mice, rabbits, herbivorous insects, and squirrels
- G** Predaceous insects, toads, spiders, and foxes
- H** Spiders, foxes, owls, hawks, and snakes
- J** Insectivorous birds, seed-eating birds, owls, and hawks

- 37** An animal can wound a tree by scratching away the bark. The tree can respond to the wound in many ways. Usually sap quickly covers the wound, and then the tree covers the wound with new growth. The diagram shows a cross section of a tree with a healed wound.



What process worked most directly with the transport system to heal the wound?

- A** Cellular reproduction
 - B** Photosynthesis
 - C** Water intake
 - D** Carbohydrate storage
-
- 38** The Linnaean taxonomic system classifies organisms into divisions called taxa. If two organisms belong to the same taxonomic group, they are related. Similarity at which of these levels indicates the closest relationship?
- F** Kingdom
 - G** Class
 - H** Order
 - J** Genus

- 39** Sickle-shaped red blood cells result from a mutation in the gene that codes for hemoglobin. This mutation results in sickle-cell anemia. A partial sequence of bases from a normal hemoglobin gene and a sequence that results in sickle-cell anemia are shown below.

Normal hemoglobin:	T-G-A-G-G-T-C-T-C-C-T-C
Sickle-cell hemoglobin:	T-G-A-G-G-T-C-A-C-C-T-C

What type of mutation is depicted in this sequence?

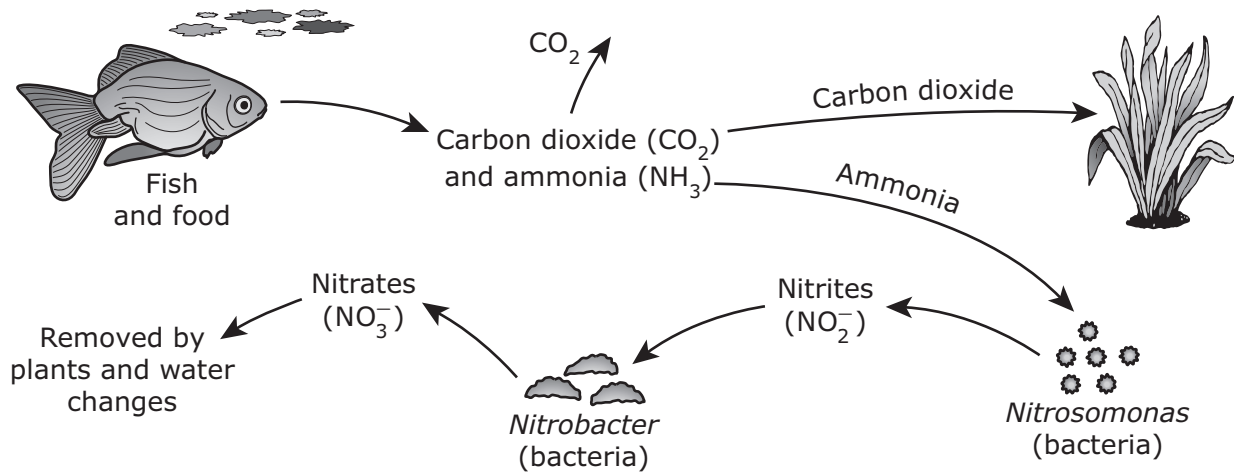
- A** Substitution
 - B** Insertion
 - C** Deletion
 - D** Frameshift
-
- 40** In Madagascar scientists have discovered a moth, *Xanthopan morgani praedicta*, that has a 30.5 cm proboscis and feeds from and pollinates Darwin's orchid, *Angraecum sesquipedale*. The orchid has a nectar-producing tube that is 27.9 cm long.



How is the moth's proboscis size an adaptation for its environment?

- F** The moth can avoid larger animals.
- G** The moth can pollinate other flowers.
- H** The moth has little competition for food.
- J** The moth has time to feed during the day.

- 41 The diagram below represents the nitrogen cycle in a student's aquarium. Ammonia, nitrites, and, to a lesser degree, nitrates can be harmful to fish. The student wants to keep the nitrogen in this aquarium cycling normally without having to continually change the water.



Which of the following should the student add more of to help remove nitrates and improve the natural cycling of nitrogen in this aquarium?

- A Fish
 - B Plants
 - C *Nitrobacter*
 - D Water
-
- 42 Genome maps provide the DNA sequences of chromosomes. Some scientists have compared the genome maps of a hedgehog and a sloth. What do these genome maps allow the scientists to determine?
- F The color patterns of the offspring of each species
 - G How much the size ranges of the two species differ
 - H The methods of protein synthesis that each species uses
 - J How closely related the two species are to each other

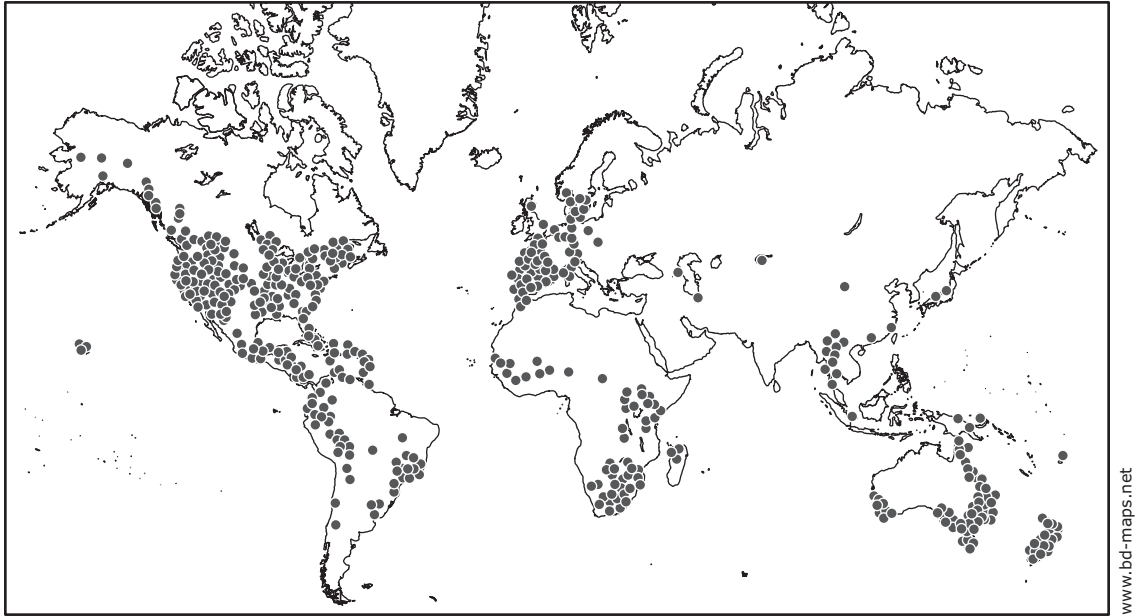
43 Tomato plants usually have hairy stems. Hairless stems are present in tomato plants that are homozygous recessive for this trait. If the stem characteristics are determined by a single gene, what is the expected outcome of crossing two tomato plants that are heterozygous for hairy stems?

- A** 75% hairy stems: 25% hairless stems
- B** 100% hairy stems
- C** 100% hairless stems
- D** 50% hairy stems: 50% hairless stems

44 Which of the following biomolecules typically contains both nitrogen and phosphate?

- F** Lipid
- G** Protein
- H** Nucleic acid
- J** Carbohydrate

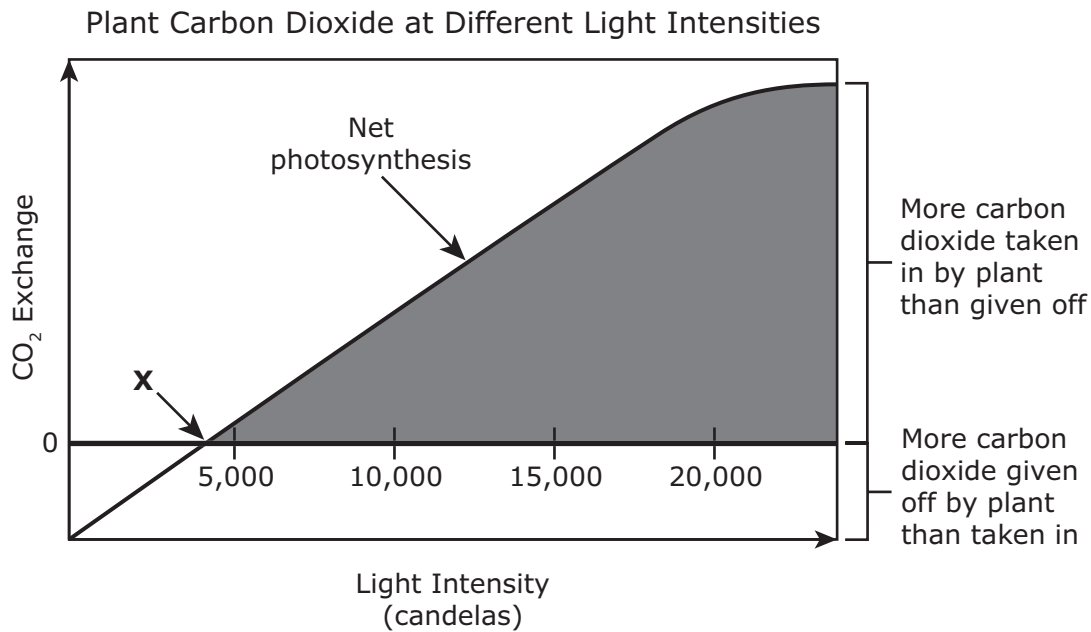
- 45** Amphibians are dying in large numbers after being infected by an aquatic fungus called *Batrachochytrium dendrobatidis*. The origin of this fungus is unknown, but scientists suspect that humans are helping spread it. More than 350 amphibian species have been affected, and at least 200 species of frogs have suffered serious reductions in population or become extinct. The map below shows the worldwide distribution of *B. dendrobatidis*.



What will be the most likely impact of the decline in frog populations resulting from the fungal infection?

- A** New species of frogs that feed on both the fungus and the infected species of frogs will evolve.
- B** Plants will no longer grow in the waters of the affected ecosystems, and fish species will increase.
- C** The fungus will move on land and destroy reptile and mammal populations in tropical ecosystems.
- D** Populations of algae and mosquitoes will increase, leading to fish die-offs and potential increases in human malaria cases.

- 46 Most plant leaves take in more carbon dioxide as light increases. They give off carbon dioxide if light intensity is too low. The graph shows a plant's carbon dioxide levels at different light intensities.



At point X, the rate of which process is equal to the rate of photosynthesis?

- F Cellular respiration
 - G Transpiration
 - H Growth
 - J Reproduction
-
- 47 Telophase is a stage of a cellular process that begins after the chromosomes have moved to opposite poles of the cell. During which cellular process does telophase occur?
- A Translation
 - B Interphase
 - C Transcription
 - D Mitosis

48 Which of the following polypeptides is coded for by the mRNA sequence

5' AUGGUUAAACGACAAUCC 3'?

		Second Base				
		U	C	A	G	
First Base	U	Phenylalanine	Serine	Tyrosine	Cysteine	U
		Phenylalanine	Serine	Tyrosine	Cysteine	C
		Leucine	Serine	Stop	Stop	A
		Leucine	Serine	Stop	Tryptophan	G
	C	Leucine	Proline	Histidine	Arginine	U
		Leucine	Proline	Histidine	Arginine	C
		Leucine	Proline	Glutamine	Arginine	A
		Leucine	Proline	Glutamine	Arginine	G
	A	Isoleucine	Threonine	Asparagine	Serine	U
		Isoleucine	Threonine	Asparagine	Serine	C
		Isoleucine	Threonine	Lysine	Arginine	A
		Methionine	Threonine	Lysine	Arginine	G
	G	Valine	Alanine	Aspartic acid	Glycine	U
		Valine	Alanine	Aspartic acid	Glycine	C
		Valine	Alanine	Glutamic acid	Glycine	A
		Valine	Alanine	Glutamic acid	Glycine	G
		Third Base				

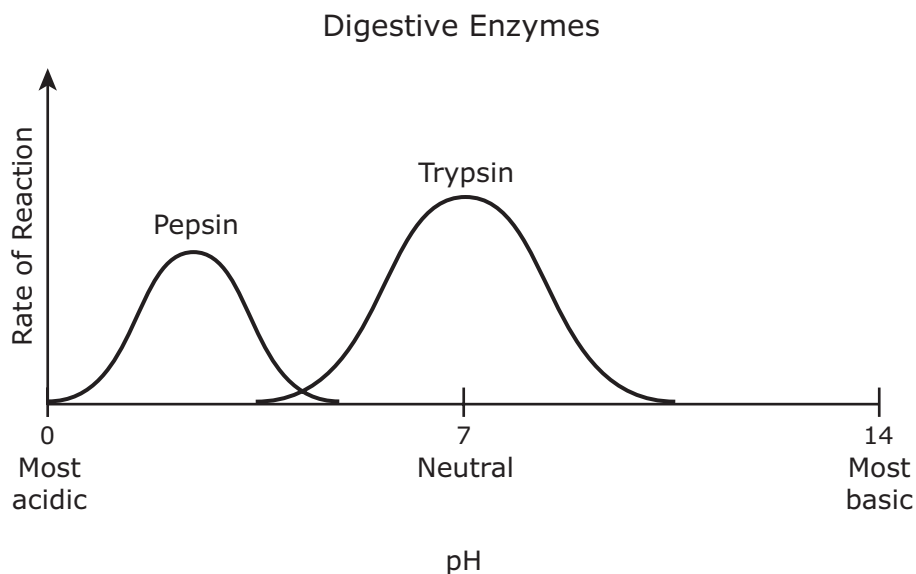
F Val, Lys, Phe, Gly, Ser

G Met, Asp, Phe, Ala, Arg

H Met, Val, Lys, Arg, Gln, Ser

J Ile, Gln, Lys, Asp, Gly, Leu, Ser

- 49 Pepsin and trypsin are two of the digestive enzymes that break down protein. A group of students studied the pH requirements of these enzymes. The graph below shows the results.

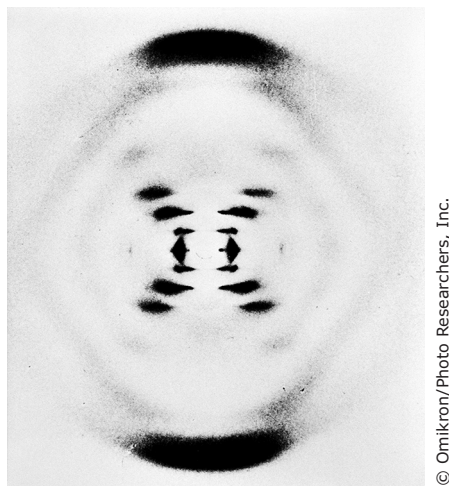


The students found that pepsin functions best in an acid environment and trypsin functions best in a neutral environment. Based on their observations, pepsin most likely aids in digestion in which part of the human body?

- A Pancreas
 - B Intestines
 - C Mouth
 - D Stomach
-
- 50 Which condition is essential for natural selection to result in a new species?
- F Unlimited resources
 - G An inherited variation
 - H A static environment
 - J A long life span

- 51** Most plants have hair-like cells called trichomes that project from the surface and help the plants in many ways. In some plants trichomes secrete toxic substances that most likely perform which function?
- A** Absorb carbon dioxide
 - B** Protect against herbivorous insects
 - C** Reflect light off leaves
 - D** Reduce water loss from evaporation

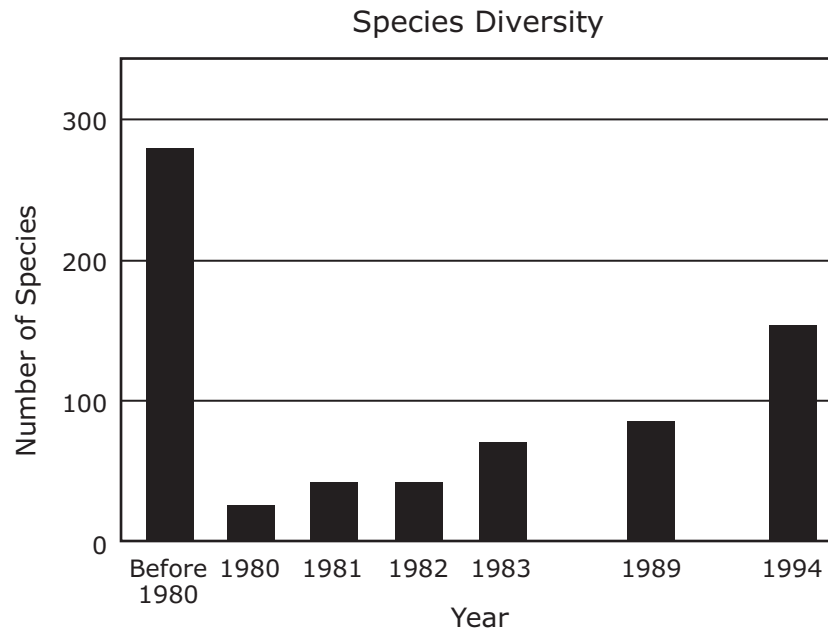
-
- 52** In 1952 Rosalind Franklin took the x-ray photograph shown below, which gave the world its first look at DNA.



By studying this photograph, scientists gained knowledge about the —

- F** role of DNA in protein synthesis
- G** mutation of nucleotide sequences in DNA
- H** sequence of DNA that makes up the human genome
- J** double-helix structure of DNA

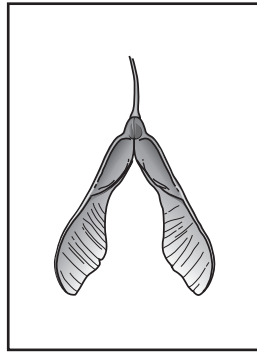
53 The graph below shows the changes in the number of species in an ecosystem.



Which event was most likely the cause of the changes in species diversity in this ecosystem?

- A A large volcanic eruption
- B A flash flood
- C A small tornado
- D A migration of locusts

54 The diagram shows a dichotomous key and a picture of a fruit.



Key to Some Winged Fruits

1a	Fruit with a single wing	Go to 2
1b	Fruit with a pair of wings.....	Go to 3
2a	Fruit with a very narrow lance shape, about 7 times longer than it is wide	<i>Fraxinus americana</i>
2b	Fruit with a wide lance shape, about 4 times longer than it is wide.....	<i>Fraxinus nigra</i>
3a	Fruit that forms a very wide angle, almost a straight line.....	<i>Acer platanoides</i>
3b	Fruit that forms an acute angle, almost a V shape	<i>Acer negundo</i>

According to the key, the fruit comes from which species of tree?

F *Fraxinus americana*

G *Fraxinus nigra*

H *Acer platanoides*

J *Acer negundo*



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