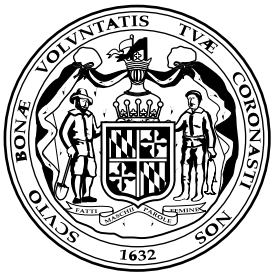
Biology



Maryland High School Assessment

Public Release, Fall 2002

CTB/McGraw-Hill

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Session 1

Sample A

Which of these instruments should a student use to measure the length of a housefly?

A microscope

B metric ruler

C funnel

D graduated cylinder

Sample B

Which of these systems in the human body is directly involved in movement?

F skeletal system

G excretory system

H endocrine system

J reproductive system

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STOP

Notice that the answer choices for Sample B are FGHJ. Selected response answer choices will alternate ABCD and FGHJ.

In addition to selected response questions such as Sample A and Sample B, there will be constructed response questions that require a written answer. Brief constructed response questions, which require a short written answer, are labeled "BCR" below the question number in the Student Test Book. The Rubric Sheet provides information about how constructed response questions will be scored. You may refer to the Rubric Sheet during the test.

Remember, read all directions and questions very carefully and choose the best answer for each question. If you are not sure about an answer, do the best you can, but don't spend too much time on any one question.

Answer all questions until you come to the end of Session 1, where you will see a stop sign. If you finish early, you may check your answers in Session 1, but do not go on to Session 2. You have 65 minutes to complete Session 1.

In order to protect the security of future test forms, one SR item and one BCR item on the form administered in 2002 are not being released here.

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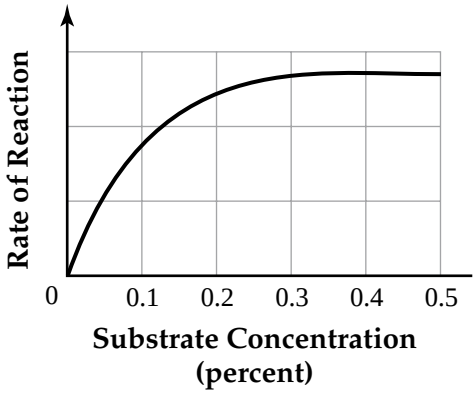
GO ON

Directions

Use the information and the graph below to answer Numbers 1 and 2.

The graph below shows the rate of reaction when different amounts of a substrate are added to a constant amount of a specific enzyme. This enzyme is functioning at its optimal temperature, 30°C, and at its optimal pH, 7.0.

EFFECT OF SUBSTRATE CONCENTRATION ON THE RATE OF ENZYME REACTION



1 **According to the graph, what happens to the rate of the reaction when the substrate concentration increases from 0.4 percent to 0.5 percent?**

A It decreases.

B It increases.

C It increases, then decreases.

D It remains the same.

2 **If the temperature in this experiment were reduced by ten degrees, what would most likely happen to the rate of reaction?**

F It would increase.

G It would decrease.

H It would remain the same.

J It would increase, then decrease.

3 **To test the effectiveness of a new medicine, a drug company performed a study. Researchers from the company gave pills that contained the new medicine to one group of patients; they gave pills that did not contain any medicine to another group of patients. Why were the patients not told which type of pill they were taking?**

A to keep patients from becoming angry

B to prevent bias when collecting data

C to prevent errors when collecting data

D to keep patients from dropping out of the study

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4 **A scientist is testing milk for the presence of bacteria. Exactly 25 milliliters of a test solution must be added to each milk sample. Which of these instruments would most accurately measure the volume of the test solution?**

F a beaker

G a test tube

H a measuring cup

J a graduated cylinder

5 **Read the conversion shown below.**

1 millimeter (mm) = 1000 micrometers (μm)

A cell measures 5 micrometers in diameter. Which of these is the diameter in millimeters?

A 5×10^{-3} mm

B 5×10^{3} mm

C 5×10^{-6} mm

D 5×10^{6} mm

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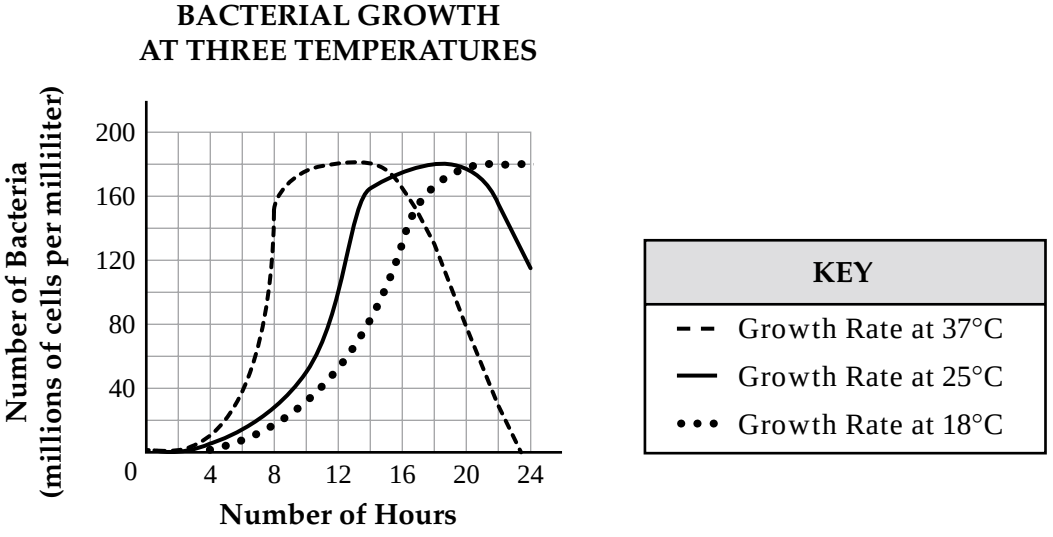
GO ON

Directions

Use the information and the graph below to answer Numbers 6 and 7.

A scientist was studying the effect of temperature on the growth of bacteria. She prepared three identical cultures of the bacteria, but grew each culture at a different temperature—18°C, 25°C, and 37°C. All other factors in the experiment remained the same. She counted the number of bacteria in the cultures every four hours during the experiment. The graph below shows the results.



6 **The scientist grew a fourth culture at 30°C for 12 hours. About how many bacteria per milliliter would be produced in this culture?**

F less than 80 million

G between 80 and 120 million

H between 120 and 180 million

J more than 180 million

7 **Which of these treatments would result in a mutation in some of the bacteria?**

A adding salt water to the culture

B changing the pH of the culture

C increasing the temperature of the culture

D exposing the culture to ultraviolet radiation

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8
BCR

A student wants to know if glucose is present in an unknown liquid. She places five milliliters of the liquid in a test tube and adds five drops of Benedict solution. She transfers the test tube to a beaker of boiling water for five minutes, then removes it and observes changes in the color of the solution. What other equipment does the student need to perform this experiment safely? Use your knowledge of laboratory safety to explain why she needs this equipment. Write your answer in your Answer Book.

9

The major role of carbohydrates in the human diet is to

A form cell membranes

B catalyze cellular reactions

C supply energy for the body

D provide building blocks for proteins

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GO ON

Directions

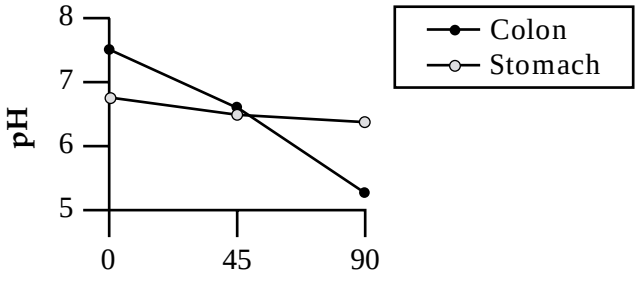
Use the technical passage below to answer Numbers 10 and 11.

CATTLE DIETS CAN DECREASE RISK OF FOOD POISONING

Food poisoning from undercooked meat products remains a problem in today's food industry. The most common infectious agent is a strain of the bacteria *E. coli* known as 0157:H7. Animal and human digestive tracts normally contain strains of *E. coli* that are not disease producing. The low pH of stomach acid is usually sufficient to kill bacteria contained in food before they can cause illness. However, the harmful *E. coli* 0157:H7 is particularly resistant to stomach acid and produces toxins that may cause diarrhea and kidney failure.

While the disease-causing bacteria can be killed by heating and irradiation, consumption of undercooked meat still results in some 20,000 infections and 200 deaths in the United States each year. A group of scientists have discovered that changing the diet of cattle may significantly reduce contamination with 0157:H7 and thus reduce the number of infections in humans. Cattle feed is usually a mixture of grains, which are high in available carbohydrates, and hay, which cattle digest more slowly. Traditionally, cattle awaiting slaughter have been fed high-grain diets. This study indicates that high-grain diets result in lowered pH in the stomach and colon of cattle as shown in graph I below.

I **THE EFFECT OF DIET ON pH IN CATTLE**



Notice that as the percentage of grain in the diet increases, the pH decreases slightly in the stomach and dramatically in the colon of cattle.

The study also found that this lowered pH promoted the growth of 0157:H7 in the stomach and colon of cattle. Therefore, high-grain diets result in an increase in the amount of 0157:H7, as shown in graph II on the next page.

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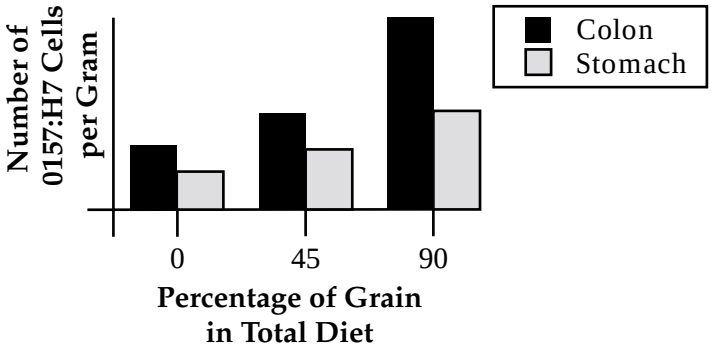
GO ON

II **EFFECT OF GRAIN ON 0157:H7 IN CATTLE**



Notice that as the percentage of grain in the diet increases, the amount of 0157:H7 produced increases in the stomach and colon of cattle.

Decreased numbers of bacteria found in the cattle's colons occurred in as few as four days after changing from grain to hay diets. With this discovery, scientists may have found a simple method for decreasing the incidence of contamination by harmful *E. coli*.

10 **Which of these is most likely the hypothesis that guided the scientists' studies?**

F A grain diet is high in available carbohydrates.

G Harmful *E. coli* bacteria can be killed by heating and irradiation.

H Cattle that are fed a grain-rich diet have a colon pH that is lower than those fed a hay-rich diet.

J Cattle that are fed a grain-rich diet have a larger amount of harmful *E. coli* bacteria in their digestive tracts.

11 **Which of these is suggested by the data from this study of cattle diets?**

A People should eat only vegetables to avoid food poisoning.

B More people are dying of food poisoning from undercooked meat than 5 years ago.

C Increasing the amount of grain in a cow's diet increases its body weight.

D Food poisoning may decrease in humans when they eat meat from cattle that are fed a hay-rich diet.

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GO ON

12 **BCR**

Compare the function of chloroplasts and mitochondria in a cell. In your response, include

- **the name of the process that occurs in each organelle**
- **the products of each process**
- **the importance of each process to the cell**

Write your answer in your Answer Book.

13 **Which of these is not recycled through Earth's ecosystems?**

A water

B energy

C nitrogen

D carbon

Directions

Use the information below to answer Numbers 14 and 15.

Researchers have discovered a toxin that stops cells from releasing stored energy. Cells exposed to this toxin cannot carry out many of their normal processes.

14 **Which of these cell organelles are most directly affected by this toxin?**

F ribosomes

G chloroplasts

H mitochondria

J vacuoles

15 **When cells are exposed to this toxin, which of these processes is least affected?**

A cell division

B osmosis

C aerobic respiration

D photosynthesis

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GO ON

16 **BCR**

Gibberellic acid is a plant hormone that affects the growth of plants.

Describe a controlled experiment a student could perform to test the effect of gibberellic acid on the height of pea plants over a three-week period. Be sure to include

- **all materials and equipment**
- **the kind of data that will be collected**
- **the experimental procedure**

Write your answer in your Answer Book.

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GO ON

17 **What technology was made possible by the discovery of the structure of DNA?**

A organ transplants

B antibiotic production

C gene splicing

D artificial fertilization

18 **Which body system produces chemicals that act at different sites in the body?**

F the circulatory system

G the endocrine system

H the excretory system

J the skeletal system

19 **Which of these is <u>not</u> used to transport food and water throughout a tree?**

A a leaf

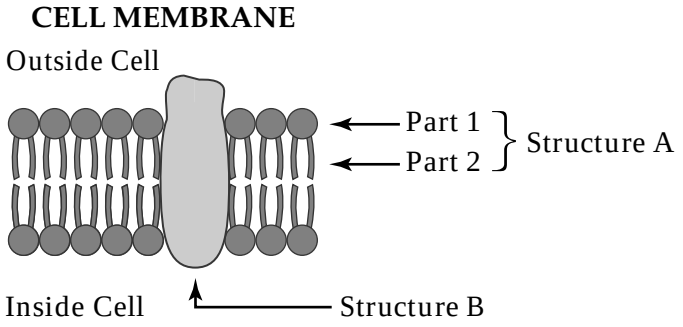
B a seed

C the vascular tissue

D the root tissue

Directions

Use the figure of a cell membrane below to answer Numbers 20 and 21.



20 **What kind of molecule is Structure A?**

F an amino acid

G a phospholipid

H a carbohydrate

J a nucleic acid

21 **What characteristic of Part 1 of Structure A gives it the ability to attract water molecules?**

A acidity

B conductivity

C density

D polarity

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22 **A scientist wants to study photosynthesis in a newly discovered species. Which of these cell structures should the scientist study?**

F vacuoles

G chloroplasts

H mitochondria

J ribosomes

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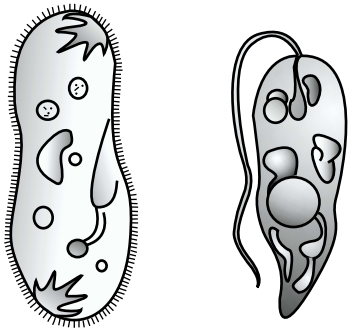
Directions

Refer to the diagram below of the single-celled, eukaryotic organisms to answer Numbers 23 and 24.



Paramecium *Euglena*

23 ***Euglena*** **uses which of these to move?**

A cilia

B a vacuole

C a flagellum

D pseudopodia

24 ***Euglena*** **and** ***Paramecium*** **are eukaryotes because they both**

F have a nucleus

G have ribosomes

H reproduce by sexual reproduction

J reproduce by asexual reproduction

25 **Crossing-over most commonly results in**

A new species

B new populations

C new combinations of genes

D new numbers of chromosomes

26 **Each body cell in an earthworm contains 36 chromosomes. How many chromosomes are in each of its gametes?**

F 18

G 36

H 54

J 72

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STOP

Session 2

Answer all questions until you come to the end of Session 2, where you will see a stop sign. If you finish early, you may check your answers in Session 2, but do not go back to Session 1. You have 55 minutes to complete Session 2.

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27 **If a nucleotide pair were removed from a gene, which of these would most likely be directly affected?**

A the membrane of a cell

B the sequence of a protein

C the pH of the cytoplasm

D the size of a cell nucleus

28
BCR

A student cut three identical slices from a potato. She determined the mass of each slice and placed them into labeled beakers. She then added a different solution to each beaker. After 20 minutes, she removed each potato slice from its solution, dried it with a paper towel, and determined its mass. Results of this experiment are shown in the table below.

THE EFFECT OF DIFFERENT SOLUTIONS ON THE MASS OF POTATO SLICES

Beaker	Solution	Change in Mass
1	distilled water	gained 3 grams
2	5% salt solution	lost 0.3 grams
3	15% salt solution	lost 4.6 grams

Name the process that caused these changes in mass. Explain why each potato slice had a different mass after 20 minutes. Write your answer in your Answer Book.

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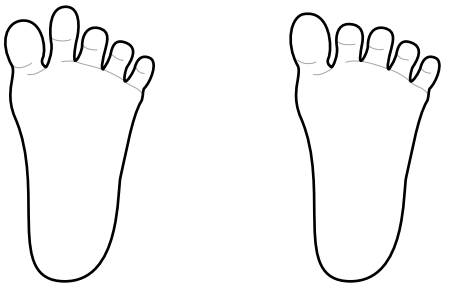
29 **In humans, the trait for having a second toe that is longer than the big toe (T) is dominant; the trait for having a second toe that is shorter than the big toe (t) is recessive. The two traits are shown in the figure below.**



Dominant Trait Recessive Trait

A family has eight children. Six children have second toes that are longer than the big toe. Two children have second toes that are shorter than the big toe. What are the most likely genotypes of the parents?

A Tt and Tt

B Tt and tt

C TT and tt

D TT and TT

30 **Mammals living in extremely cold climates typically have thick fur and a layer of fat to insulate them from the cold. Which of these terms best describes these characteristics?**

F translations

G alterations

H adaptations

J recombinations

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GO ON

31 **Individuals within a population of rabbits have different colors of fur as shown in the diagram below.**

DISTRIBUTION OF RABBIT FUR COLOR

The difference in the fur color of the individual rabbits is described as

A speciation

B variation

C evolution

D succession

32
BCR

A genetic disorder is sex-linked and is caused by a recessive allele (e). The allele for the unaffected condition (E) is dominant. A woman who is a carrier of this disorder marries an unaffected man. The couple would like to have a child, but they are concerned that their child will inherit the disorder.

Using this example,

- **construct a Punnett square in your Answer Book with the genotypes of the woman and the man, and the possible genotypes of their child**
- **identify the probability that the child will inherit the disorder**
- **identify the probability that the child will not inherit the recessive allele (e)**
- **explain the pattern of inheritance of a sex-linked trait**

Write your answer in your Answer Book.

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GO ON

Directions

Use the information below to answer Numbers 33 through 36.

A scientist is studying a group of related flowering plants. She set up a series of experiments to study relatedness, classification, and patterns of inheritance within this group of plants.

33 **In one plant, the allele for long stems (L) is dominant; the allele for short stems (l) is recessive. The scientist crossed a heterozygous, long-stemmed plant with a short-stemmed plant. Which of these shows the expected results of this cross?**

A 50% long-stemmed plants and 50% short-stemmed plants

B 75% long-stemmed plants and 25% short-stemmed plants

C 100% long-stemmed plants

D 100% short-stemmed plants

34 **One of the plants that the scientist is studying has an extra copy of one chromosome in all its cells. This variation most likely occurred during**

F meiosis

G protein synthesis

H mitosis

J DNA synthesis

35 **To study the relatedness among plants, the scientist compared a specific RNA sequence in four different species of plants. The results are shown in the table below.**

PERCENT SIMILARITY OF A SPECIFIC RNA SEQUENCE

		Plant Species			
		1	2	3	4
Plant Species	1	—	88	92	85
	2	88	—	93	95
	3	92	93	—	87
	4	85	95	87	—

Which two species are most closely related?

A 1 and 3

B 1 and 4

C 2 and 3

D 2 and 4

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GO ON

36 **The scientist used the table below of four of the kingdoms of life to classify the group of plants.**

CLASSIFICATION TABLE

Characteristic	Kingdom			
	1	2	3	4
Makes own food	no	yes	sometimes	sometimes
Cell nucleus present	yes	yes	no	yes
Multicellular organism	yes	yes	no	sometimes

To which kingdom do flowering plants belong?

F 1

G 2

H 3

J 4

37 **During cell replication, an error may result in a base pair substitution. Which of these terms describes the change in the base pair sequence?**

A cloning

B meiosis

C mutation

D translation

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GO ON

38 **Which of these best describes the process of chemosynthesis?**

F DNA molecules are formed.

G Cell membranes are constructed.

H Food is produced using energy from inorganic compounds.

J Food is produced using energy from light.

39 **The exchange of oxygen and carbon dioxide between the body and the air occurs in the lungs. This exchange of gases takes place at the cellular level. What part of the cell is primarily responsible for this exchange?**

A the cell membrane

B the nucleus

C the cell wall

D the ribosome

40 **In the human body, which of these systems transports sugars to the cells where they are used?**

F excretory

G respiratory

H circulatory

J digestive

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GO ON

41 **Which of these organelles in animal cells provide energy for cell activities?**

A mitochondria

B chloroplasts

C ribosomes

D nuclei

42 **A scientist crossed a tall pea plant with a short pea plant. All of the four hundred offspring produced were tall pea plants.**

Which of these explains these results?

F The allele for tall pea plants is dominant.

G The offspring are homozygous dominant.

H The allele for short pea plants is dominant.

J The offspring inherited a new mutation.

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GO ON

43 **The messenger RNA codes for six different amino acids are shown in the table below.**

MESSENGER RNA CODES FOR AMINO ACIDS

Amino Acid	Messenger RNA Codes
Arginine	CGU, CGC, CGA, CGG
Cysteine	UGU, UGC
Glutamic acid	GAA, GAG
Leucine	CUU, CUC, CUA, CUG
Serine	AGU, AGC
Valine	GUU, GUC, GUA, GUG

In one type of mutated gene for hemoglobin, CAC has replaced the normal CTC in the DNA code. What amino acid substitution has taken place in the mutated hemoglobin?

A Serine has replaced leucine.

B Arginine has replaced leucine.

C Valine has replaced glutamic acid.

D Cysteine has replaced glutamic acid.

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GO ON

44
BCR

Scientists discovered a new species of fish. Using gel electrophoresis, they analyzed samples of DNA from the new species and from four known fish species. The figure below shows the bands of fish DNA from the gel electrophoresis.

GEL ELECTROPHORESIS RESULTS FROM FIVE SPECIES OF FISH

New Species	Known Species A	Known Species B	Known Species C	Known Species D
———		———	———	———
———	———		———	———
———		———	———	
———		———		
———	———		———	———
	———			

KEY
——— = Bands in the Gel

Use the results of the gel electrophoresis to

- **identify which of the four known species is most closely related to the newly discovered species of fish**
- **explain how the relatedness of the fish species can be determined by examining where the bands are located in the electrophoresis gel**

Write your answer in your Answer Book.

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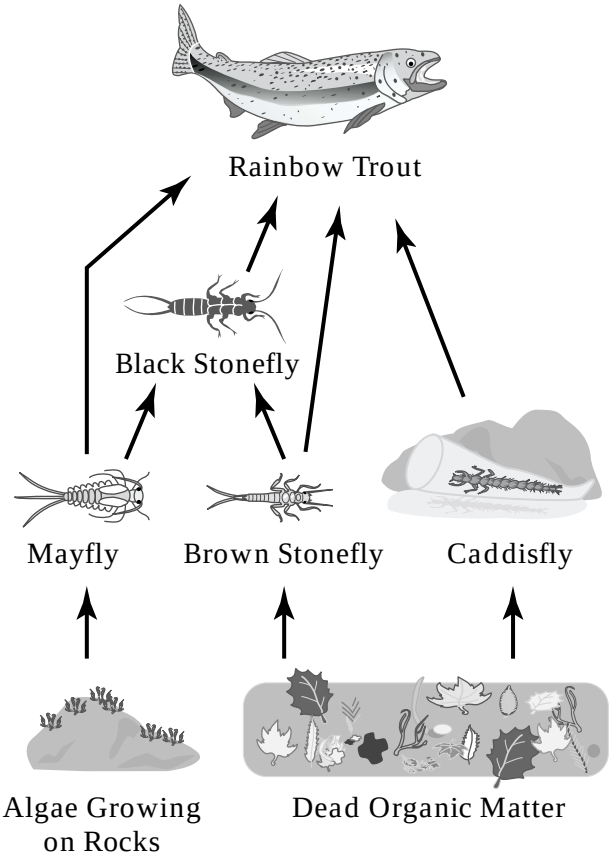
Directions

Use the creek food web and the information below to answer Numbers 45 through 47.

CREEK FOOD WEB



A small, cold creek flows through a dense forest. The trees that line the banks of the creek provide shade for most of the day. Algae grow well only in the few areas of the creek that receive direct sunlight for several hours each day. Most of the food energy enters the creek ecosystem in the form of dead leaves that fall from the trees.

45 **Which of these describes the role of the brown stonefly in the creek food web?**

A parasite

B omnivore

C scavenger

D carnivore

46 **Which of these is a predator in the creek food web?**

F brown stonefly

G black stonefly

H caddisfly

J mayfly

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47 **A fire swept through the forest, burning all the leaves but leaving the trees standing. This greatly increased the amount of direct sunlight reaching the creek, but did not produce more than the usual amount of erosion. As a result of the fire, which of these most likely increased in the creek?**

A organic matter

B brown stoneflies

C caddisflies

D algae

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GO ON

48 **Which of these is an example of mutualism?**

F a dragonfly eating beetles

G algae and fungi providing food and shelter for each other

H a wasp laying its eggs inside a caterpillar

J a woodpecker drilling for insects in the bark of a tree

49 **Approximately 45 million acres of tropical rain forest are destroyed each year. Which of these probably does not result from the burning and clearing of tropical rain forests?**

A an increase in global warming

B a decrease in the sources for new medicines

C an increase in oxygen in the atmosphere

D a decrease in the number of different species

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GO ON

Directions

Use the information and the table below to answer Numbers 50 through 53.

A scientist studied iguanas on the Galapagos Islands. He discovered two species of iguanas that live in different habitats and display very different behaviors. His observations are listed in the table below.

OBSERVATIONS OF TWO SPECIES OF IGUANAS

Marine Iguana	Land Iguana
• spends most of its time in the ocean • is never found more than 10 yards from the shore • eats mainly marine algae	• spends most of its time on land • is found far inland • eats cacti and other land plants

50 **Which of these is a correct statement about the two species of iguanas?**

F Both species of iguanas arose through the process of succession.

G The two species of iguanas occupy two distinct niches.

H The two species of iguanas occupy overlapping niches.

J The marine iguana is a scavenger, and the land iguana is an omnivore.

51 **Visiting sailors brought goats to the Galapagos Islands. The goats competed with native animals for food and shelter. Which of these was probably <u>not</u> affected by the goats?**

A food supply

B spread of disease

C natural disasters

D stability of the ecosystem

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GO ON

52 **Which of these describes the role of the algae and the cacti in this island ecosystem?**

F herbivore

G omnivore

H decomposer

J producer

53 **The Galapagos Islands were formed by undersea volcanoes. At first, they had no living organisms. Many years later, a wide variety of plant and animal species inhabited the islands. Which of these identifies the process by which different species colonize and replace other species?**

A variation

B succession

C reproduction

D recombination

STOP

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