1.

A veterinarian for a zoo wanted to determine the pedigree of a lion cub born at the zoo. Four male adult lions had to be considered as possible sires of the cub. DNA testing was conducted and partial DNA fingerprints are shown above. Based on this data, which male lion most likely sired the cub?

☐ A. Matt
☐ B. Streak
☐ C. Wilbur
☐ D. Goldy

2.

<table>
<thead>
<tr>
<th>Element</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur</td>
<td>28.68</td>
</tr>
<tr>
<td>Copper</td>
<td>28.42</td>
</tr>
<tr>
<td>Iron</td>
<td>24.98</td>
</tr>
<tr>
<td>Oxygen</td>
<td>9.54</td>
</tr>
<tr>
<td>Other</td>
<td>8.38</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Which graph best shows the comparison of the elements to the total composition of the copper ore?
3. Suppose that the central C-G base pair in the DNA molecule below is substituted by an A-T base pair.

What is the most likely result of this mutation?

- [ ] A. incomplete translation
- [ ] B. identical offspring
4. Which of the following can cause a genetic mutation in an organism's DNA?

- A. exposure to high energy radiation
- B. insertion of a nucleotide during replication
- C. exposure to toxic chemicals
- D. all of these

Lake Erie

Lake Erie has suffered long term pollution problems. While the situation is improving for this Great Lake, there are still areas of concern. The table below shows an advisory from the early 1990s for eating fish taken from Lake Erie that may contain PCBs.

**Recommended Restrictions for Eating Selected Sport Fish (PCB Advisory)**

<table>
<thead>
<tr>
<th>Fish Species</th>
<th>Lake Erie</th>
<th>Ashtabula River</th>
<th>Maumee River</th>
<th>Ottawa River</th>
<th>Portage River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carp under 20 inches</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Carp 20+ inches</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Channel Catfish</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Freshwater Drum</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Lake Trout</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

**Key**

1 = No Restriction  
3 = One Meal per Month  
5 = Do Not Eat!  
2 = One Meal per Week  
4 = Six Meals per Year

5. Which Lake Erie tributary is probably most contaminated with PCBs?

- A. Ashtabula River
6. Which of these characteristics might help a plant species survive in an area with limited sunlight?

☐ A. bright flowers  
☐ B. large leaves  
☐ C. thick cuticles  
☐ D. short stems

7. The Earth’s carbon cycle consists of the flow, cycling, and recycling of all of the carbon on the Earth. Every living organism’s composition includes the element carbon. How does carbon become part of living organisms?

☐ A. Producers take in carbon directly from the soil through their roots, and consumers eat the producers.  
☐ B. Consumers take in carbon dioxide from the air, and producers eat the consumers.  
☐ C. Producers take in carbon dioxide from the air, and consumers eat the producers.  
☐ D. Carbon is a part of sunlight and enters through the skins of all organisms.

8. Giraffes have longer necks than other herbivores. This trait is probably most important for...

☐ A. gaining access to different food sources.  
☐ B. sleeping while standing up.  
☐ C. conserving water during droughts.  
☐ D. detecting prey at great distances.

9. Which cell organelle stores water and other materials?

☐ A. ribosome  
☐ B. lysosome  
☐ C. vacuole  
☐ D. mitochondrion
10. In the above animal cell, what is the function of the cellular organelle labeled with the letter Y?

- A. packages and distributes proteins and lipids
- B. contains the cellular DNA
- C. provides the cell with energy
- D. digests cellular wastes

11. Because of this animal's adaptations, it would be most successful at —

- A. running very rapidly.
- B. competing with birds.
- C. hiding from predators.
- D. making its own food.

12. A 10 gram rubber ball is placed in a graduated cylinder filled with 15 mL of water. If the volume in the graduated cylinder increases to 21 mL after the ball sinks to the bottom of the cylinder, what is the density of the rubber ball?

- A. 0.48 g/mL
13. A science class is conducting an experiment that produces noxious fumes. Because of inadequate ventilation, some students begin to feel nauseated and dizzy. The first response should be to...

- A. spray the reaction with a fire extinguisher.
- B. leave the room and go to an area with fresh air.
- C. neutralize the acid that is reacting to produce the noxious fumes.
- D. carry the reactants outside, away from other students.

14. Bacteria, organisms from the Prokaryote kingdom, and organisms from the Plant kingdom share several different traits. Which of these is something that they have in common?

- A. membrane-bound nucleus
- B. photosynthesis
- C. propulsion
- D. reproduction by binary fission

15. New, inheritable characteristics can result from...

   I. the recombination of genes during meiosis.
   II. the formation of daughter cells during mitosis.
   III. mutations in the genes found in sex cells.
   IV. mutations in the genes found in non-sex cells.

- A. I, II, and III only
- B. I and III only
- C. I, II, III, and IV
- D. II and IV only

16. The cell membrane serves many functions. One of the cell membrane's functions is to help the cell maintain homeostasis. Which of the following statements best supports this claim?
A. The cell membrane regulates what goes in and out of the cell.
B. The cell membrane contains proteins.
C. The cell membrane contains phospholipids.
D. The cell membrane contains a polar region and a nonpolar region.

17. Which of the following measurement tools is used to measure mass?

A. balance
B. graduated cylinder
C. meter stick
D. thermometer

18. The chart above shows the mass and dimensions of three blocks of unknown materials. The blocks are shaped like rectangular prisms. What can be concluded from the data above?

(Hint: density = mass ÷ volume)

A. All three blocks have the same density, so they could all be the same material.
B. None of the blocks could be the same material.
C. Blocks A and B have the same density, so they could be the same material.
D. Blocks A and C have the same density, so they could be the same material.

19. Which of the following will allow measurement of a liquid's volume with the greatest precision?

A. 200 mL cylinder graduated in 5 mL increments
B. 50 mL cylinder graduated in 1 mL increments
C. 100 mL cylinder graduated in 0.5 mL increments
D. 100 mL cylinder graduated in 1 mL increments

In the recent past, many of the Great Lakes were dying lakes. Toxic chemicals, such as PCBs
(polychlorinated biphenyls), had been dumped into the lakes. Many of these chemicals entered the food chain. Deformed gull chicks were some of the first warning signs.

A simplified food chain in the Great Lakes is shown in the figure below. The numbers show the concentration of PCB (in parts per million) in the tissues of the various organisms.

In addition, nitrates and phosphates from farmland and household detergents ran off into the lakes. These nutrients caused rapid growth of algae and other aquatic plants. When the plants died, they were decomposed by bacteria, a process that uses oxygen. Eventually, the level of dissolved oxygen in deeper waters fell, resulting in the decline or elimination of many native species.

Today, the water quality of the Great Lakes is much improved.

20. Which of the following generalizations about biodiversity and pollution is best supported by the information given?

- **A.** Pollution initially decreases, then increases the biodiversity in an ecosystem
- **B.** Pollution has no effect on the biodiversity of ecosystems.
- **C.** Pollution results in decreased biodiversity in an ecosystem.
- **D.** Pollution results in increased biodiversity in an ecosystem.

21. Proteins are large, organic biomolecules that consist of varying arrangements of
amino acids linked together by peptide bonds. In which of the following cellular processes are proteins involved?

- A. cellular regulation
- B. cellular communication
- C. cellular reproduction
- D. all of these

22.

In this food chain, the spiders are —

- A. secondary consumers.
- B. competitors.
- C. producers.
- D. primary consumers.

23.

The chain above represents three codons. Which of the following changes would be expected in the amino acid chain if the mutation shown above occurred?
24. Energy conversion within an animal cell would be severely limited by removal of the cell's —

- A. chloroplasts.
- B. plastids.
- C. lysosomes.
- D. mitochondria.
In the above plant cell, what is the name of the cellular organelle labeled with the letter W?

A. cell wall
B. vacuole
C. chloroplast
D. nucleus
An experiment was set up to test the effects of light on the growing tip of a plant. The diagram shows a longitudinal section of the growing plant tip. Which of these observations correctly describes the results?

A. There are more cells on the side of the plants facing away from the light source.
B. The cells farther away from the light source are longer than the cells facing the light.
C. The cells in the center of the plant are more flexible than cells on the sides.
D. The walls of the cells farther away from the light source are thicker.

27. Every year, a new influenza vaccine is developed. What is the most likely reason that doctors do not use the same vaccine each year?
28. Which conclusion is best supported by these data?

<table>
<thead>
<tr>
<th>Element</th>
<th>Percent by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>46.6</td>
</tr>
<tr>
<td>Silicon</td>
<td>27.7</td>
</tr>
<tr>
<td>Aluminum</td>
<td>8.13</td>
</tr>
<tr>
<td>Iron</td>
<td>5.00</td>
</tr>
<tr>
<td>Calcium</td>
<td>3.63</td>
</tr>
</tbody>
</table>

A. Earth's surface is composed mostly of silicon and calcium.
B. Oxygen is closer to Earth's surface than aluminum.
C. There is more aluminum than calcium at Earth's surface.
D. Silicon is much heavier than iron at Earth's surface.

29. When a person inhales, oxygen fills tiny air sacs in the person's lungs. Next, the oxygen moves from these air sacs into small blood vessels that line the lungs, and then it moves into the bloodstream so that it can be transported around the body.

Oxygen moves by random molecular motion from the air sacs of the lungs to the blood vessels because the concentration of oxygen in the air sacs is higher than the concentration of oxygen in the blood vessels.

This movement of oxygen molecules from an area of higher concentration to an area of lower concentration is known as _______.

A. diffusion
B. photosynthesis
C. osmosis
D. respiration
30. Match the plant with the adaptation most useful to survive in a cooling climate.

☐ A. apple tree flowering earlier
☐ B. pine tree increasing length of dormancy
☐ C. rosebush growing shallower roots
☐ D. palm tree increasing in height

31. The diagram below shows three different enzymes and their substrates.

This diagram shows that

☐ A. enzymes contain specific proteins which cause them to exhibit similar colors.
☐ B. enzymes have specific shapes that influence how they function and interact with other molecules.
☐ C. enzymes are interchangeable and are not specific to particular substrates.
☐ D. enzymes do not have important functions since they have little interaction with other molecules.
32. Laboratory equipment is cleaned and properly stored after use primarily so that
   
   - A. time is saved in setting up the next experiment.
   - B. chemical products can be measured and recorded as data.
   - C. the possibility of contamination in the laboratory is minimized.
   - D. toxic materials can be kept in the laboratory.

33. Which of the following is true about DNA and RNA?
   
   I. DNA is a nucleic acid, whereas RNA is a protein.
   
   II. DNA stores genetic information, whereas RNA is directly involved in protein production.
   
   III. Both DNA and RNA always contain the nitrogenous base thymine.
   
   IV. DNA contains the sugar deoxyribose, whereas RNA contains the sugar ribose.

   - A. III only
   - B. II and IV only
   - C. I, II and IV only
   - D. I, II, III, and IV

34. A DNA molecule is a large polymer that...

   - A. forms from linked subunits of four kinds of nitrogen bases.
   - B. forms a single chromosome within a cell.
   - C. contains the five-carbon sugar deoxyribose.
   - D. All of these answers are correct.

35. Alexis's school class will be traveling to the city library next week to collect information on specific topics that each student has chosen to learn about. Alexis wants to learn about the cheetah, but she still needs to choose a hypothesis for her research. Which of these would work as a hypothesis for Alexis?

   - A. The cheetah can run faster than the tiger but not as fast as the jaguar.
   - B. Is the cheetah the fastest land mammal?
   - C. What makes a cheetah run fast?
D. The cheetah runs fast only when it is frightened.

36. Scientists have observed evolution on a rapid time scale in what organism?

A. bacteria
B. horses
C. dogs
D. mustard plants

37. Examine the structural formula below.

![Structural formula of DNA or RNA](image_url)

Which of the following biomolecules is best represented by this formula?

A. protein
B. carbohydrate
C. nucleic acid
D. lipid

38. The processes of photosynthesis and cellular respiration form a continuous cycle.
During this cycle, the products from one process serve as the starting materials for the other. Which of the following materials correspond(s) to box number 1?

- A. oxygen and glucose
- B. sunlight
- C. ATP (energy) and heat
- D. carbon dioxide and water

39. Which of the following lab safety rules is demonstrated in the picture below?
A. Tie back long hair and avoid loose fitting clothing in the lab.
B. Arrange lab equipment in such a way that you never have to reach across a flame.
C. Wear safety goggles, a lab coat, and gloves when handling chemicals.
D. Avoid inhaling fumes from chemical reactions; use a fume hood when necessary.
40. Which statement describes how this ecosystem is likely to change after many years of succession?

- A. The elevation of the hill will increase.
- B. The number of plants will increase.
- C. The level of the water will increase.
- D. The variety of fish will increase.

41. The bullfrog, *Rana catesbeiana*, is most closely related to the...

- B. northern leopard frog, *Rana pipiens*.
- C. Asian flying frog, *Polypedates leucomystax*.
- D. spotted chorus frog, *Pseudacris clarki*. 
The above diagram suggests that

- **A.** energy flows from secondary consumers to primary consumers in an ecosystem.
- **B.** there are more tertiary consumers than producers in an energy pyramid.
- **C.** tertiary consumers are the ultimate source of energy in an ecosystem.
- **D.** producers are the foundation of all energy pyramids.
A herd of zebra eating grass includes groups of organisms from different species. These groups best exemplify

☐ A. a population interaction.
☐ B. a biome interaction.
☐ C. a community interaction.
☐ D. an ecosystem interaction.

44. Robert Koch

In the nineteenth century Robert Koch scientifically investigated the transmission of diseases. He proposed a procedure that would enable a person to determine if a specific microorganism caused a given disease. The first four steps of this procedure are listed below:

1. Microbes must be isolated from an infected host organism.
2. The isolated microbes are then grown in a pure culture.
3. The microbes from the pure culture are injected into a new host.
4. If the new host contracts the disease, the microbes must be isolated from the new host and grown in a new culture.

What final step should be taken to prove that these specific microbes cause the given disease?
A. Mix the microbes from the new and old cultures.
B. Inject diseased organisms with the microbes from the new culture.
C. Compare the original microbes with the microbes in the new culture.
D. Inject an organism immune to the disease with microbes from the new culture.

45. When a sea urchin egg is removed from the ocean and placed in freshwater, the egg swells and bursts. Which of these causes water to enter the egg?

A. osmosis
B. coagulation
C. sodium pump
D. active transport

46. Which of the following pieces of equipment would be most appropriate for measuring the volume of a marble?

A. a ruler
B. a graduated cylinder
C. a beaker
D. a digital scale

47. Dr. Bennett is a physician. One of his patients presents with a high fever and muscle aches. After examining the patient, Dr. Bennett diagnoses the patient with influenza.

Influenza is caused by a ________, which contains genetic information but cannot reproduce independently and is not considered to be a living organism.

A. fungus
B. virus
C. yeast
D. bacterium

48. Charles Darwin developed his theory of evolution of organisms in the 19th century. Which of these was part of his theory?
A. Often, organisms produce more offspring than can survive in their environment.
B. In a very short time, natural selection will accumulate favorable traits in a species.
C. Genetic recombinations of DNA cause variations of genetic traits.
D. DNA mutations cause variations in genetic traits.

49. How does comparing physiological similarities of living species provide evidence of evolution?

A. Physiological similarities show changes in organisms' forms.
B. Physiological similarities suggest that natural selection played a role in the evolution of the species.
C. Physiological similarities suggest the species evolved from the same ancestor.
D. Physiological similarities indicate the species evolved through punctuated equilibrium.

50. Genetically-modified organisms (GMOs) have included corn crops engineered to produce a natural pesticide to kill a certain insect which would normally destroy the corn. The benefits include a larger corn crop, because the destructive influence of the insects is lowered. What might be one negative result of growing this specific GMO?

A. All of the insects could disappear, allowing the corn crop to grow too large.
B. The genetically-modified corn would require more water to produce enough pesticide to fend off the insects.
C. The insects could grow resistant to the pesticide in the genetically-modified corn and become immune to regular pesticides.
D. The natural pesticide could get into the soil and kill the next corn crop.

Composting

As part of a class exercise on composting, two students constructed identical worm bins (containers), which they kept at their homes. Red worms were then added to the bins. Both students counted the number of red worms in their bins on the first of the month. The results are shown in the graph below.
A worm bin should be kept between 12C and 25C and 2.5 kg of food should be added to a bin each week. Student 1 followed these requirements exactly. During December, Student 2 left town for three weeks; during March, the temperature in Student 2’s worm bin reached 30C.

51. It was hypothesized that there was a maximum number of red worms that could survive in the worm bins.

Is this hypothesis supported by the data in the graph?

☐ A. Yes, because the number of red worms in Student 1’s bin remained fairly constant between December and May.

☐ B. No, because the number of red worms in Student 1’s bin decreased between December and May.

☐ C. No, because the number of red worms in Student 2’s bin decreased between December and January.

☐ D. Yes, because the number of red worms in Student 2’s bin continued to increase between September and May.

52. Multicellular eukaryotes that are usually mobile and obtain food from other organisms probably belong to the kingdom —
A. Protista.
B. Animalia.
C. Plantae.
D. Fungi.

53. What information do fossils provide about the history of organisms on Earth?

A. Fossils do not provide any information about the history of organisms on Earth.
B. Organisms have stayed exactly the same since the Earth was formed.
C. Organisms on Earth have evolved and changed significantly over time.
D. Organisms on Earth have not evolved or changed during the last 200 years.

54. Why does an enzyme function as a catalyst in a reaction?

A. It decreases the amount of energy needed for the reaction.
B. It maintains the proper temperature needed for the reaction.
C. It provides the extra energy needed for the reaction.
D. It creates the right pH needed for the reaction.

55. A laboratory investigation included examining prepared slides of pond water. Single-celled organisms with a nucleus and either cilia or flagella were visible. These organisms probably belong to the kingdom —

A. Protista
B. Animalia
C. Plantae
D. Fungi

Answers
42. D
43. C
44. C
45. A
46. B
47. B
48. A
49. C
50. C
51. A
52. B
53. C
54. A
55. A

Explanations