1. **Evidence exists that during the thousands of years in which the Grand Canyon formed, the canyon divided a single population of squirrels into two populations. One of these squirrel populations now lives on the North Rim of the canyon, and the other population lives on the South Rim. Which of the following factors would make the evolution of the populations into separate species LESS likely?**

   A Different predators live on the North and South rims of the canyon.

   B A few of the squirrels manage to cross the canyon and breed with squirrels on the other side.

   C Different trees grow on the North and South rims of the canyon because of changes in the water table.

   D A disease attacks one population of squirrels and kills most of them. The squirrels on the other side of the canyon are not affected.

2. **Male birds of paradise have extremely long, showy tail feathers. Which of the following statements BEST describes a selective advantage for having this trait?**

   A The bird is easier for predators to spot.

   B The bird must eat more to produce extra-large feathers.

   C The bird flies slowly because of drag created by the feathers.

   D The bird attracts more females and therefore mates more frequently.

3. **Which of the following mutations would be MOST LIKELY to improve the chances that an organism will survive?**

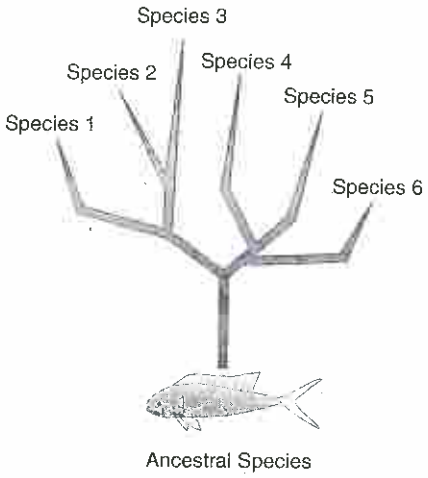
   A weaker leg muscles that make an animal slower

   B a stronger scent that makes an animal easier to find

   C a weaker scent that makes a flower less attractive to bees

   D stronger leg muscles that allow an animal to jump away from danger

4. The diagram below illustrates the concept of adaptive radiation.



Which of the following circumstances may result in this pattern?

A the movement of a large number of individuals between populations
B if parents are particularly selective of their mates
C if a species enters a new environment that has relatively few other species
D if a species enters a new environment where there is an abundance of competition

---

5. The evolutionary model that suggests that evolution happens in sudden spurts due to drastic environmental changes, such as ice ages, is known as

A catastrophism.
B punctuated equilibrium.
C gradualism.
D species drift.

---

6. Darwin's theory of natural selection was based partly on his observation that

A DNA is the genetic material.
B some organisms have more offspring than others do.
C all eukaryotic cells have a nucleus.
D garden pea plants can self-pollinate.

---

7. Examine the pictures below. Notice the similarities among the structures.

Cat's leg Dolphin's flipper Bat's wing

These similarities provide evidence for which of the following hypotheses?

A All mammals have evolved from an ancestor that was a bat.
B Legs and wings may have evolved from flippers.
C A cat's leg, a dolphin's flipper, and a bat's wing have identical functions.
D Cats, dolphins, and bats may have had the same ancestor millions of years ago.

8. Which of the following statements is NOT a prediction of the theory of evolution?

A Closely related species will show similarities in nucleotide sequences.
B If species have changed over time, their genes should have changed.
C A land animal that spends most of its life in water will evolve lungs.
D Closely related species will show similarities in amino acid sequences.

9. The Miller-Urey experiment showed that under certain conditions, organic compounds could form from inorganic molecules. What is one consequence of this experiment?

A Scientists think it is possible that organic compounds formed from the inorganic compounds present on Earth billions of years ago.
B The experiment used the exact inorganic compounds present on Earth billions of years ago and left no doubt about the mechanism of early life.
C The experiment proved that methane and ammonia will always give rise to organic molecules in any circumstances.
D There were no immediate consequences of this experiment to evolutionary thought.

10. Modern scientists have observed that genetic changes happen over time in all natural populations. Therefore, by comparing amino acid sequences, scientists can determine how similar one species is to another. The table below compares amino acids in a number of species. Some scientists have tried to use a "molecular clock," which provides information on how long ago species diverged by assigning a time period that it takes for a change to happen in a molecule. By multiplying the number of molecular changes by the time period, one can estimate how long ago two species diverged.

Hemoglobin Comparison	
Animal with hemoglobin	**Amino acids that differ from human hemoglobin**
Gorilla	1
Rhesus monkey	8
Mouse	27
Chicken	45
Frog	67

Based on the information in the table, which animal is MOST CLOSELY related to humans?

A rhesus monkey
B gorilla
C chicken
D lamprey

---

11. What is the major source of new alleles in natural populations?

A mutations in somatic cells
B mutations in sex cells
C adaptations in individual organisms
D trait selection by natural selection

---

12. **At first, a mutation may make no difference to an individual. Even if the mutation results in a nonfunctional protein, the body's cell may have a functional copy of the gene as its second allele. However, this new nonfunctioning version could be passed on as a recessive allele. This kind of mutation is the probable origin of many recessive disorders. Only characteristics that are expressed can be targets of natural selection. Therefore, natural selection CANNOT operate against recessive alleles, even if they are unfavorable. What does this explain?**

A why natural selection can only act against heterozygous carriers of a recessive disorder

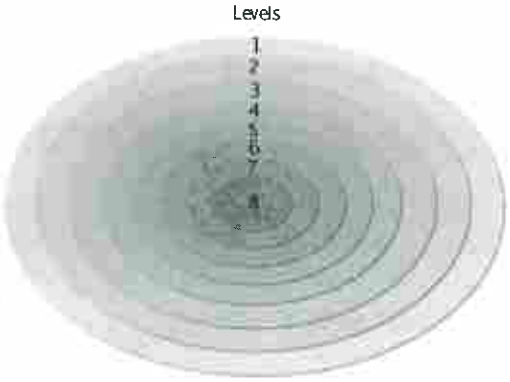
B why genetic disorders can persist in a population

C why advantageous offspring are more likely to survive and reproduce

D why recessive alleles are never expressed

---

13. **Carl Linnaeus was an 18th century biologist who set out to catalog all known species. To this end, he devised a system that assigned a unique two-name scientific name to each known species. His naming system, called binomial nomenclature, has been universally accepted. In trying to catalog every known species, Linnaeus devised more than a naming system. He also devised a system to classify all plants and animals known in his time. In the Linnean system of classification, organisms are grouped in successive levels of hierarchy based on similarities in their form and structure. There are eight basic levels in the modern Linnean system, although many new groups and some new levels have been added.**



Which level of organization has the MOST individual species in it?

A Level 1

B Level 3

C Level 7

D Level 8

---

14. Which of the following is the fundamental unit of biological classification?

A an individual
B a population
C a species
D a phylum

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15. Some large snakes, such as pythons, have small internal leg bones. These bones are examples of what?

A extinction
B fossil organs
C polyploidy
D vestigial structures

---

16. Which of the following BEST summarizes the scientific theory of evolution?

A an explanation of the origin of all species on Earth, along with fossil and genetic evidence, that has been scientifically tested and supported
B a guess about why there are so many different kinds of organisms living on Earth today
C an idea that scientists cannot come to an agreement about and argue about among themselves
D a logical explanation of the origin of all species on Earth that cannot be proved because there are still missing links in the fossil record

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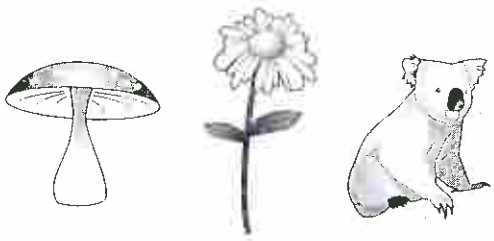
17. The drawings below illustrate a fungus, a plant, and an animal.



Which of the following is true of fungi, plants, and animals?

A They are organisms that live only on land.
B They are organisms that form mycorrhizae.
C They are three successful kingdoms that evolved from protists.
D They are three successful kingdoms that evolved from archaebacteria.

---

18. During the Industrial Revolution, scientists in England noted that moths were changing in color from light gray to dark gray as the trees on which they rested became soot covered. Which of Darwin's key observations does this transformation support?

A Organisms tend to produce more offspring than can survive; thus, all populations must be limited by their environment.

B Individuals that carry advantageous traits will increase in a population over time.

C Species are modified over time as different populations specialize in different types of food.

D Inheritance plays a role in evolution.

19. How does the study of extinct species help scientists understand current life forms?

A The species that exist at any time are the net result of speciation and all past extinctions.

B The species that exist at any time are the result of speciation caused by past extinctions.

C Past extinctions show scientists the traits that were selected against and that no longer exist in present life forms.

D Past extinctions show scientists the ancient ancestors of modern life forms.

20. Which of the following do biologists NOT use to classify organisms?

A homologous structures

B derived characteristics

C appearance

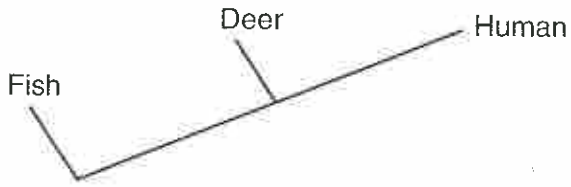
D analogous structures

21. A new animal was discovered in a remote area of Southeast Asia. The animal seems to resemble a crocodile. Biologists want to classify the mystery animal and determine its evolutionary history. The first step in this process is to analyze the characteristics in Figure 1. The second step is to use that information to create a cladogram (Figure 2).

Figure 1

Animal	Characteristics			
	Backbone	Lungs	Mammary glands	Bipedal
Fish	Yes	No	No	No
Deer	Yes	Yes	Yes	No
Human	Yes	Yes	Yes	Yes
Mystery animal	Yes	Yes	No	No

Figure 2



Where would a biologist place the mystery animal on the cladogram?

A between the deer and the human
B before the fish
C between the fish and the deer
D The mystery animal cannot be placed on this cladogram.

---

22. In the current system of classification of organisms, kingdoms are identified by five characteristics: cell type, the presence of cell walls, body type, genetics, and nutrition. Which of the following incorrectly associates a currently recognized kingdom with the form(s) of nutrition used by the members of that kingdom?

A Eubacteria: autotroph or heterotroph
B Archaebacteria: autotroph or heterotroph
C Fungi: autotroph
D Animalia: heterotroph

---

23. A taxonomist discovers a new animal in a remote valley in Papua New Guinea. Using genetic testing, he is able to classify the animal. Which of the following would result from this classification?

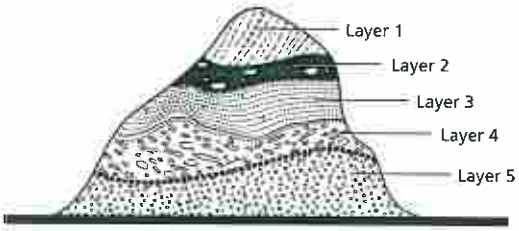
A a new species name for the animal
B the complete genetic code for the animal
C a characterization of the animal's ecological niche
D an understanding of the animal's mating and foraging behaviors

24. Which of the following were MOST LIKELY the first multicellular organisms to invade land?

A arthropods and primitive algae
B plants and fungi living symbiotically
C mosses
D amphibians and flowering plants

25. While cutting through the side of a mountain to build a highway, workers expose several layers of rock, as shown in the sketch below. Fossils of whale bones, shark teeth, and sand dollars are found in the rocks that form Layer 4. Fossils of rodents, toads, and lizards are found in Layer 2.

ROCK LAYERS



The observations above support which of the conclusions below?

A When Layer 4 formed, the mountain was near a large lake.
B When Layer 4 formed, whales, sharks, and sand dollars lived in the mountains.
C When Layer 4 formed, the area where the fossils were found was covered by an ocean.
D When Layer 4 formed, whales, sharks, lizards, toads, and rodents were in the same food web.

26. Which of the following evidence supports the theory of endosymbiosis?

A Many different species of animals have embryos with similar structures at similar stages of development.
B The replication of DNA found in mitochondria and chloroplasts takes place independently of the cell cycle.
C Two different groups of prokaryotes appear to have evolved.
D Lipids form tiny droplets that resemble cell membranes.

27. The organisms from a particular kingdom are eukaryotes; they have a cell wall made from chitin, they can be either unicellular or multicellular, and they are heterotrophic. An example of an organism from this kingdom is *Penicillin notatum*. Which kingdom is being described?

A Eubacteria
B Plantae
C Fungi
D Protista

---

28. According to endosymbiotic theory, which kingdom represents organisms that may have given rise to mitochondria and chloroplasts?

A Archaebacteria
B Eubacteria
C Fungi
D Protists

---

29. In the 1520s, the Spanish explorer Cortés and his armies carried the virus that causes smallpox to North America and South America. The death rate from smallpox in Europe at that time was approximately 10%. However, the death rate among the American Indians who were exposed to smallpox averaged 70%. Which of the following statements BEST explains the difference in death rates?

A People in Europe were healthier than American Indians.
B Antibiotics were available in Europe but not in North America.
C American Indians had never been exposed to the smallpox virus, so resistant individuals had not yet become common.
D The American Indians were exposed to a virus that was different from the virus for smallpox in Europe.

---

30. How are viruses different from living organisms?

A Viruses have no DNA or RNA.
B Viruses require host cell parts to reproduce.
C Viruses contain no proteins.
D Viruses can be killed by antibiotics.

---

31. Diseases that can spread from person to person are known as communicable diseases. Many different types of organisms, including viruses, can cause communicable diseases. Which of the following communicable diseases is caused by a virus and can be transmitted from an infected mother to her baby during childbirth?

A herpes
B malaria
C ringworm
D tetanus

32. Which of the following is true of fungi?

A They are never poisonous, and therefore all mushrooms can be eaten.
B They do not impact the world around them because they are so small.
C They are unsuitable for use as an alternative to gasoline.
D They can grow within human tissue to cause infections.

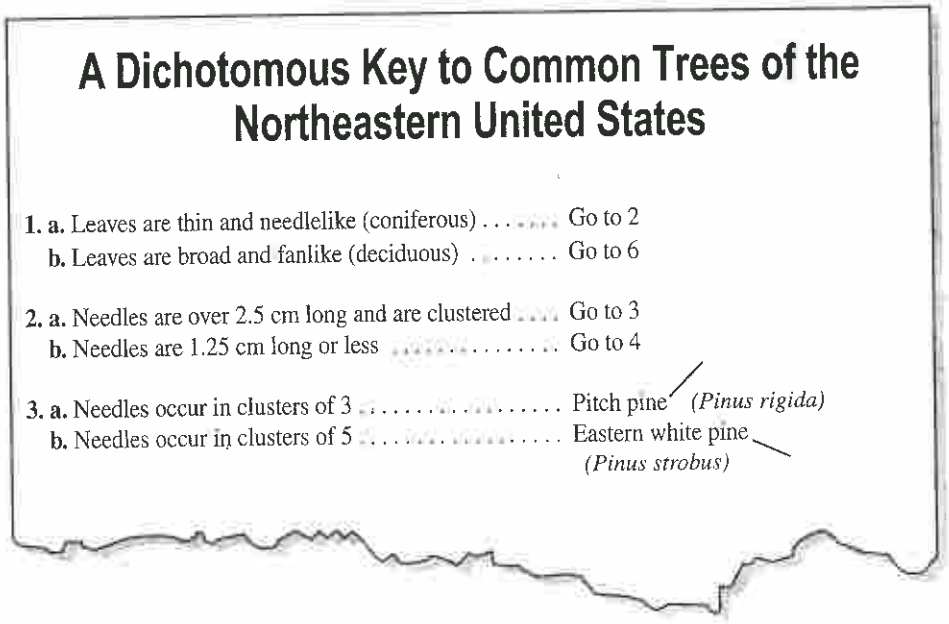
33. Explain how the body structure of a fungus makes athlete's foot, ringworm, and other fungal infections difficult to cure.

A Fungi have threadlike hyphae that grow into and absorb nutrients from human tissues.
B Fungi have sexual organs that enable them to reproduce more rapidly than they can be killed by drugs.
C Fungi have bodies that can slowly move across surfaces to escape from drug applications.
D Bacteria enclose fungi in a protective layer, making treatments with drugs less effective.

34. Which of the following statements correctly identifies the hypothesized progression of algae to modern plants?

A green algae—nonvascular plants—gymnosperms—vascular plants
B green algae—gymnosperms—vascular plants—nonvascular plants
C green algae—gymnosperms—vascular plants—nonvascular plants—angiosperms
D green algae—nonvascular plants—vascular plants—gymnosperms—angiosperms

35. Below is part of a field guide that several students have been using to identify trees in a local park. The students notice that one plant has thin 1.2 cm needles that occur in clusters.



A Dichotomous Key to Common Trees of the Northeastern United States

1. **a.** Leaves are thin and needlelike (coniferous) . . . . . Go to 2
   b. Leaves are broad and fanlike (deciduous) . . . . . Go to 6

2. **a.** Needles are over 2.5 cm long and are clustered . . . . Go to 3
   b. Needles are 1.25 cm long or less . . . . . Go to 4

3. **a.** Needles occur in clusters of 3 . . . . . Pitch pine *(Pinus rigida)*
   b. Needles occur in clusters of 5 . . . . . Eastern white pine *(Pinus strobus)*

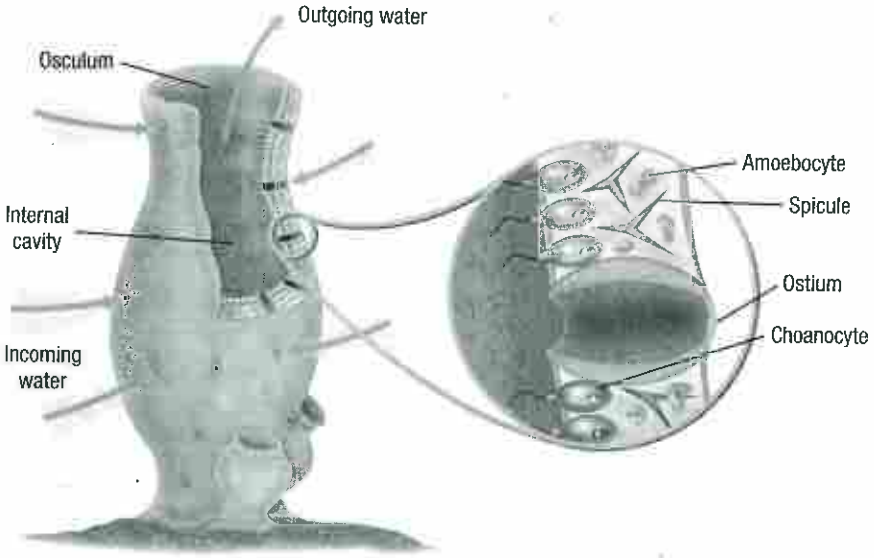
Which of the following inferences can be made?

A The plant is deciduous.
B The plant is a *Pinus rigida*.
C The plant is an eastern white pine.
D The plant cannot be identified from the information provided.

36. Which characteristic separates mammals from all other animals?

A Mammals produce milk.
B Mammals are endotherms.
C Mammals give birth on land.
D Mammals have four-chambered hearts.

37. The picture below shows a sponge.



Early biologists thought that sponges were plants. What evidence supported this classification?

A Sponges have specialized cells.
B Sponges prey on small animals.
C Sponges carry out photosynthesis.
D Sponges move very slowly, if they move at all.

---

38. Today, biologists classify sponges as animals rather than plants. What evidence supports today's classification?

A Sponges have asymmetry.
B Sponges do not have a backbone.
C Sponges cannot make their own food.
D Sponges do not have tissues or organs.

---

39. In a classroom experiment, students conducted a survey to determine the similarities and differences among groups of invertebrates. They recorded their observations in Figure 1. They also made a chart of phyla in the animal kingdom showing evolutionary milestones (Figure 2). They wanted to know where each invertebrate specimen they examined would fit on a phylogenetic tree.

Figure 1

Animal	Phylum	Symmetry	Internal body plan	Other observations
Sponge	Porifera	Asymmetrical	Full of holes	
Hydra	Cnidaria	Radial	Tissues & Stinging cells	
Planarian	Platyhelminthes	Bilateral	Acoelomate	Gut has one opening
Roundworm	Nematoda	Bilateral	Pseudocoelomate	Threadlike
Earthworm	Annelida	Bilateral	Coelomate	Segmented
Snail	Mollusca	Bilateral	Coelomate	Muscular foot
Beetle	Arthropoda	Bilateral	Coelomate	Paired legs
Star fish	Echinodermata	Bilateral	Coelomate	Five arms with tube feet

Figure 2

Phylum	Evolutionary milestone
Chordata	Notocord
Echinodermata	Deuterosomes
Arthropoda	Jointed appendages
Annelida	Segmentation
Mollusca	Coelom
Nematoda	Pseudocoelom
Platyhelminthes	Bilateral symmetry
Cnidaria	Tissues
Porifera	Multicellularity

Which four of the animals studied are most alike in terms of shared evolutionary characteristics?

A The earthworm, snail, beetle, and starfish are most alike, because they all have bilateral symmetry and a coelom.

B The sponge, hydra, snail, and starfish are most alike, because they all can live in water.

C The hydra, planarian, roundworm, and earthworm are most alike, because none of them has legs.

D All of the animals studied are very different from one another.

---

40. Gastropods, cephalopods, and bivalves share the same basic organ structures and tissue layers. This is because they are all members of the same

A kingdom.

B phylum.

C genus.

D species.

---

41. A high school student did a field investigation of Phylum Mollusca, Class Pelecypoda, at an ocean beach. The student collected and counted the animals, identified them to genus using a field guide, and noted where each had been found. The table illustrates the results.

Marine Forms of Class Pelecypoda of Phylum Mollusca on an Ocean Beach			
Sand or Mud	**Wood**	**Rock**	**Open Water**
Mya (33)	*Mytilus* (50)	*Pholas* (19)	*Pecten* (102)
Tagelus (20)	*Teredo* (23)	*Ostrea* (10)	
Ensis (10)			
Yoldia (11)			
Nucula (11)			
Venus (14)			

What could the student reasonably infer from the census of mollusks on the beach?

A Fewer *Ensis* may live on that beach than any other mollusk in the class Pelecypoda, but further study is required.

B More species of Pelecypoda were found in the sand or mud than any other environment studied.

C Protective measures should be taken to ensure that *Ostrea* does not become endangered.

D *Pholas* and *Ostrea* that live in rocky environments compete for resources.

---

42. Which of the following BEST describes why animals usually behave in ways that are favorable for them?

A because natural selection favors traits that benefit the environment

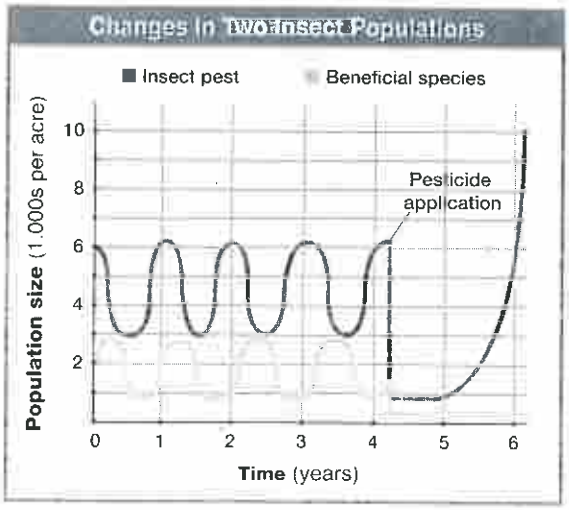
B because natural selection favors traits that benefit the individual

C because natural selection favors traits that benefit behavior

D because natural selection favors traits that are innate

---

43. A group of scientists studied the effects of pesticides on a local ecosystem. Over a number of years, they estimated the size of the populations of insect pests and beneficial species of insects in one area. Their findings from the first years of their study are illustrated below.



Which statement BEST describes the relationship between the two populations of insects after the introduction of pesticides?

A As the population of the beneficial insects increased, so did the population of the pests.
B As the population of the beneficial insects decreased, so did the population of the pests.
C As the population of the beneficial insects increased, the population of the pests decreased.
D The populations do not appear to have had an effect on each other.

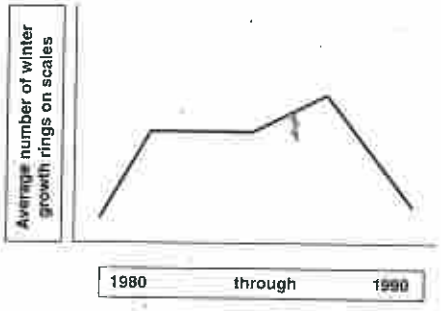
---

44. What major evolutionary characteristic is shared by sponges, chordates, jellyfish, and echinoderms?

A body cavity
B notochord
C multicellularity
D segmentation

---

45. **In the bony fishes, growth results in a series of fine concentric ridges that end obliquely on the scale margin. After cessation of growth during winter, the first ridges of the next growth season form parallel to the scale margin, making a definite winter line. This makes age determination possible in salmon, trout, bass, and others. A wildlife biologist studied the growth rings on preserved scales of rainbow trout taken from an inland lake over a ten-year period and drew this graph.**



What can you infer from the graph about the trout in this lake from 1980 to 1990?

A The number of winter rings remained steady throughout that period.
B The trout population increased steadily during that period.
C The population of older trout decreased rapidly in the late 1980s.
D The number of winter rings decreased steadily throughout that period.

---

46. **Birds and reptiles share many characteristics. Which statement accurately describes some of the differences between birds and reptiles?**

A Birds have feathers and wings; reptiles have dry, scaly skin.
B Birds have hollow bones and toothless beaks; reptiles have large teeth and solid bones.
C Bird eggs have a leathery shell; reptile eggs have a hard shell.
D Birds live in all types of ecosystems; reptiles only live in deserts.
