

Name _____

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Indicate the answer choice that best completes the statement or answers the question.

1. Based on current fossil evidence,
 - a. whales were likely fully aquatic before they evolved peg-like teeth or baleen.
 - b. evolution of baleen forced whales to become fully aquatic.
 - c. the teeth of extinct whales such as Dorudon were similar to those of extinct land mammals.
 - d. whales were likely fully aquatic before they evolved peg-like teeth or baleen and the teeth of extinct whales such as Dorudon were similar to those of extinct land mammals.
 - e. evolution of baleen forced whales to become fully aquatic and the teeth of extinct whales such as Dorudon were similar to those of extinct land mammals.
2. New mutations
 - a. are random with respect to their effects on fitness.
 - b. are necessary for natural selection to cause evolutionary change.
 - c. are rare in a population.
 - d. All the given choices are correct.
 - e. are random with respect to their effects on fitness and are necessary for natural selection to cause evolutionary change.
3. From examining the fossil record, scientists have postulated that long-term historic changes in cetacean diversity depended on
 - a. changes in the abundance of diatoms, one of their main food sources.
 - b. changes in the abundance of diatoms, which serve as food for animals that were preyed upon by cetaceans.
 - c. changes in sea temperature.
 - d. rising pollution levels in the ocean.
 - e. changes in the abundance of organisms that prey on cetaceans.
4. Which of the following statements is accurate regarding the evolution of drug resistance in a virus?
 - a. The drug causes mutations in the virus that make it resistant.
 - b. Even before the drug is administered, some virions might be resistant.
 - c. An individual virion that is exposed to the drug will adapt by becoming resistant; future applications of the drug will be ineffective against this virion.
 - d. All the given choices are correct.
5. The placement of whales within the artiodactyls is supported by
 - a. morphology of limb bones (e.g., the astragalus) in extinct whales.
 - b. DNA evidence.
 - c. the fact that some artiodactyls (e.g., hippos) spend a significant amount of time in the water.
 - d. morphology of limb bones (e.g., the astragalus) in extinct whales and DNA evidence.
 - e. morphology of limb bones (e.g., the astragalus) in extinct whales, DNA evidence, and the fact that

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some artiodactyls (e.g., hippos) spend a significant amount of time in the water.

6. Biologist Theodosius Dobzhansky wrote an essay in 1973 entitled "Nothing in _____ Makes Sense Except in the Light of _____."

- a. Evolution; Biology
- b. Biology; Phylogenetics
- c. Biology; Evolution
- d. Genetics; Biology

7. What types of mutations are possible in viruses?

- a. beneficial
- b. neutral
- c. harmful
- d. All the given choices are correct.
- e. None of the given choices are correct.

8. Which of the following may result in evolutionary change in a population?

- a. genetic drift
- b. natural selection
- c. mutation
- d. All the given choices are correct.
- e. natural selection and mutation

9. Drawing on your knowledge of evolution, why is treatment and/or vaccination against viruses particularly difficult?

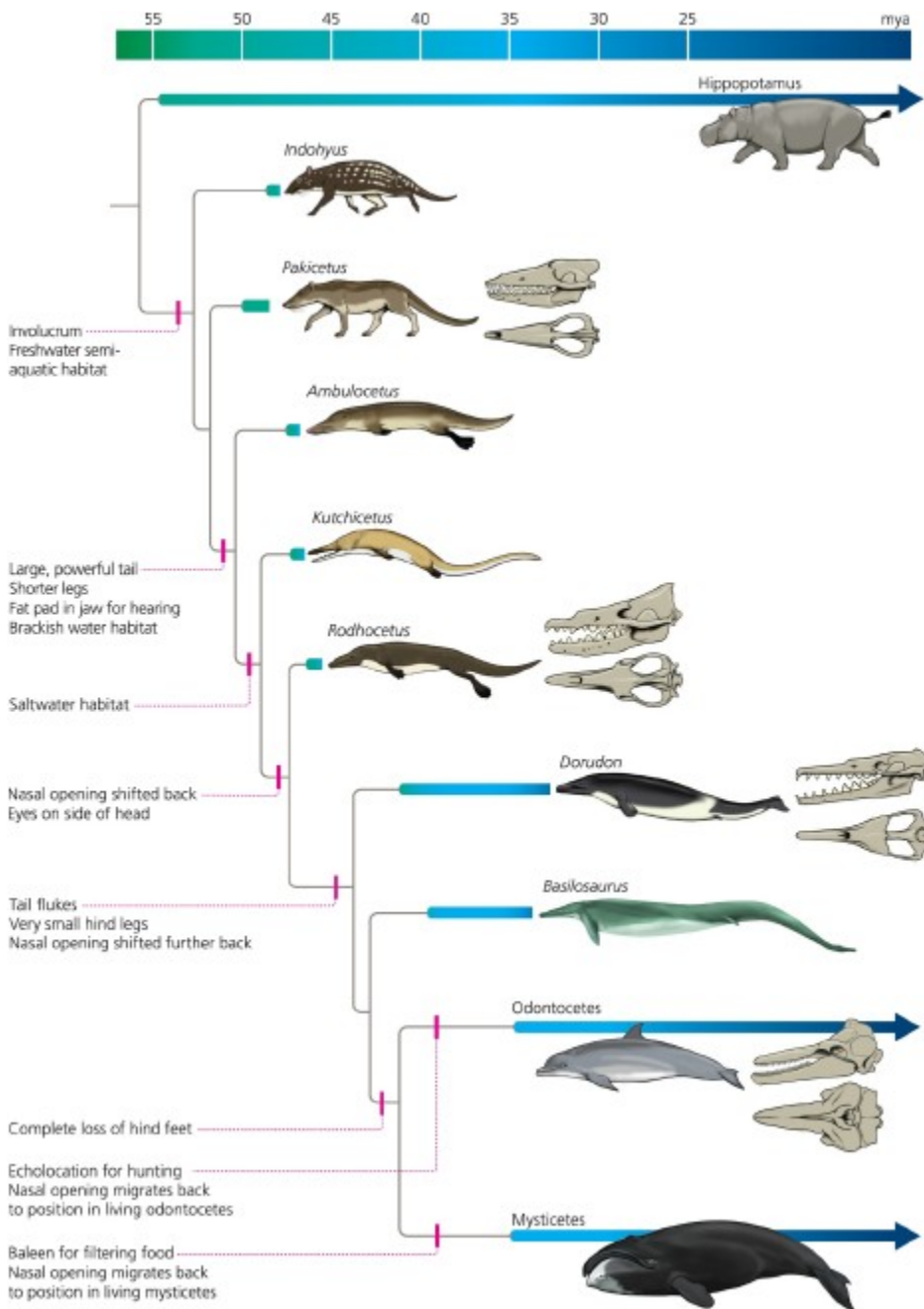
- a. Their high replication rate increases the probability of beneficial mutations.
- b. Their high mutation rate increases the probability of beneficial mutations.
- c. Viral reassortment increases the pathogenicity of viruses.
- d. Their high replication rate increases the probability of beneficial mutations and their high mutation rate increases the probability of beneficial mutations.
- e. Their high replication rate increases the probability of beneficial mutations, their high mutation rate increases the probability of beneficial mutations, and viral reassortment increases the pathogenicity of viruses.

10. Which of the following would explain why viruses such as influenza evolve so rapidly?

- a. They have a high mutation rate.
- b. They have a high replication rate.
- c. They can undergo viral reassortment.
- d. None of the given choices are correct.
- e. All the given choices are correct.

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11. Given the phylogeny of extant and extinct cetaceans below, which of the following conclusions is correct?



Zimmer/Emlen, *Evolution: Making Sense of Life*, 3e, © 2020 W. H. Freeman and Company

- The hippopotamus belongs to the cetacean group.
- The traits present in modern cetaceans appeared quickly and de novo.
- All living cetaceans have completely lost their hind feet.
- The hippopotamus belongs to the cetacean group and all living cetaceans have completely lost their hind feet.
- None of the given choices are correct.

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12. Which of the following is not an example of evolution?
- a. Beak size in a population of birds becomes larger from one generation to the next because larger beaked birds had higher reproductive success and passed the trait to their offspring.
 - b. Over long periods of time, whales gradually lost their hindlimbs.
 - c. When humans travel to a high altitude, their physiology changes to accommodate lower oxygen levels.
 - d. None of the given choices are correct.
13. Mammary glands in whales and humans
- a. are a synapomorphy for these species and other mammals.
 - b. are homologous traits.
 - c. were likely present in the most recent common ancestor of humans and whales.
 - d. All the given choices are correct.
 - e. None of the given choices are correct.
14. Evolution occurs when
- a. individuals in a population change in response to the environment.
 - b. the average value of trait in a population changes from one generation to the next.
 - c. individuals in a population change in response to the environment and the average value of trait in a population changes from one generation to the next.
 - d. None of the given choices are correct.
15. Viral reassortment
- a. can make a strain of virus especially deadly within a host population.
 - b. is a way for viruses to swap genes.
 - c. is only possible for viruses that infect the same host species.
 - d. All the given choices are correct.
 - e. can make a strain of virus especially deadly within a host population and is a way for viruses to swap genes.
16. Which of the following is not an example of an organism's phenotype?
- a. a plant gall produced by gall flies
 - b. the waving behavior of fiddler crabs
 - c. a heterozygote that has one dominant and one recessive allele
 - d. the open circulatory system in a beetle
17. Darwin defined evolution as
- a. change over time.
 - b. descent with modification.
 - c. change in allele frequencies in a population over time.
 - d. differential survival and reproduction of individuals with adaptive traits.

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18. What type of virus is the influenza virus?

- a. an enveloped RNA virus
- b. a non-enveloped RNA virus
- c. an enveloped DNA virus
- d. a non-enveloped DNA virus

19. One important feature that links extinct organisms such as *Pakicetus* and *Indohyus* to cetaceans is

- a. the shape of a bone in the middle ear.
- b. the presence of forelimb flippers.
- c. the lack of hindlegs.
- d. peg-like teeth.

20. The fluke of a whale and the fluke of a shark

- a. are homologous traits.
- b. arose through convergent evolution.
- c. are the result of natural selection.
- d. arose through convergent evolution and are the result of natural selection.
- e. are homologous traits, arose through convergent evolution, and are the result of natural selection.

21. Hemagglutinins are

- a. proteins on the viral surface used to aid the release of a new virus from the host cell.
- b. proteins on the surface of host cells used in the immune response against viruses.
- c. proteins on the viral surface used to aid in the entry of a virus into a host cell.
- d. All the given choices are correct.

22. The molecular clock used to date the emergence of the 2009 H1N1 strain would be inaccurate if

- a. mutations arose at different rates in different lineages.
- b. the most recent common ancestor of the viral strains existed long ago.
- c. the most recent common ancestor of the viral strains existed recently.
- d. None of the given choices are correct.

23. In the context of epidemiology, what does it mean to describe the world as "smaller"?

- a. The size of Earth has been shrinking since it formed 4.56 billion years ago.
- b. The size of the world's population is larger than Earth can sustain.
- c. Humans can travel from continent to continent within hours or days.
- d. The continents are shifting in a way to make the land on Earth smaller.

24. Which of the following is not a homology?

- a. the fluke of a whale and the tail fin of a tuna
- b. the mammary glands of a whale and of a platypus

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- c. the ectotympanic of a human and the ectotympanic of a whale
- d. the lack of hind limbs in whales and dolphins

25. Given what you learned about how influenza changes over time, how could you explain the emergence of drug resistance in bacterial pathogens? For example, certain strains of tuberculosis are resistant to many of the major classes of antibiotics traditionally used to fight this pathogen.

26. Describe one piece of evidence that indicates that early four-legged whales such as *Indohyus* and *Pakicetus* are more closely related to modern-day whales than they are to the closest living four-legged relative of modern whales, the hippopotamus.

27. Describe evidence three pieces of evidence found in extant cetaceans that supports the idea that their ancestors had hindlimbs.

28. When scientists infected vaccinated and nonvaccinated mice with influenza, they found that after nine sequences of viral passage the hemagglutinin protein was altered in one of the groups. Which group was it, and what is the evolutionary explanation for the differences between the groups?

29. You discover a new 50-million-year-old fossil that you believe might be an ancient cetacean. The creature looks nothing like a modern cetacean—it has four legs and clearly spent considerable time on land. Describe one feature that would indicate that this creature was, in fact, an early cetacean.

30. Describe two examples from extant cetacean anatomy or development that reflect their ancestral past.

31. What is a scientific theory, and how does this differ from how we often use the term in a nonscientific context?

32. Before DNA evidence, scientists had a difficult time discerning where cetaceans fit into the mammalian family tree. Based on morphological features used to classify artiodactyls, why would it have been difficult to link cetaceans to artiodactyls based on morphological evidence alone? How do more recent discoveries in the fossil record link cetaceans to artiodactyls?

33. The 2009 H1N1 pandemic strain included genes from influenza that normally infects pigs, birds, and humans. How is this possible? Why are mixed strains particularly likely to cause high mortality?

34. Describe how scientists used carbon isotopes to determine whether extinct whales likely inhabited freshwater or saltwater.

35. Sirenians (manatees and dugongs) are aquatic mammals that, like whales, lack hind limbs. Is lack of hindlimbs a homologous trait for sirenians and cetaceans?

36. The influenza virus has only ten genes, which is far fewer than other nonviral organisms. Why do you think viruses are able to survive and replicate with so few genes compared to other organisms?

37. Evolution is often described as a completely random process. Is this true? Why or why not?

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Answer Key

1. d
2. e
3. b
4. d
5. d
6. c
7. d
8. d
9. e
10. e
11. c
12. c
13. d
14. b
15. e
16. c
17. b
18. a
19. a
20. d
21. c
22. d
23. c

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