

Evolution Post-Test

LOGIN CODE = BOOPAD2

This is a multiple-choice test on evolution ideas you will cover during the next several weeks. You may not know the answers to some questions, but that is ok. We ask you to do your best.

As you move through the test:

- Carefully read each question and circle the answer choice you think is correct.
- Work slowly and carefully. You will have the whole class period to complete the test.
- Answer as many test questions as you can. Your answers are very important to the research team and will help them further improve the teaching material.

Thank you for your help and good luck!

Please provide the following information (optional):

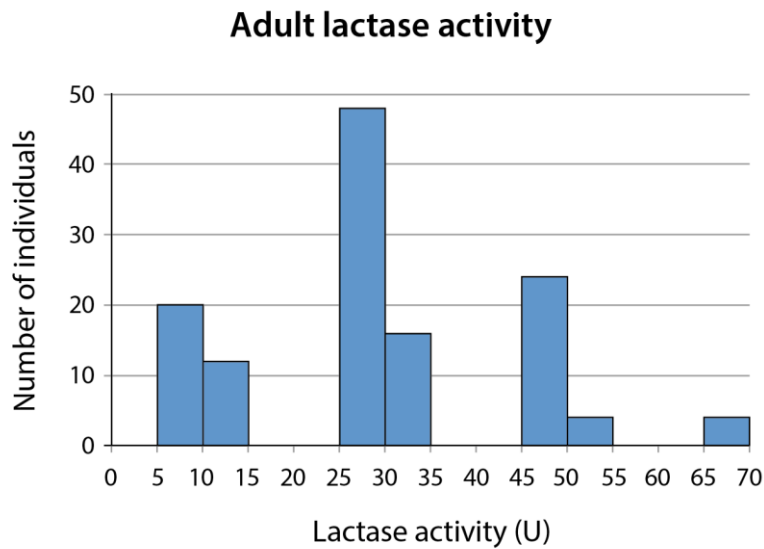
- What is your gender?
 - Male
 - Female
- What best describes your race/ethnicity? (Choose all that apply)
 - American Indian or Alaskan Native
 - Asian
 - Hispanic of Latin American
 - Native Hawaiian or other Pacific Islander
 - White
 - Other
- What is your age? (Write below)

- Is English your primary language?
 - Yes
 - No
- What is your current or highest level of education?
 - 7th grade
 - 8th grade
 - 9th grade
 - 10th grade
 - 11th grade
 - 12th grade
 - High School Graduate

EM51-2

1. Lactase is an enzyme that helps digest milk. All human infants make lactase, but some individuals make less of it by the time they reach adolescence. A person's lactase activity is measured in units (U).

Below is a graph that shows the lactase activity of adults in a population.



Which of the following claims is supported by this graph?

- A. Lactase activity is changing over time in the population.
- B. Lactase activity varies among individuals in the population.
- C. Lactase activity is undergoing natural selection in the population.
- D. Lactase activity is the same throughout the population.

2. A researcher makes the claim:

"Algae and fish share a common ancestor"

Which of the following statements provide valid evidence and sound reasoning to support this claim?

- A. Algae and fish both live in the ocean. The place where organisms live can be used as evidence that they share a common ancestor.
 - B. Algae and fish are composed of matter. Being made of matter can be used as evidence that two organisms share a common ancestor.
 - C. Fish are able to eat algae. A predator-prey relationship can be used to determine whether two organisms share a common ancestor.
 - D. Fish cells and algae both have DNA. Whether an organism has DNA can be used as evidence that they share a common ancestor.
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3. The table below shows the presence or absence of traits in seven different species.

Character	Frog	Bird	Crocodiles	Whale	Pig	Gorilla
Blowhole				Yes		
Body hair				Yes	Yes	Yes
Amniotic egg		Yes	Yes	Yes	Yes	Yes
Forelimbs	Yes	Yes	Yes	Yes	Yes	Yes
Backbone	Yes	Yes	Yes	Yes	Yes	Yes
Holes in Skull		Yes	Yes			

There is not enough information in the table to determine which organism is most closely related to whales. What else could help scientists determine which organism is most closely related to whales?

- A. If fossils of an extinct whale were found that had pig-like hooves
 - B. If whales and crocodiles both have traits adapted to living underwater
 - C. If whales, pigs, and gorillas all start to develop pelvic bones as embryos
 - D. If whales have some genes that are not found in any of the other organisms
-

4. What is required for two populations of the same species to become two different species through natural selection?

- A. The only thing required is that the two populations have to be separated so that they cannot reproduce with each other.
 - B. The only thing required is that the two populations have to experience different environmental conditions.
 - C. The populations must be separated so that they cannot reproduce with each other, and they have to experience different environmental conditions.
 - D. Two populations of the same species cannot become two different species.
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CA23-3

5. Assume that some type of forelimbs were present in the common ancestor of pigs, crocodiles, whales, and birds, and that those ancient forelimbs evolved into the arms, fins, and wings of animals that exist today. What would be true about the genes that code for forelimbs in these different animals that evolved from the forelimbs of the common ancestor?

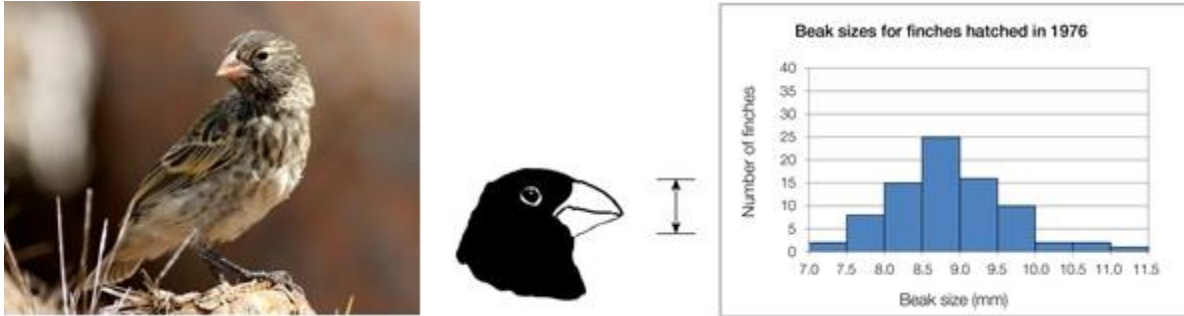
- A. Exactly the same genes would code for forelimbs in all of these animals.
 - B. Many of the same genes would code for forelimbs in all of these animals.
 - C. Many of the same genes would code for arms in pigs and crocodiles, but these genes would be completely different from the genes that code for wings in birds or fins in whales.
 - D. Completely different sets of genes would code for forelimbs in these different kinds of animals.
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EN46-11

6. Some organisms, such as a chimpanzee and a gorilla, have many similarities. Others, such as a chicken and an oak tree, have fewer similarities. What is TRUE about the ancestors of these organisms?

- A. Chimpanzees and gorillas share a common ancestor with each other, but chickens and oak trees do not share a common ancestor with each other.
 - B. Chimpanzees and gorillas share a common ancestor with each other, and chickens and oak trees share a common ancestor with each other, but chimpanzees and gorillas do not share a common ancestor with chickens and oak trees.
 - C. Because chimpanzees, gorillas, chickens, and oak trees are separate species, none of them shares a common ancestor with any other.
 - D. Chimpanzees, gorillas, chickens, and oak trees all share an ancient common ancestor.
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7. The ground finch (*Geospiza fortis*) is a species of bird. To learn more about the kinds of foods the finches could eat, scientists observed the finches and measured the size of their beaks. The graph below shows the beak size (in millimeters) of a sample of ground finch recorded in 1976.



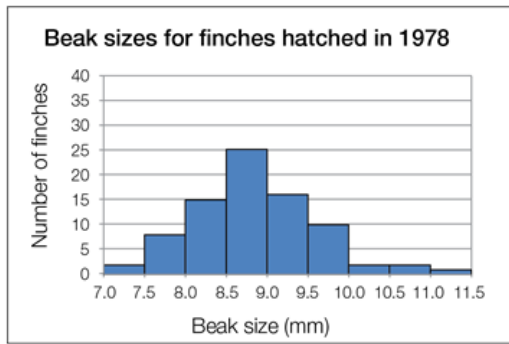
Left: An individual female ground finch. Middle: A drawing showing the part of the finches' beaks that the scientists were measuring. Right: Graph showing beak size (in millimeters) of a sample of ground finches.

Seeds are the finches' main source of food. Finches with small beaks can eat only small seeds, but finches with large beaks can eat both small and large seeds. Beak size is inherited.

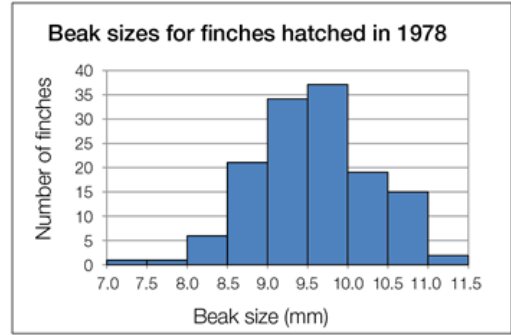
Imagine that a drought (a long period without rain) killed most of the plants that make small seeds. Except for the small seeds being gone, nothing else changed about the environment.

What do you think will happen to beak size in the next generation of finches? **Choose the graph that best matches your prediction by clicking its corresponding letter at the bottom of the screen.**

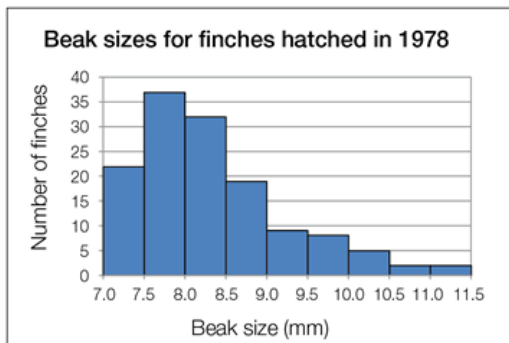
A.



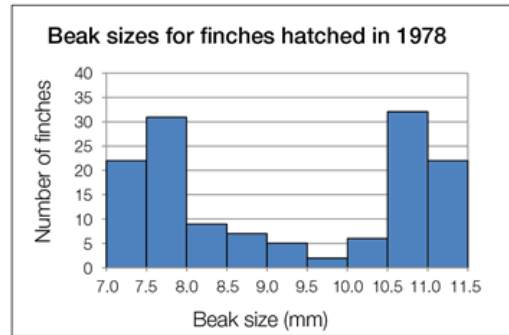
B.



C.



D.



8. A population is a group of individuals of the same species. Could a population living today differ from their ancestors from many generations ago? Why or why not?

- A. Yes, an environmental change could affect which individuals are more likely to survive and reproduce based on which inherited traits they have.
 - B. Yes, an environmental change could cause individuals to make more use of certain inherited traits and pass down improved versions of these traits to their offspring.
 - C. No, populations are all the same species and therefore have the same set of inherited traits no matter how many generations pass.
 - D. No, the environment could not change enough over time for certain inherited traits to become more useful than others.
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9. There are two kinds of monkeyflower plants in a field: one has pink flowers and one has red flowers. Scientists wondered if the pink and red monkeyflower plants were different species. They knew that a particular genotype in the monkeyflower plants determines what each plant reproduces with. Descriptions of the three possible genotypes are shown below:

Monkeyflower Genotype	
CC	Reproduces with red monkeyflower plants
LL	Reproduces with pink monkeyflower plants
LC	Reproduces with pink monkeyflower plants and red monkeyflower plants

If scientists determined the genotypes of a representative sample of monkeyflower plants in the field, what would provide the best evidence that the red monkeyflower plants and the pink monkeyflower plants do not reproduce with each other?

- A. All of the plants in the sample have the LC genotype.
- B. All of the plants in the sample have either the LL or CC genotypes.
- C. Equal numbers of plants in the sample have the LL genotype, LC, and CC genotypes.
- D. Most of the plants in the sample have the LC genotype, a few have the LL genotype, and a few have the CC genotype.

The scenario presented here is based on an actual scientific study (Bradshaw and Schemske, 2003); however, it has been simplified for testing purposes.

10. Because the traits of organisms depends on the proteins they produce, evolutionary biologists study the proteins that organisms make. Which of the following describes ways that protein molecules are important to an organism?

- A. Proteins play a part in the development of an organism's physical characteristics and in the function of the organism's cells.
 - B. Proteins play a part in the development of an organism's physical characteristics but not in the functions of the organism's cells.
 - C. Proteins play a part in the function of the organism's cells but not in the development of the organism's physical characteristics.
 - D. Proteins do not play a part in the development of an organism's physical characteristics nor in the function of the organism's cells.
-

11. A student is reading a newspaper article and comes across the statement:

“Sharks and dolphins share a common ancestor.”

Their teacher asks them to read the article to see whether the journalist provides clear evidence and good reasons to support the claim.

Which of the following should the student look for in the article?

- A. **Evidence:** Data comparing the DNA sequence of sharks and dolphins.
Reasoning: A statement that having a similar DNA sequence suggests common ancestry.
 - B. **Evidence:** Data comparing the DNA sequence of sharks and dolphins.
Reasoning: A statement that new species can be produced when the environment favors the survival and reproduction of a population with particular traits.
 - C. **Evidence:** A statement that says that all vertebrates are related.
Reasoning: A statement that says that if all vertebrates are related, they must have similarities in their DNA sequence.
 - D. **Evidence:** A description of the similarities between the skeletons of sharks and the skeletons of dolphins.
Reasoning: A statement that both humans and fish have internal skeletons that include backbones and a skull.
-

12. The table below shows the presence or absence of traits in seven different species.

Character	Frog	Bird	Crocodiles	Whale	Pig	Gorilla
Blowhole				Yes		
Body hair				Yes	Yes	Yes
Amniotic egg		Yes	Yes	Yes	Yes	Yes
Forelimbs	Yes	Yes	Yes	Yes	Yes	Yes
Backbone	Yes	Yes	Yes	Yes	Yes	Yes
Holes in Skull		Yes	Yes			

Based only on the traits presented in the table, are birds, frogs, or crocodiles, most closely related to pigs?

- A. Birds
- B. Frogs
- C. Crocodiles
- D. Not enough information

13. What do scientists find out when they trace the ancestors of dogs and cats?

- A. All dogs and cats living today share a common ancestor with each other that lived a very long time ago.
- B. All dogs share a common ancestor with each other, and all cats share a common ancestor with each other, but cats and dogs do not share a common ancestor with each other.
- C. Some, but not all, dogs share a common ancestor with cats. Some, but not all, cats share a common ancestor with dogs.
- D. Scientists cannot trace the ancestors of any two species back far enough to find out whether they had a common ancestor.

14. The DNA sequences of dogs and the DNA sequences of beetles differ in many ways. Which of the following mechanisms could lead to differences in the DNA sequences of dogs and beetles?

- A. Gene mutations
- B. Recombination of genes
- C. Gene mutations and recombination of genes
- D. Gene mutations, recombination of genes, and natural selection

15. The table below shows the presence or absence of traits in seven different species.

Character	Frog	Bird	Crocodile	Whale	Pig	Gorilla
Blowhole				Yes		
Body hair				Yes	Yes	Yes
Amniotic egg		Yes	Yes	Yes	Yes	Yes
Forelimbs	Yes	Yes	Yes	Yes	Yes	Yes
Backbone	Yes	Yes	Yes	Yes	Yes	Yes
Holes in Skull		Yes	Yes			

Based only on the traits presented in the table, which organism would you expect to have the most genetic similarity with crocodiles?

- A. Birds
- B. Gorillas
- C. Whales
- D. Not enough information is available

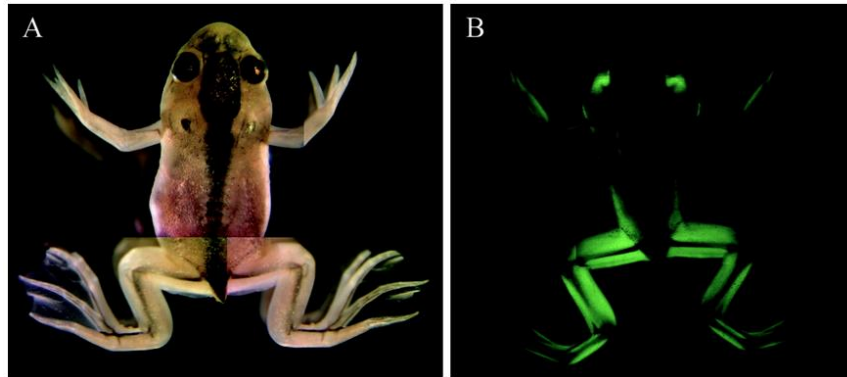
EH51-1

16. Which of the following are mechanisms that contribute to new heritable traits in a population?

- A. Gene mutations and natural selection
 - B. Gene mutations and recombination of genes
 - C. Recombination of genes and natural selection
 - D. Recombination of genes, gene mutations, and natural selection
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17. Observation: Scientists introduce a copy of the GFP (green fluorescent protein) gene into the DNA of a frog embryo to make a frog that glows green. They notice that only the frog's muscles but none of the other cells glow green.

Question: Why do only the muscles of the frog glow green?



Left: A genetically engineered frog with the GFP gene. Right: The same frog under a light that makes the GFP glow. Image from Lim et al. (2004)

Claim: Only the muscles glow green because the GFP gene is turned on only in muscle cells and is turned off in all the other cell types.

Evidence: Several of the frog's different cell types were examined for the presence of the GFP gene and GFP protein. The GFP gene was found in every cell type tested, but GFP protein was detected only in muscle cells. Which of the following statements provides the best reasoning to justify why the evidence supports the claim?

- A. The GFP gene is found in every cell because multicellular organisms develop from a single cell. Therefore, in multicellular organisms all of an individual's cells have the same DNA.
- B. The same genes are present in all cell types of an organism, but not all genes are turned on in those different cell types. Different cell types turn on different genes. This means that, if GFP protein is found only in muscle cells, it is because the GFP gene is turned on only in those cells.
- C. Not all cells are identical. There are different cell types that are able to perform different functions in the body.
- D. Genetic switches are segments of DNA that respond to cellular signals to turn genes on or off.

RH45-1

18. Humans, dogs, and trees are all living things. In which of these organisms would you find DNA molecules?

- A. Only in humans
 - B. Only in humans and dogs
 - C. In humans, dogs, and trees
 - D. DNA molecules are not found in any of these organisms
-

EN98-1

19. Which of the following statements about natural selection is true?

- A. Natural selection acts on traits, which influences the inheritance of alleles.
 - B. Natural selection acts on alleles, which influences the inheritance of traits.
 - C. Natural selection acts on traits, which influences the inheritance of proteins.
 - D. Natural selection acts on proteins, which influences the inheritance of alleles.
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SP1-1

20. Cichlids are fish that live in freshwater lakes. There are over a thousand different species of cichlids that differ in size, color, habitat, and diet. Which piece of evidence might scientists use to determine that two populations of cichlids are from different species?

- A. The two populations have a common ancestor.
 - B. One population eats algae and the other population eats snails.
 - C. Individuals from the two populations cannot reproduce with each other.
 - D. One population lives at the bottom of the lake and the other lives near the surface.
-

21. A class of students is visiting the primate room of a natural history museum. Some of the students are looking at the skeleton of a chimpanzee next to the skeleton of a gorilla.

A sign next to the skeletons reads:

“Do chimpanzees and gorillas share a common ancestor?”

The teacher asks the students to think about that question and then to write an argument to justify their answer. This is what one of the students writes:

Common ancestors are a topic in evolution. Similar skeletal features likely indicate a common ancestor. Chimpanzees and gorillas have similar anatomical features. For example, chimpanzees and gorillas both have opposable thumbs and their ribcages are very similar. Chimpanzees and gorillas may have a common ancestor.

Identify the claim, evidence, and reasoning statement in the student’s argument.

- A. **Claim:** Similar skeletal features likely indicate a common ancestor.
Evidence: Chimpanzees and gorillas both have opposable thumbs and similar ribcages.
Reasoning: Chimpanzees and gorillas have similar skeletal features.
 - B. **Claim:** Similar skeletal features likely indicate a common ancestor.
Evidence: Chimpanzees and gorillas have similar skeletal features.
Reasoning: Chimpanzees and gorillas both have opposable thumbs and similar ribcages.
 - C. **Claim:** Chimpanzees and gorillas may have a common ancestor.
Evidence: Similar skeletal features likely indicate a common ancestor.
Reasoning: Chimpanzees and gorillas both have opposable thumbs and similar ribcages.
 - D. **Claim:** Chimpanzees and gorillas may have a common ancestor.
Evidence: Chimpanzees and gorillas both have opposable thumbs and similar ribcages.
Reasoning: Similar skeletal features likely indicate a common ancestor.
-

22. *Annosum* are a group of sexually reproducing fungi that live on and eat trees in North America, Europe, and Asia. Which of the following would provide the strongest evidence that the *Annosum* living in Europe and Asia are different species?



Photo taken by James Lindsey, distributed under a CC-BY-SA 2.5 license

- A. *Annosum* collected in Europe have genetic differences compared to *Annosum* collected in Asia.
 - B. *Annosum* collected in Europe are all white in color and *Annosum* collected in Asia are all brown in color.
 - C. *Annosum* collected in Europe and *Annosum* collected in Asia do not mate because they live on different continents.
 - D. *Annosum* collected in Europe and *Annosum* collected in Asia cannot mate to produce viable offspring even when they are brought together.
-

EN46-10

23. Some animals, such as a cat and a dog, have many similarities. Others, such as a fish and a bird, have fewer similarities. What is TRUE about the ancestors of these animals?

- A. Cats and dogs share a common ancestor with each other, but fish and birds do not share a common ancestor with each other.
 - B. Cats and dogs share a common ancestor with each other, and fish and birds share a common ancestor with each other, but cats and dogs do not share a common ancestor with fish and birds.
 - C. Because cats, dogs, fish, and birds are separate species, none of them shares a common ancestor with any other.
 - D. Cats, dogs, fish, and birds all share an ancient common ancestor.
-

EM42-4

24. Which of the following would support the claim that a particular behavioral trait found in a population of organisms is inherited?

- A. If many individual organisms in that population had the trait
 - B. If a gene was found for the trait
 - C. If the trait could be learned by offspring from their parents
 - D. If the trait was found in only one individual in that population
-

CA10-2

25. If the DNA of jellyfish and insects is more similar than the DNA of jellyfish and plants, what is a reasonable conclusion about the common ancestors of these three groups?

- A. Jellyfish and insects have a common ancestor, but jellyfish and plants do not.
 - B. Jellyfish and plants have a more recent common ancestor than jellyfish and insects.
 - C. Jellyfish and insects have a more recent common ancestor than jellyfish and plants.
 - D. Similarities in DNA cannot provide information about the common ancestors of jellyfish and insects because jellyfish and insects do not share a common ancestor.
-

CA33-3

26.

Gene X in Dog  . . . T A C G C A A C A **A** T . . .
Gene X in Pig  . . . T A **A** G C **C** A C **C** **T** T . . .
Gene X in Cat  . . . T A C G C A **C** C A **C** T . . .

Dogs, pigs, and cats have similar genes for traits that they have in common, such as four legs, tails, and a rib cage. One of those genes, Gene X, is pictured above. Why does the DNA sequence of Gene X differ in some positions (highlighted in red) for dogs, pigs, and cats?

- A. Over time, the organisms' traits changed, which caused Gene X to change.
- B. Over time, mutations occurred in Gene X.
- C. All three organisms had different needs, so they intentionally created different genes.
- D. Not enough information is given.

27. Anoles are lizards that live in the southeastern United States, South America, and the Caribbean islands. Different anoles vary from each other in many ways. One trait on which anoles vary is their hind-leg length ratio. The hind-leg length ratio is the hind-leg length divided by the body length.

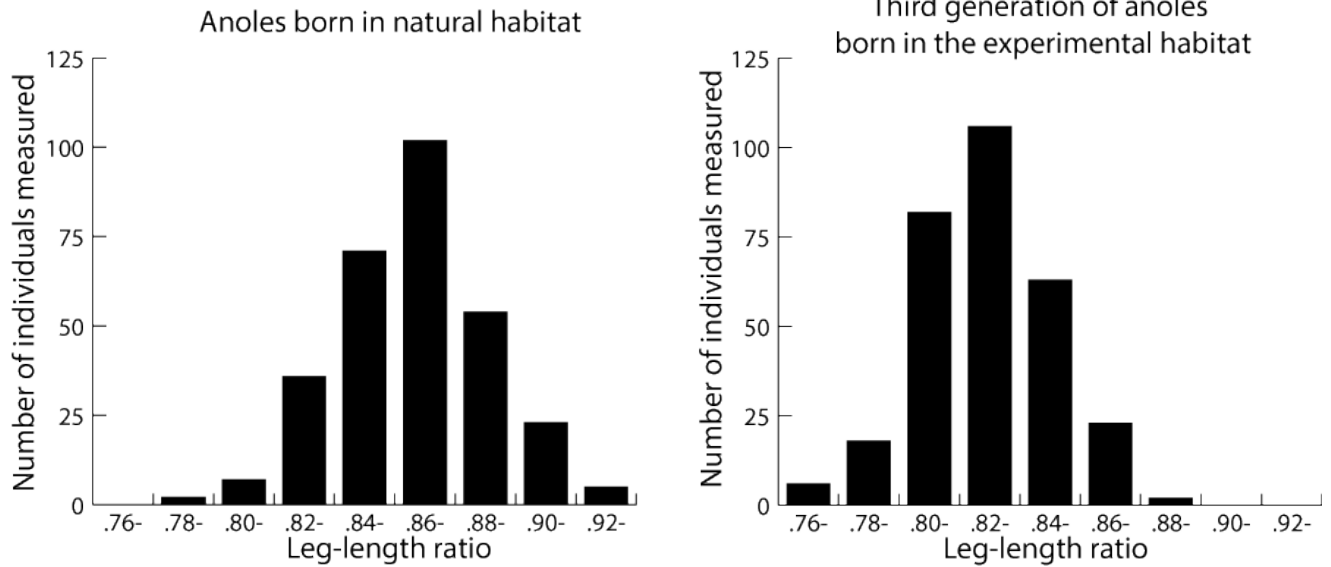
The images below show an anole and an X-ray image showing how scientists measure leg length (red line) and body length (blue line). They use these measurements to calculate the anole's leg-length ratio. Anoles that have smaller leg-length ratios are better at running on thin branches and anoles that have larger leg-length ratios are better at running on thick branches.



Left Image: Photograph of an Anole (Photo by Kristin Winchell.) Right Image: X-ray image showing how the leg-length ratio is calculated.

Adult hind-leg length ratio is a heritable trait. Scientists decided to test whether the leg-length ratio is a trait that undergoes evolution by natural selection. To do this they placed a group of anoles on small islands where there are only bushes with thin branches (no trees) and no other anoles. They called this the experimental habitat.

Each year, the scientists returned to the experimental habitat to measure the leg-length ratio of individuals from each generation of anole lizards. The graphs below show the leg-length ratios of anoles born in their natural habitat and the leg-length ratio of the third generation of anoles born in the experimental habitat.



Left Image: Distribution of Leg-length ratio in Anoles born in the natural habitat. Right Image: Distribution of Leg-length ratio in the third generation of Anoles born in the experimental habitat.

Do you think the process of natural selection caused the change in the leg-length ratio between anoles born in the natural habitat and the third generation of anoles born in the experimental habitat?

Write your answer in the form of an **argument**. Your argument should include: A **claim** that answers the question, **evidence** in the form of specific scientific data that supports your claim, and **reasoning** that uses appropriate scientific principles and justifies why the data counts as evidence for your claim.

28. Scientists studying evolution compared the DNA of chimpanzees, gorillas, and orangutans.

The scientists summarized their data in the following table:

Pair of Species Compared	Average Genetic Similarity
Chimpanzee and Gorilla	98%
Chimpanzee and Orangutan	97%
Gorilla and Orangutan	97%

When the scientists published their research, they made the following claim:

"Chimpanzees and gorillas have a more recent common ancestry than chimpanzees and orangutans."

What **evidence** and **reasoning** are the scientists using to make this **claim**?

Your answer should include **evidence** in the form of specific scientific data that supports the scientists' claim, and **reasoning** that uses scientific principles about heredity and common ancestry to justify why the data counts as evidence for their claim. If you need more space to write your argument use the back of this page.

End of Test