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Enrich

Darwin's Theory

If you had been a biologist in the 1800s, you would have had to decide between two main theories about how evolution occurred. Consider the long neck of a giraffe. How did that evolve? Read the two explanations below. Then use a separate sheet of paper to answer the questions that follow.

Two Theories of Evolution

Theory 1

The ancestors of giraffes had short necks, and there was great competition for the plant food near the ground. Some of the giraffes kept trying to stretch their necks to reach leaves higher in the trees. As they stretched and stretched their necks became longer. As their necks became longer, they were able to reach more food. Those ancestral giraffes survived to reproduce, while the giraffes that had not stretched their necks died. The offspring of giraffes with stretched necks inherited the longer necks. This process continued for generation after generation. In this way, giraffes evolved with longer and longer necks.

Theory 2

The ancestors of giraffes had short necks, and there was great competition for the plant food near the ground. Some of the ancestral giraffes naturally had slightly longer necks than others. The individuals with longer necks could reach leaves higher in trees, and therefore could eat more food. Because those ancestral giraffes ate more food, they survived to produce offspring, while the individuals with shorter necks did not. The offspring of giraffes with longer necks inherited the longer necks. This process continued for generation after generation. In this way, giraffes evolved with longer and longer necks.

1. In Theory 1, what caused the giraffe neck to become longer?
2. In Theory 2, what caused the giraffe neck to become longer?
3. According to what scientists now know about genes, could the giraffes' offspring have inherited longer necks, as described in Theory 1? As described in Theory 2? Explain.
4. Which of the two theories matches Darwin's theory of evolution? Explain.

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Evidence for Evolution

Scientists use fossils to better understand how organisms evolve. But how do scientists determine the age of a particular fossil? Read the passage below. Then use a separate sheet of paper to answer the questions that follow.

Dating the Fossil Record

Paleontologists, or scientists who study fossils, use two basic methods to identify the age of fossils: relative dating and radiometric dating.

Relative dating determines the age of a fossil by looking at its relative position in the layers of rock in the ground. This method is also known as *stratigraphic dating.* Stratigraphic refers to the order and relative position of the layers of rock. For example, a fossil is found in a certain layer of rock, so the layers below the fossil are older and layers above the fossil are younger. Index fossils are an important tool used in relative dating. These are commonly found fossils that have a known range in the geologic record. For instance, trilobites first appeared 570 to 500 million years ago and died out about 265 million years ago. Paleontologists can use the general age of trilobites to determine the age of other fossils found in the same rock layer.

Relative dating is not a precise measurement, however. Scientists can only say when it first appeared in the fossil record and compare this information to fossils found in earlier or later layers.

To be more precise, paleontologists use radiometric dating. In this method, scientists measure the amounts of naturally occurring radioactive isotopes (atoms that carry an electrical charge) found in rocks. This tells scientists how old the rock layer is, as well as the age of fossils in that rock layer.

Radiometric dating has drawbacks as well. Most radiometric dating can only be used on igneous rocks, not sedimentary rocks or actual fossils. Fossils are found in sedimentary rock. So paleontologists have to use radiometric dating information on igneous rocks found in layers below and above the fossils in order to determine an age range of the sedimentary rock.

1. How do scientists use relative dating to determine the age of a fossil?
2. What are index fossils?
3. Identify a drawback of using radiometric dating to determine the age of a fossil.

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Rate of Change

In the fossil record, new species of organisms sometimes appear rapidly in a process known as punctuated equilibrium. Read the passage below. Then use a separate sheet of paper to answer the questions that follow.

Punctuated Equilibrium

Punctuated equilibrium is a process used to explain the evolution of certain species in which rapid change takes place in a short period of time. This change usually occurs as a result of some significant geological event. The following example describes this process:

1. A population of mice live in a coastal area. This population is stable, with members living, dying, and getting fossilized over time.

2. A rise in the sea level creates an island along the coast. A small group of mice is isolated on the island away from the rest of the population on the coast.

3. The isolated population of mice experiences rapid change because of the small population size and the new environment. Because the population is small, any mutations in individual mice influence the evolution of the population. Also, there are no major predators on the new island. Over a short period of time, the mice become larger in size.

4. The fossil record for this time period does not contain many fossils showing this transition from smaller to larger mice. This is due to the small population size, the rapid pace of change, and the isolated location of the island.

5. The sea level drops again and the island becomes part of the mainland again. The new population of large mice comes into contact with the older population of small mice. The large mice now out-compete the small mice for food and shelter, resulting in the extinction of the small mice.

6. The population of large mice now achieves stability, with members living, dying, and getting fossilized over time.

1. What is punctuated equilibrium?
2. In the example above, why do the small mice become extinct?
3. Imagine that you are a scientist studying the mice described in the example above. Describe what you would see in the fossil record for these mice.