chapter 15

Evolution

section 2 Evidence of Evolution

MAIN Idea

Multiple lines of evidence support evolution.

What You'll Learn

- how fossils provide evidence of evolution
- evidence of evolution from morphology
- how physiology and biochemistry provide evidence of evolution

Before You Read

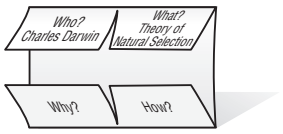
To learn how different organisms might be related, scientists look for similarities and differences between the organisms. On the lines below, compare a cat and a frog. What physical features are the same? What physical features are different?

Mark the Text

State Main Ideas As you read, stop after every few paragraphs and put what you have just read into your own words. Then highlight the main idea in each paragraph.

FOLDABLES™

Take Notes Make a four-door Foldable, as shown below. As you read, take notes and organize what you learn about Charles Darwin and the development of the theory of natural selection.



Read to Learn

Support for Evolution

Science uses theories that provide explanations for how some aspects of the natural world operate. Any theory should explain available data and suggest further areas for experiments. Darwin's theory of evolution by natural selection explains the patterns scientists see in past and present organisms.

In most cases, people cannot observe evolution directly because it happens over millions of years. Fossils help us understand evolution because they are a record of species that lived long ago. The fossil record shows that some species from long ago are extinct today. Other species alive today are similar to those in fossils.

What did Darwin predict about the fossil record?

Darwin predicted that scientists would find fossils that would show organisms that were intermediate between different species. Darwin's prediction has come true. Scientists have found intermediate species for the evolution of mollusks, modern horses, whales, and humans.

What are two classes of traits?

Scientists have found fossils of *Archaeopteryx*, a dinosaur that has the teeth, claws, and a bony tail of a reptile and feathers and the ability to fly like a bird. *Archaeopteryx* is likely an intermediate organism and is evidence that birds evolved from dinosaurs.

Scientists divide traits into two classes. **Derived traits** are newly evolved traits that have not appeared in common ancestors. **Ancestral traits** are traits that are shared by species with a common ancestor. In *Archaeopteryx*, teeth are an example of an ancestral trait.

What does anatomy reveal about evolution?

The limbs of vertebrates perform different functions, but they have similar anatomy. Wings and legs have similar structures because birds and animals evolved from the same ancestor. **Homologous structures** are similar structures inherited from a common ancestor. Darwin's theory of evolution by natural selection predicts that new structures are more likely to be modifications of ancestor's structures than entirely new features. The figure below shows the homologous forelimbs of three different animals.

_____ _____ _____

What are vestigial structures?

In some cases, a functioning structure in one species is smaller or doesn't function in a closely related species. **Vestigial structures** are features that are reduced forms of functional structures in other organisms. Vestigial structures are reduced when structures are no longer needed. The structures become smaller over time and might eventually disappear.

Picture This

1. Identify On the blank lines in the figure, write the function of the forelimbs in each animal.

Reading Check

2. Define What are vestigial structures?

_____

_____

_____

What are analogous structures?

Two organisms can have similar structures without being closely related. **Analogous structures** have the same function but different construction because they are not inherited from a common ancestor. Bird wings and insect wings are analogous structures. They have the same function but different anatomy.

Picture This

3. Name What analogous structure is found in both birds and insects?

What do embryos reveal about evolution?

An **embryo** is an early stage of development in organisms. Embryos of fishes, birds, reptiles, and mammals have several homologous structures that are not present when the organisms are adults. These structures suggest that vertebrates evolved from a common ancestor.

What do molecules reveal about evolution?

The metabolism of different organisms is based on the same complex molecules: DNA, RNA, ATP, and many enzymes. These molecules are similar because the organisms have a common ancestor.

The more closely related two organisms are, the more similar their molecular patterns will be. Scientists have observed this pattern for DNA and RNA sequences, as well as for the amino acid sequences of proteins. Scientists now use similarities in DNA and RNA sequences to determine evolutionary relationships between species.

Reading Check

4. Define What is biogeography?

What does biogeography predict?

Darwin's theory of evolution by natural selection predicts that species respond to similar environments in similar ways. **Biogeography** is the study of how plants and animals are distributed on Earth. Biogeography provides evidence that similar environments can lead to the evolution of similar animals, even if the environments are far apart.

Adaptation

Some traits contribute greatly to an organism's survival or reproduction. Traits that enable organisms to survive or reproduce better than organisms without those traits are called adaptations.

Fitness is one way to measure the effectiveness of traits. **Fitness** is a count of offspring born to organisms with a trait compared to offspring born to organisms without that trait. Traits that enable organisms to survive or reproduce better than organisms without those traits are adaptations.

Camouflage (KA muh flahj) is an adaptation that allows an organism to blend with its surroundings. Camouflage increases fitness because it allows the organism to hide from predators.

Mimicry is an adaptation that occurs when one species looks like another species. In one form of mimicry, a harmless species evolves to look like a dangerous one. In another form of mimicry, two or more harmful species resemble one another. In both cases, predators cannot tell the species apart, so they avoid both. Mimicry increases the chance that a species will survive and reproduce.

Do all traits evolve slowly?

Bacteria that were originally killed by antibiotics such as penicillin have quickly evolved into populations of resistant bacteria. For most antibiotics, at least one species of resistant bacteria exists. Some diseases, such as tuberculosis, that doctors once believed could be controlled with antibiotics have now come back. The forms of these diseases are more harmful than the forms that were treated with antibiotics. These new forms resist treatment with today's antibiotics.

Do all traits increase fitness?

Not all features of organisms are adaptations that increase fitness. Some features arise because they are unavoidable consequences of other evolutionary changes.

For example, human babies are born helpless at an earlier stage of development than other primates. Many scientists believe that early birth is not an adaptation but is a consequence of evolution. Human babies must be small in order to squeeze through a narrow birth canal. The birth canal is narrow because human females have a narrow pelvis. The shape of the pelvis is an adaptation that enables people to walk on two legs instead of four.

Reading Check

5. Explain What is an adaptation?

Reading Check

6. Name a problem with the rapid evolution of antibiotic-resistant bacteria.