Name Date Class

Section 15.1

Natural Selection and the Evidence for Evolution

North Carolina Objectives **Objective 3.05** Examine the development of the theory of evolution by natural selection including: Development of the theory; Fossil and biochemical evidence

Before You Read

In biology, evolution means that populations of a species change over time. In this section you will learn about Charles Darwin and his theory of evolution. Skim the Read to Learn section below and find three important facts about Darwin. Write those facts on the lines below. After you have written your facts, highlight the one you think is the most important.

Read to Learn

Charles Darwin and Natural Selection

Evolution describes the way populations change over time. The modern theory of evolution, in fact, is the main concept in biology. What you learn about evolution will make it easier for you to understand the subject of biology. A place to start is by learning about the ideas of Charles Darwin, an English naturalist who lived from 1809 to 1882. Darwin's ideas about evolution have been supported by fossil evidence.

How did fossils shape ideas about evolution?

A fossil is evidence that an organism lived long ago. Scientists wondered how fossils formed. They wondered why many fossil species had died out or become extinct. They also wanted to know more about how extinct species and modern species might be related. There were many ideas about how species evolved. But the ideas of Charles Darwin became the basis of modern evolutionary theory.

What did Darwin study?

Darwin spent five years on a research voyage around the world. He became interested in how species might be related to one another. While in the Galápagos (guh LAH puh gus) Islands off the west coast of South America, Darwin saw many species of plants and animals. He noted that these species looked similar to species he had seen in other places. He wondered if a species might be able to change over time. But at the time, he could not explain how such changes might happen.

STUDY COACH

Mark the Text **Locate Information** Underline every heading in the reading that asks a question. Then, use a different color to highlight the answers to those questions as you find them.

Reading Check

1. What forms the basis of modern evolutionary theory?

Section 15.1 Natural Selection and the Evidence for Evolution, *continued*

After returning to England, Darwin spent twenty years doing research. He studied, experimented, read, and collected samples. He tried to figure out why some animals survive and others do not. Darwin bred pigeons and saw that there were small differences, or variations, in traits of individual pigeons. He also noticed that these traits could be inherited by offspring. Eventually, he conducted an experiment where he bred pigeons that had certain desirable traits. He observed that their offspring were born with the same desirable traits. Breeding organisms with a certain trait to produce offspring with identical traits is called **artificial selection.** Darwin decided that there must be a process in the natural world that works like artificial selection. Using evidence from his research, Darwin decided that that process in nature was natural selection.

Reading Check

2. What is the process in which organisms with favorable traits tend to survive and pass on these traits to their offspring?

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What is natural selection?

In **natural selection,** organisms with favorable traits are able to reproduce and pass their traits on to their offspring, who then reproduce. Those without such favorable traits are more likely to die out before reproducing. For example, suppose fish that are slow get eaten before they can reproduce, while fish that are fast survive and reproduce. These offspring inherit the trait of speed from their parents. This way, they too are more likely to survive and pass on that trait to their offspring.

What have we learned since Darwin?

Much evidence supports Darwin's theories. However, it is hard to directly observe evolutionary processes that take place over millions of years. Despite this, much data has been gathered for many years from many sources. Most of today's biologists agree that evolution by natural selection best explains this data. The study of genetics adds even more to our understanding of evolution. We now know that traits are controlled by genes. All the genes that are available in a population are its gene pool. Changes in a population's gene pool over time play an important role in evolution.

Adaptations: Evidence for Evolution

An adaptation is anything that gives an organism a better chance of survival. The two main types of adaptations are structural adaptations and physiological (fih zee uh LAH jih kul) adaptations.

Section 15.1 **Natural Selection and the Evidence for Evolution,** *continued*

What are structural adaptations?

Structural adaptations take many different forms. Thorns, teeth, hair, beaks, and color are examples of structural adaptations that are inherited. Some adaptations take millions of years to become widespread in a population. Mole rats developed large teeth and claws. This structural adaptation helps them dig holes and protect themselves. Adaptations that keep predators from approaching an organism include a rose's thorns and a porcupine's quills.

Some animals develop coloring that helps them blend with their surroundings. This is an example of a subtle structural adaptation called **camouflage** (KA muh flahj). Camouflaged organisms survive and reproduce because they cannot be easily found by predators.

Mimicry (MIHM ih kree) is another type of structural adaptation. It occurs when one species looks like another species. In one form of mimicry, a harmless species takes on the look of a dangerous species. Predators that avoid the harmful species have a hard time telling the two species apart, and so they avoid both. In this way, the harmless species benefits. Another type of mimicry happens when two or more harmful species grow to resemble each other. For example, bees, wasps, and yellow jacket hornets all look alike and can sting. For this reason, some predators stay away from anything that has a bee-like appearance.

What are physiological adaptations?

Some changes in gene pools can happen fairly quickly. A few medicines that have been developed within the last 50 years have begun to lose their effectiveness. The bacteria that the medicines used to treat have undergone physiological adaptations. These adaptations keep the bacteria from being killed off by various medications. Physiological adaptations are changes in an organism's metabolic processes. Some insects and weeds also have evolved to the point where they are not affected by chemical sprays.

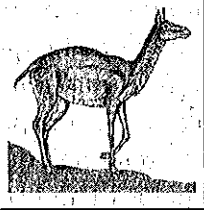
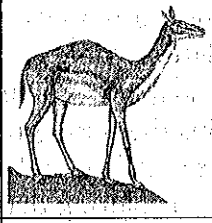
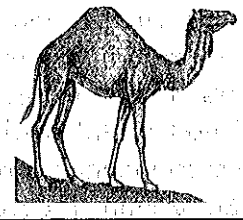
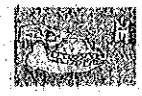
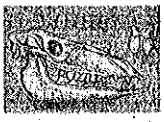
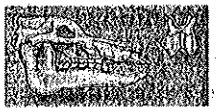
Other Evidence for Evolution

Structural and physiological adaptations are considered direct evidence of evolution. But most of the evidence to support evolution is indirect. It comes from fossils and sciences such as anatomy, embryology (em bree AHL uh jee), and biochemistry. Scientists do not have fossils for all the changes that have taken place. However, fossils provide a big picture of how groups have changed.

Think it Over

3. **Analyze** Which of the following is an example of mimicry? (Circle your choice.)
   a. A harmless fly looks like a wasp.
   b. A frog's color matches the tree it lives in.
   c. A pesticide stops working on certain types of weeds.

Section 15.1 Natural Selection and the Evidence for Evolution, *continued*

Age	Paleocene 65 million years ago	Eocene 54 million years ago	Oligocene 33 million years ago	Miocene 23 million years ago	Present
Organism					
Skull and teeth					
Limb bones					

Fossils are important to the study of evolution because they provide a record of early life. When you compare an organism as it looks today with a fossil of that organism, you can see how it has changed over time. For example, scientists have learned from fossils that the ancestors of camels were as small as rabbits are today. This is illustrated on the table above.

Reading Check

4. What is the term for structural features that have a common evolutionary origin?

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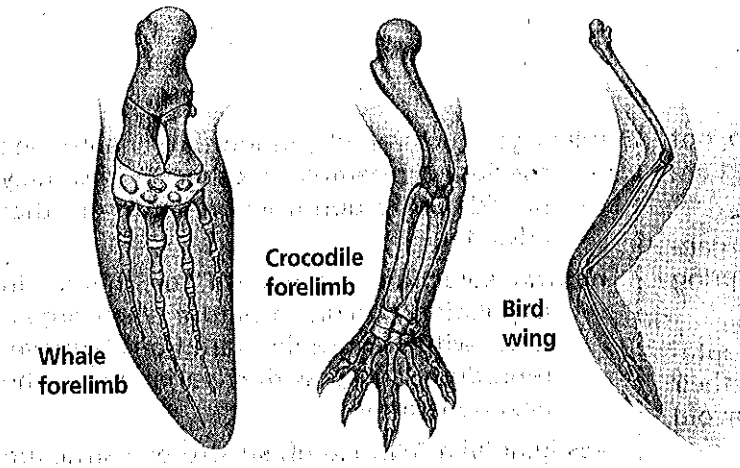
What can anatomy teach us about evolution?

Homologous Structures The anatomy of different organisms also shows evolutionary patterns. For example, some organisms have **homologous structures.** These are structural features with a common evolutionary origin. Such structures can be similar in arrangement, function, or both.

The figure on page 167 shows how the forelimbs of three very different animals can be homologous. Biologists think that such similarities are evidence that these organisms evolved from a common ancestor.

Analogous Structures However, being structurally similar does not always mean that two species are closely related. For instance, birds and butterflies both have wings. But insects and birds evolved separately. When body parts of organisms do not have a common evolutionary origin but are similar in function, they are known as **analogous structures.**

Section 15.1 Natural Selection and the Evidence for Evolution, *continued*



Although analogous structures do not have the same origin, they do provide evidence of evolution. For example, the ancestors of birds and insects both probably evolved wings separately while adapting to similar ways of life.

Vestigial Structures Another type of body feature that shows evolutionary relationship is a **vestigial** (veh STIH jee ul) **structure.** This is a body structure in a present-day organism that no longer serves its original purpose. The eyes of mole rats are an example. Mole rats still have eyes, but they are no longer used for sight. Vestigial structures are evidence of evolution because they show structural change over time.

Embryology An **embryo** is the earliest stage of growth and development of a plant or animal. Young embryos of fishes, birds, reptiles, and mammals have structures that suggest they all had a common ancestor.

Think it Over

5. Compare What is the difference between analogous and vestigial structures?

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What evidence does biochemistry provide for evolution?

Biochemistry also provides strong evidence for evolution. Nearly all organisms share DNA, ATP, and many enzymes in their chemical makeup. Groups that share more similarities in their biochemistry are considered to be more closely related. In the 1970s, biologists began to use RNA and DNA nucleotide sequences to construct evolutionary diagrams that show the levels of relationship among species. Today, scientists combine data from fossils and studies of anatomy, embryology, and biochemistry to interpret relationships among species.

After You Read

Mini Glossary

analogous structures: structures that do not have a common evolutionary origin but are similar in function

artificial selection: process of breeding organisms with specific traits to produce offspring with the same traits

camouflage (KA muh flahj): structural adaptation that enables species to blend with their surroundings; allows a species to avoid detection by predators

embryo: the earliest stage of growth and development of a plant or an animal

homologous structures: structures with common evolutionary origin; can be similar in arrangement, function, or both

mimicry: structural adaptation that enables one species to resemble another species; may provide protection from predators or other advantages

natural selection: mechanism for change in populations; occurs in nature when organisms with favorable variations survive, reproduce, and pass their variations to the next generation

vestigial (veh STIH jee ul) structure: a structure in a present-day organism that no longer serves its original purpose, but was probably useful to its ancestor

1. Read the terms and their definitions in the Mini Glossary above. Then, choose a term that describes a type of structural adaptation. On the lines below, write a sentence using the term.

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2. Use the table below to review what you have learned about adaptation. Write two types of adaptations you read about in the first column. Write a fact about the rate at which the adaptation occurs in the second column, and an example of each type of adaptation in the third.

Adaptation Table

Type of Adaptation	Rate at Which it Occurs	Example

Visit the Glencoe Science Web site at **science.glencoe.com** to find your biology book and learn more about natural selection and the evidence for evolution.