

The Environment and Change Over Time

Theory of Evolution by Natural Selection


..... Before You Read

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements to see if you have changed your mind.		
Before	Statement	After
	3. Environmental change causes variations in populations.	
	4. Variations can lead to adaptations.	

..... Read to Learn

Charles Darwin

How many species of birds can you name? Robins, penguins, and chickens are a few. There are about 10,000 species of birds on Earth today. Each species has wings, feathers, and beaks. Scientists hypothesize that all birds evolved from an earlier, or ancestral, group of birdlike organisms. As this group evolved into different species, birds developed different sizes, colors, songs, and ways of eating. Yet, they kept their key bird traits.

How do species evolve? Charles Darwin, a scientist, worked to answer this question. Darwin was an English naturalist who, in the mid-1800s, developed a theory of how evolution works. A **naturalist** is a person who studies plants and animals by observing them. Darwin spent years studying plants and animals in nature before developing his theory. Recall that a theory is an explanation of the natural world that is well supported by evidence. Darwin's theory of evolution was not the first, but his theory is the one best supported by evidence today. 

Voyage of the Beagle

Darwin worked as a naturalist on the HMS *Beagle*, a ship of the British navy. During his trip around the world, Darwin observed and collected many plants and animals.

Key Concepts

- Who was Charles Darwin?
- How does Darwin's theory of evolution by natural selection explain how species change over time?
- How are adaptations evidence of natural selection?

Study Coach

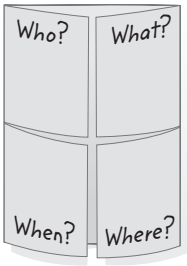
Make Flash Cards Think of a quiz question for each paragraph. Write the question on one side of a flash card. Write the answer on the other side. Work with a partner to quiz each other using your flash cards.

Key Concept Check

1. Describe Who was Charles Darwin?

FOLDABLES[®]

Make a small four-door shutterfold book. Use it to investigate the who, what, when, and where of Charles Darwin, the Galápagos Islands, and the theory of evolution by natural selection.



✓ Reading Check

2. Explain What made Darwin become curious about the organisms that lived on the Galápagos Islands?

ACADEMIC VOCABULARY

convince

(verb) to overcome by argument

The Galápagos Islands

Darwin was interested in the organisms he saw on the Galápagos (guh LAH puh gus) Islands. These islands are 1,000 km off the South American coast in the Pacific Ocean. Darwin saw that each island had a slightly different environment. Some were dry. Some were more humid. Others had mixed environments.

Tortoises Darwin saw that the giant tortoises on each island looked different. On one island, tortoises had shells that came close to their necks. They could eat only short plants. On other islands, tortoises had more space between the shell and neck. They could eat taller plants.

Mockingbirds and Finches Darwin was also curious about the different mockingbirds and finches he saw. Like the tortoises, different types of mockingbirds and finches lived in different island environments. Later, he was surprised to find that many were different enough to be separate species. ✓

Darwin's Theory

Darwin discovered a relationship between each species and the food found on the island where it lived. Tortoises with long necks lived on islands that had tall cacti. Their long necks made it possible for them to reach high to eat the cacti. The tortoises with short necks lived on islands that had plenty of short grass.

Common Ancestors


Darwin became convinced that all the tortoise species were related. He thought they all shared a common ancestor. He suggested that millions of years before, a storm had carried a group of tortoises to one of the islands from South America. In time, the tortoises spread to the other islands. Their neck lengths and shell shapes changed to match their islands' food sources. How did this happen?

Variations

Darwin knew that individual members of a species have slight differences, or variations. A **variation** is a slight difference in the appearance of individual members of a species. Variations arise naturally in populations. They occur in the offspring as a result of sexual reproduction. You might recall that variations are caused by random mutations, or changes, in genes. Mutations can lead to changes in phenotype. Recall that an organism's phenotype is all of the observable traits and characteristics of the organism. Genetic changes to phenotype can be passed on to future generations.

Natural Selection

Darwin did not know about genes. But he saw that variations were the key to how evolution worked. He knew that there was not enough food on each island to feed every tortoise that was born. Tortoises had to compete for food. As the tortoises spread to the different islands, some were born with random variations in neck length. If a variation helped a tortoise compete for food, the tortoise lived longer than other tortoises without the variation. Because it lived longer, it reproduced more. It passed on the helpful variation to its offspring.

This is Darwin's theory of evolution by natural selection. **Natural selection** is the process by which populations of organisms with variations that help them survive in their environments live longer, compete better, and reproduce more than those that do not have the variations. Natural selection explains how Galápagos tortoises became matched to their food sources, as shown below. It also explains why there were so many different kinds of Galápagos finches and mockingbirds. Birds with beak variations that helped them compete for food lived longer and reproduced more. 

Key Concept Check

3. Analyze What role do variations have in the theory of evolution by natural selection?

Visual Check

4. Illustrate Mark all the tortoises in the figure that have short necks with the letter S. Mark those that have long necks with the letter L. What trend do you see over time?

Natural Selection



1 Reproduction
A population of tortoises produces many offspring that inherit its characteristics.



2 Variation
A tortoise is born with a variation that makes its neck slightly longer.

3 Competition
Due to limited resources, not all offspring will survive. An offspring with a longer neck can eat more cacti than other tortoises. It lives longer and produces more offspring.




4 Selection
Over time, the variation is inherited by more and more offspring. Eventually, all tortoises have longer necks.



Adaptations

Natural selection explains how all species change over time as their environments change. Through natural selection, a helpful variation in one individual can eventually pass to future members of a population.

As time passes, more variations come about. The buildup of many similar variations can lead to an adaptation (a dap TAY shun). An **adaptation** is a characteristic of a species that enables the species to survive in its environment. The long neck of certain species of tortoises is an adaptation to an environment with tall cacti. 

Key Concept Check

5. Explain How do variations lead to adaptations?



Think it Over

6. Apply An opossum will play dead when a predator frightens it. That way the predator might think it is not good food and will leave it alone. What kind of adaptation is this? (Circle the correct answer.)

- a. structural
- b. behavioral
- c. functional



Reading Check

7. Contrast How do camouflage and mimicry differ?

Types of Adaptations

Every species has many adaptations. Scientists classify adaptations into three categories: structural, behavioral, and functional.

Structural Adaptations These adaptations involve color, shape, and other physical characteristics. The shape of a tortoise's neck is a structural adaptation.


Behavioral Adaptations The way an organism behaves or acts is a behavioral adaptation. Hunting at night and moving in herds are behavioral adaptations.

Functional Adaptations The last category is functional adaptations. These adaptations involve chemical changes in body systems. A drop in body temperature during hibernation is a functional adaptation.

Environmental Interactions

Many species have evolved adaptations that make them nearly invisible. For example, a seahorse may be the same color as and similar in texture to the coral it rests on. This is a structural adaptation called camouflage (KAM uh flahj).

Camouflage is an adaptation that enables species to blend in with their environments.

Some species have adaptations that draw attention to them or make them more visible. A caterpillar may resemble a snake. Predators see it and are scared away. *The resemblance of one species to another species is* **mimicry** (MIH mih kree). Camouflage and mimicry are adaptations that help species avoid being eaten. Many other adaptations help species eat. For example, the pelican has a beak and mouth uniquely adapted to its food source—fish. 

Role of Environment Environments are complex. Species must adapt to an environment's living parts as well as to its nonliving parts. Some nonliving things are temperature, water, nutrients in soil, and climate. Deciduous trees shed their leaves due to changes in climate. Camouflage, mimicry, and mouth shape are adaptations mostly to an environment's living parts.

Extinct Species Living and nonliving factors are always changing. Even slight environmental changes affect how species adapt. If a species is unable to adapt, it becomes extinct. The fossil record contains many fossils of species unable to adapt to change.

Artificial Selection

Adaptations show how closely Earth's species match their environments. This is exactly what Darwin's theory of evolution by natural selection predicted. Darwin gave many examples of adaptation in *On the Origin of Species*, the book he wrote to explain his theory. Darwin wrote his book 20 years after he developed his theory. He spent those years collecting more evidence for his theory.

Darwin also had a hobby of breeding pigeons. He bred pigeons of different colors and shapes. In this way, he produced new, fancy varieties. *The breeding of organisms for desired characteristics is called **selective breeding**.* Like many plants and animals produced from selective breeding, pigeons look different from their ancestors.

Darwin saw that changes caused by selective breeding were much like changes caused by natural selection. Instead of nature selecting variations, humans selected them. Darwin called this process artificial selection. ✓

Artificial selection explains and supports Darwin's theory. In Lesson 3, you will read about other evidence that supports the idea that species evolve from other species.



Think it Over

8. Synthesize How do you think some fur-bearing species might adapt to a gradual change in climate in which global temperature increased?



Reading Check

9. Compare How are artificial selection and natural selection alike?

After You Read

Mini Glossary

adaptation (a dap TAY shun): a characteristic of a species that enables the species to survive in its environment

camouflage (KAM uh flahj): an adaptation that enables species to blend in with their environments

mimicry (MIH mih kree): the resemblance of one species to another species

naturalist: a person who studies plants and animals by observing them

natural selection: the process by which populations of organisms with variations that help them survive in their environments live longer, compete better, and reproduce more than those that do not have the variations

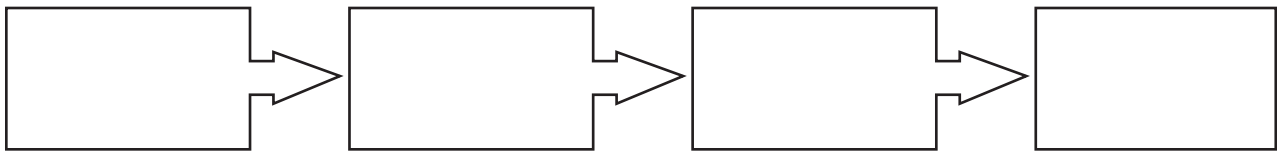
selective breeding: the breeding of organisms for desired characteristics

variation: a slight difference in the appearance of individual members of a species

1. Review the terms and their definitions in the Mini Glossary. Describe a living organism that depends on camouflage or mimicry to survive.

2. Write a letter in each box to show the correct sequence that demonstrates the process of natural selection.

- a. Birds eat more light green beetles. Dark green beetles live longer and reproduce more.
- b. A beetle is born with a variation in its color: It is dark green.
- c. Over time, all beetles in the environment are dark green.
- d. A population of beetles is light green. They stand out against dark green leaves.



3. Compare selective breeding and evolution.

What do you think **NOW?**

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?



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END OF LESSON