



# UNIT 3

## Evolution — Change over Time

**Lonesome Tortoises** These tortoises are found nowhere else on Earth, except the Galapagos Islands. These islands are well known for their species that exist here alone. The islands are being threatened by introduced species and other human activities.



### 10,000–9,000 Years Ago

Horses migrate over the land bridge between North America and Asia; horses in the western hemisphere then became extinct.

### 1500s

The Spanish reintroduce horses to the western hemisphere (to California in the late 1700s); these modern horses evolved from those that migrated to Asia thousands of years before.

A.D. 1 1500 1600 1700 1800 1900



### 2,300 Years Ago

Aristotle, a Greek scientist, observes nature and classifies organisms as belonging to one of two kingdoms—plant or animal—based on the way they move, eat, and grow.



### 1831–1836

Charles Darwin, a naturalist, studies rock formations, fossils, life-forms, and how the life-forms varied; he then proposes the idea of natural selection, published in 1859.





To learn more about naturalists and their work, visit [ca7.msscience.com](http://ca7.msscience.com).



Concepts in Motion

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**1987**

The last wild California condor is added to 26 others being raised in captivity to increase the population; as the condors are ready, they are released and can be seen flying over California's Central Coast.



**1997–2001**

Scientists from UC Berkeley find jawbone and teeth fossils in Ethiopia, dating around 5.5 million years ago; in 2004 this human ancestor is named as a species, *Ar. Kadabba*.

**1970**

**1977**

Carl Woese discovers single-celled organisms without a nucleus that are not bacteria; Kingdom Archaeobacteria is added to classification system in the mid-1980s.



**1990**

**1996–1997**

Three dinosaurs, the first ones found with feather impressions, are discovered in China; scientists say these dinosaurs provide a definite link to the evolution of birds from dinosaurs.

**2000**

**2010**

**March 2005**

Scientists in Montana discover T. rex fossil that includes soft tissue, cells, and blood vessels; the dinosaur was female and more closely related to modern birds than to crocodiles.





# CHAPTER 5

## The Process of Evolution

### The BIG Idea

Genetic changes occurring in populations can result in new species, the extinction of species, and organisms suited for different environments.

### LESSON 1 3.a, 3.b, 7.c

#### Natural Selection

**Main Idea** Charles Darwin developed a theory of how organisms with the same ancestors can look and behave differently over time.

### LESSON 2

 3.a, 3.e, 7.a, 7.b, 7.c

#### Adaptation and Extinction

**Main Idea** Adaptations are traits that help an organism survive and reproduce in a particular environment, and the inability to adapt can lead to extinction.

### Major Fossil Find

*Archaeopteryx* means “ancient wing” and wings and feathers are a few things that link the *Archaeopteryx* with birds. Unlike birds they had teeth, claws on their wings, and a bony tail. *Archaeopteryx* lived about 150 million years ago in the Jurassic period.

**Science Journal** Imagine you are the geologist who discovered the *Archaeopteryx* fossil. Write a paragraph about how you feel when you first realize what you have found.



# Start-Up Activities

## Launch Lab

00:10  
minutes

### What attracts insects to certain flowers?

An insect might be attracted to a specific flower by its color, or it might be attracted to many kinds of flowers.

#### Procedure

1. Read the **description of the flower** you have been assigned. Look at the **photo**.
2. Select a **pollinator** you think would be attracted to the flower.
3. Draw the pollinator on a **small card**.
4. Attach your flower and its pollinator to the board under the proper heading.

#### Think About This

- **Explain** why flowers have a variety of traits to attract pollinators.
- **Infer** why some insects prefer a specific flower.

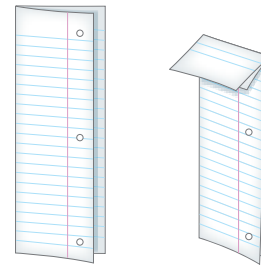


## FOLDABLES™ Study Organizer

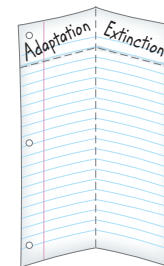
### Process of Evolution

Make the following Foldable to classify the outcomes of evolution.

- **STEP 1 Fold** a sheet of paper in half lengthwise. **Fold** the top down about 3 cm from the top.



- **STEP 2 Unfold** and draw lines along all folds. **Label** as shown.



### Reading Skill

#### Interpreting

As you read this chapter, identify each outcome of evolution and classify it by placing it in the correct column.



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# Get Ready to Read

## Visualize

**1 Learn It!** Visualize by forming mental images of the text as you read. Imagine how the text descriptions look, sound, feel, smell, or taste. Look for any pictures or diagrams on the page that may help you add to your understanding.

**2 Practice It!** Read the following paragraph. As you read, use the underlined details to form a picture in your mind.

... notice the unique shape of the shells found in the two different tortoises. Darwin found that tortoises had dome-shaped shells and short necks in places where they primarily ate low-growing plants. But, tortoises that fed on high-growing cacti had saddle-shaped shells that seemed to allow their longer necks to reach the cactus pads.

—from page 212

Based on the description above, try to visualize the two different tortoises. Now look at the photos on page 212.

- How closely does it match your mental picture?
- Reread the passage and look at the picture again. Did your ideas change?
- Compare your image with what others in your class visualized.

**3 Apply It!** Read the chapter and list three subjects you were able to visualize. Make a rough sketch showing what you visualized.

## Reading Tip

Forming your own mental images will help you remember what you read.

# Target Your Reading

Use this to focus on the main ideas as you read the chapter.

- 1 **Before you read** the chapter, respond to the statements below on your worksheet or on a numbered sheet of paper.
  - Write an **A** if you **agree** with the statement.
  - Write a **D** if you **disagree** with the statement.
- 2 **After you read** the chapter, look back to this page to see if you've changed your mind about any of the statements.
  - If any of your answers changed, explain why.
  - Change any false statements into true statements.
  - Use your revised statements as a study guide.

Before You Read A or D	Statement	After You Read A or D
	1 Organisms can change to occupy a new environment during their lifetime.	
	2 A naturalist studies plants, animals, and rocks.	
	3 Every continent has different kinds of plants and animals from those on other continents.	
	4 Offspring of animals and plants vary in size and color.	
	5 Darwin believed that Earth was only 4,000 years old.	
	6 Changes in species can be caused by mutations.	
	7 The way a bird builds its nest may help it to survive and reproduce.	
	8 There are species of organisms alive on Earth that have always existed.	
	9 Most of the species that have gone extinct did so when a catastrophe happened.	
	10 Species that have lots of genetic variations are more likely to survive.	



Print a worksheet of this page at [ca7.msscience.com](http://ca7.msscience.com).





# LESSON 1



## Science Content Standards

**3.a** Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms.

**3.b** Students know the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.

**Also covers:** 7.c

## Reading Guide

### What You'll Learn

- **Infer** how Darwin developed his theory of natural selection.
- **Identify** the ways organisms adapt to their environments or perish.

### Why It's Important

Many observations of life on Earth can be explained by the theory of evolution.

### Vocabulary

evolution  
naturalist  
natural selection  
adaptation

### Review vocabulary

**population:** the number of organisms of one species that occupy an area (Grade 6)

# Natural Selection

**Main Idea** Charles Darwin developed a theory of how organisms with the same ancestors can look and behave differently over time.

**Real-World Reading Connection** Did you know that there are more species of insects on Earth than any other type of organism? Did you ever wonder why there are so many different species? Charles Darwin thought about this very question as he explored some of life's most remarkable diversity around the world. It was Darwin who would uncover an important process that accounts for the great variety of species seen today.

## Charles Darwin

**Evolution** is change over time. Modern scientists refer to evolution as genetic change in a population over time. Charles Darwin was not the first person to talk about evolution, but he was the first person to write the most thorough collection of evidence supporting evolution.

Charles Darwin was a **naturalist**, a person who studies the natural world, including plants, rock formations, and animals. During his extensive traveling and research on the HMS *Beagle*, shown in **Figure 1**, he developed an important theory about how organisms evolve. His revolutionary theory, which is described in more detail later in this lesson, helps explain the unity and diversity of life. Darwin's theory also transformed the natural sciences and serves as the basis of much biological research today.

**Figure 1** Charles Darwin spent five years as a naturalist on the HMS *Beagle*.





## Voyage of the Beagle

In December 1831, Charles Darwin was 22 when he accepted an invitation to serve as a naturalist on the British naval ship called the HMS *Beagle*. The *Beagle* sailed from England to South America and other parts of the world to make navigational maps. The voyage of the *Beagle* would last for almost five years. Examine **Figure 2** and follow the route the *Beagle* traveled.

Darwin spent time exploring South America and its remote islands, such as the Galápagos (guh LAH puh gohs) Islands. The Galápagos Islands are located about 1000 km off the coast of South America, as shown in **Figure 2**. Darwin spent most of his time observing nature, collecting samples of new plants and animals, and writing about places and organisms few had ever seen.

## Darwin's Observations

Darwin made extensive observations and detailed notes of the biology and geology of the locations he visited. Collecting numerous samples, some of his most interesting findings were of the **diversity** and uniqueness of the organisms he saw, especially on the Galápagos Islands. He noticed many new animals and plants that had not been recorded prior to this trip. He became particularly fascinated in comparing the similarities and differences among the animals and fossils of animals from the different islands.

When he compared them, many of the turtles, birds, and lizards on the Galápagos were similar, but not the same as organisms that he found in the South American mainland. Darwin reasoned from these observations that perhaps some of the animals and plants on the Galápagos originally came from South America, and over time, they evolved to be different.

**Figure 2** The five-year voyage of the HMS *Beagle* took Darwin around the world. His visit to the Galápagos Islands would change the world view on life.

**Examine** Where did the *Beagle* stop before reaching the Galápagos Islands?

## ACADEMIC VOCABULARY

**diversity** (duh VER suh tee)

(*noun*) being different from others, variety  
There was a great diversity of ice cream flavors.





**Saddle-shaped**



**Dome-shaped**

**Figure 3** The saddle-shaped shell allows the tortoise's neck to reach higher.

**Explain** Why does the longer-necked tortoise need to reach up?

**Tortoises** During his travels, Charles Darwin made interesting observations of the giant Galápagos tortoises, or land turtles. He found tortoises on all of the Galápagos Islands and nowhere else that he visited. The tortoises were enormous in size. What was most interesting to Darwin was that the tortoises varied from island to island in the Galápagos. Darwin wondered why all the tortoises were different from each other even though they lived on islands only 80 km apart.

Look at **Figure 3** and notice the unique shape of the shells found in the two different tortoises. Darwin found that tortoises had dome-shaped shells and short necks in places where they primarily ate low-growing plants. But, tortoises that fed on high-growing cacti had saddle-shaped shells that seemed to allow their longer necks to reach the cactus pads. Darwin reasoned that perhaps the different tortoises “descended with modification” from an ancestral population in South America. Each generation of the population would change genetically until a trait for long necks evolved.



Why might one tortoise population evolve long necks?

**Finches** Darwin also made important observations of birds called finches on the Galápagos Islands. These birds were not the same as the birds he observed in other parts of the world. He described 13 finch species, although at the time he thought they were all the same species.

Like the tortoises, Darwin was impressed by the diversity of finches on the different islands, as shown in **Figure 4**. He was most fascinated by the diversity of beak size and shape in the finches, as shown in **Figure 4** and **Figure 5**. Beaks ranged from small to large and each beak type was well-suited for eating a particular food. For example, the large ground finch shown in **Figure 4** has a large beak that was well-suited for cracking open large seeds on the ground. The small tree finch in **Figure 5** has a long and narrow beak that was compatible for catching insects in the trees. Darwin would later explain that if individuals from an ancestral species in South America were separated for a long enough period of time, the future generations or descendants on the different islands might look and behave differently. Thus, in a similar way to the tortoises, the finches became different because genetically, they fit the different habitats on the islands. **Figure 5** indicates the differences in beak size and shape in all of Darwin's finches. Notice how the beak size and shape is related to the kind of food the finch eats and where it must go to get the food. Ground finches need a large beak to break and eat seeds on or near the ground. Small tree finches have smaller beaks to catch insects in the air.

## Finches



**Large Ground**



**Cactus**



**Small Ground**

**Figure 4** Each of these finches has a unique beak shape.

# Visualizing Natural Selection

**Figure 5**

British naturalist Charles Darwin hypothesized that the 13 species of finches he found on the Galápagos Islands evolved from a common ancestor through a process of natural selection. "Darwin's Finches," as they became known, probably evolved their different beak structures and feeding habits over time, as a result of the specific environment on each of the islands.



## ▼ LARGE GROUND FINCH

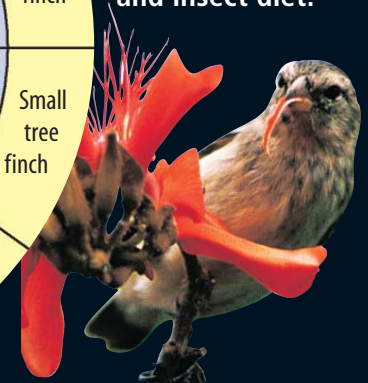
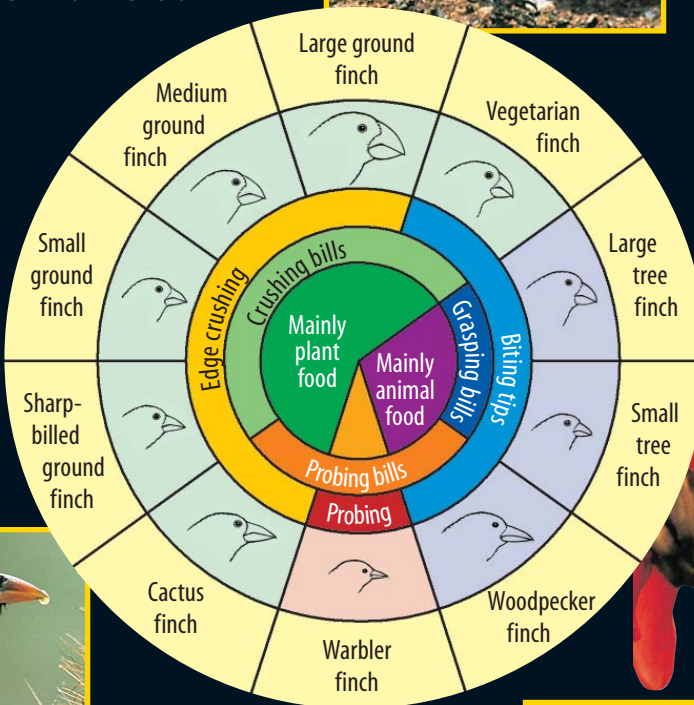
Ground finches have short, stout "crushing" beaks, useful for breaking seeds. They spend much of their time foraging on the ground.

## ▼ SMALL TREE FINCH

The beak of this tree-dwelling finch is sharper than that of the ground finch and better suited to the tree finch's plant and insect diet.

## ▼ CACTUS FINCH

The long beak of the cactus finch allows it to eat the fruit of the prickly pear cactus.



## ▼ WARBLER FINCH

The smallest of Darwin's finches, the warbler finch, has a long, narrow beak for eating insects.



▲ **WOODPECKER FINCH** This finch uses twigs or cactus spines to pry insects or their larvae out of small holes in cacti or from beneath bark.

Contributed by National Geographic





## MiniLab

00:20  
minutes

### How does the shape of a bird's beak determine what it eats?

All living organisms have structures that enable them to survive, grow, and reproduce. Birds have different sizes and shapes of beaks. Some birds eat seeds; others eat only insects or worms. Darwin's finches are a good example of how a species has adaptations for feeding in different ecological environments.

#### Procedure

1. Complete a lab safety form.
2. Study the **diagram of the beaks of Darwin's finches** and what they eat.
3. Your teacher will assign a beak style to you. Pick a **tool** that most closely matches your beak style.
4. Use your tool to try to pick up a **variety of foods** in the feeding box. See how many pieces of food you can pick up in 30 s.
5. Chart the number of each kind of food each tool was able to pick up. How did your "beak" compare to the others?

#### Analysis

1. **Explain** What might happen to a finch that had a mutation that made its beak a different shape from that of the parent birds?
2. **Conclude** What will happen if the finch cannot find anything to eat with its beak shape?



### Selective Breeding

For thousands of years humans have been breeding plants and animals. In plants the goal might be to get the largest fruit, the best taste, the tallest plant, or the prettiest flower. In animals farmers want the cow with the most milk, the largest hog, or the fastest horse. You can probably think of other traits you might want in dogs or cats. When a plant or an animal is bred to get these characteristics, it is known as selective breeding. Selective breeding does not lead to a new species. The organism is still able to breed with other members of its species. Dogs have been bred for many special features, such as size and fur length. Even so, crosses between breeds still produce animals with doglike characteristics. **Figure 6** shows some pigeons that have been selectively bred. The original species of these pigeons is the rock dove.

**Figure 6** The fantailed pigeon and the frill-backed pigeon were selectively bred from rock doves.



**Rock Dove**



**Fantailed Pigeon**



**Frill Backed Pigeon**



# Darwin's Theory of Natural Selection

Darwin and other scientists realized that organisms with a trait that allowed them to survive under particular environmental conditions produced more offspring than those organisms without this trait. Eventually, these traits would become very common in a species.

## Genetic Variation

Recall from Chapters 3 and 4 that traits are passed on to the offspring from father and mother. Traits are sorted during the process of gamete formation. Sometimes changes occur in the genes and new traits are created. **Figure 7** shows the genetic variation of some common flowers. If a trait is harmful, the organism might die, but if it is beneficial, the organism is more likely to survive and reproduce. That trait will then be passed on to the next generation. With time, it will become common in many populations of the species. Genetic variation is necessary for evolution to occur. But, survival depends on other factors as well.



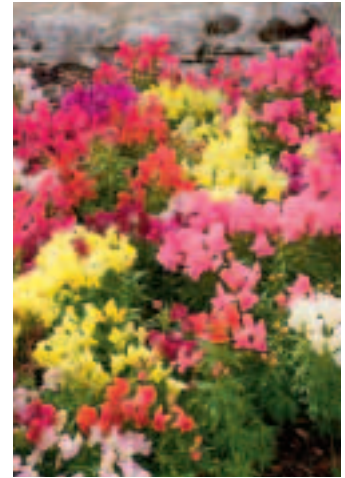
How does a trait become more predominant in a population?

## The Struggle to Survive

One influence on Darwin's ideas was an essay by Thomas Malthus, which presented the argument that if the human population were to continue to grow unchecked, eventually humans would run out of food and space. There would be a "struggle to survive."

**Population Growth** Darwin too had noticed that animals often produced more offspring than could survive. Limited resources, such as food, water, and habitat, allowed for only some individuals to survive. Darwin decided that this was a natural process that selected which organisms could survive. Darwin's next step was to find out how the organism was selected. He reasoned that an organism that was better prepared to get food or protect its space would be better able to survive. You have read about niches and the competition within those niches. **Figure 8** shows competition between two animals. The animal that is best suited to the environment will ultimately win the competition.

**Environmental Factors** Different habitats can put pressure on animals to survive as well. Darwin suggested that those organisms best prepared for living in specific habitats would survive and be most able to reproduce. Their offspring would also be able to survive in the specific habitat.



**Figure 7** Color is just one trait that varies among organisms.

**Infer** what other traits might vary in snapdragons.



**Figure 8** Competition between these two males is for the best territory and to acquire a mate.





## WORD ORIGIN

### adaptation

*ad-* from Latin, means *to* or *toward*

*-aptare* from Latin, means *to fit*

## Natural Selection

Darwin defined **natural selection** as a process by which individuals with traits that better suit the environment are more likely to survive longer and reproduce more successfully than those individuals without these traits. Inherited traits that increase an organism's chance of surviving and reproducing in a particular environment are called **adaptations**. Adaptations spread through a population in future generations if natural selection favors them.

Darwin spent a great amount of time working out how natural selection can lead to adaptation within a species and to the evolution of a new species. He proposed that if groups of organisms with common ancestors are isolated from other organisms of the same species, natural selection can cause them to become different over generations. The isolated groups adapt to different environmental conditions and this process can develop a new species. With enough time, this could explain the large number of species on Earth today.

Darwin's theory of evolution by natural selection can be best explained by the following four steps or requirements.

**1 Overproduction** Organisms produce more offspring than can be supported by the available food, water, and shelter in an environment. Many will die due to natural events such as predation, competition, and starvation.

**2 Variation** Offspring vary in traits such as color and size, as shown in a hypothetical fish population in **Figure 9**.

**3 Inherited Variation** Recall from Chapter 4 that some of the variation in populations is genetic and such traits can be passed from parents to offspring. Sources of genetic variation include mutations, formation of the gametes, and sexual reproduction. Genetic variation is necessary for evolution by natural selection to occur.

**4 Natural Selection** Individuals with inherited variations that are better able to survive and reproduce in a particular environment will have more offspring, and thus pass on these favorable traits, than individuals without those features.

Populations will change over time in particular environments. They will evolve, and come to look different and behave differently from their ancestors as favorable traits spread through a population. If the environment changes again, different heritable traits may be favored and the population can evolve again.



**Figure 9** How are the offspring different from their ancestors?

**Figure 9** Darwin proposed the idea of natural selection to explain how species change over time.





## Evolution and Diversity

Charles Darwin spent years developing his ideas on natural selection. Darwin finally published his revolutionary and controversial book called *The Origin of Species by Natural Selection*. In his book, he built a strong case for evolution by natural selection. He also developed the idea that all organisms have “descended with modification” from common ancestors over a long period of time. Thus, all species have changed through time and are related by descent from a common ancestor.

Considering the geological evidence that Earth is millions of years old, Darwin proposed there had been enough time for organisms to change and for new species to develop from ancestral species.

## LESSON 1 Review

### Summarize

Create your own lesson summary as you design a **visual aid**.

1. **Write** the lesson title, number, and page numbers at the top of your poster.
2. **Scan** the lesson to find the **red** main headings. Organize these headings on your poster, leaving space between each.
3. **Design** an information box beneath each **red** heading. In the box, list 2–3 details, key terms, and definitions from each **blue** subheading.
4. **Illustrate** your poster with diagrams of important structures or processes next to each information box.



ELA7: W 2.5



### Standards Check

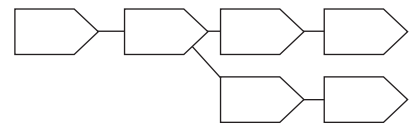
#### Using Vocabulary

1. Using your own words, define *evolution*. **3.b**
2. Traits that enable organisms to survive in a specific environment are called \_\_\_\_\_. **3.a**

#### Understanding Main Ideas

3. **Explain** why Darwin’s comparison of organisms from the South American mainland to those on the islands was significant. **3.b**
4. Which factor listed below is not important in determining an organism’s chances of survival? **3.a**
  - A. ability to get food
  - B. size of the individual
  - C. whether it is male or female
  - D. ability to protect space
5. **Explain** the relationship between population growth and potential for survival. **3.a**

6. **Sequencing** Draw a diagram to show the changes that the ancestral tortoise might have gone through to result in those that Darwin observed. Include relevant plants. **3.b**



7. **List** the steps of natural selection. **3.b**

#### Applying Science

8. **Infer** why you have not directly observed the appearance of a new species. **3.a**
9. **Summarize** the changes that might occur in a population of squirrels if acorn shells became harder. **3.a**



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# Applying Math

## The Accommodations of the HMS Beagle

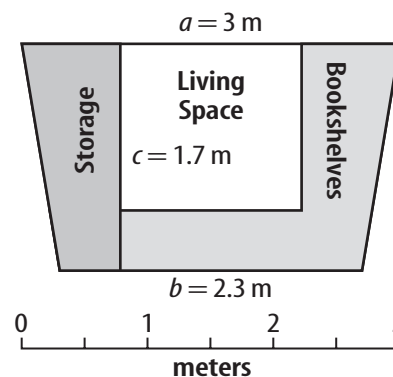


Charles Darwin traveled to the Galápagos Islands in the HMS *Beagle* in 1835. In the five-year journey of the ship, Darwin lived in small quarters in the chart room. The mizzenmast came up through the floor, and most of the room was taken by a chart table and bookshelves. The chart room was about  $3.0 \text{ m} \times 1.7 \text{ m}$  of living space shown in the diagram.

MA7: AF 1.2, MG 2.2

### Example


Find the area of the chart room including storage, living space, and bookshelves.



<b>What you know:</b>	<p>The room is shaped like a trapezoid.</p> <p>The longer width of the, <math>a</math>, room is 3.0 meters.</p> <p>The shorter width of the room, <math>b</math>, is 2.3 meters.</p> <p>The length of the room, <math>c</math>, is 1.7 meters.</p>
<b>What you need to find:</b>	Area of a trapezoid
<b>Use the formula:</b> $\frac{(a + b)}{2} \times c = \text{area of a trapezoid}$	<p>Substitute for <math>a</math>, <math>b</math> and <math>c</math> in the formula:</p> <p><math>a = 3.0 \text{ m}</math>, <math>b = 2.3 \text{ m}</math>, <math>c = 1.7 \text{ m}</math></p> $\frac{(a + b)}{2} \times c = \frac{(3.0 + 2.3)}{2} \times 1.7 =$ $\frac{9.0}{2} = 4.5 \text{ m}^2$ <p>The area of the trapezoid is <math>4.5 \text{ m}^2</math>.</p>

### Practice Problems

- What is the approximate area of the storage area?
- What is the approximate area of the book shelves?  
(**hint:** draw a line to divide the area into a trapezoid and a rectangle)



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## LESSON 2



### Science Content Standards

**3.a** Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms.

**3.e** Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

**Also covers:** 7.a, 7.b, 7.c

### Reading Guide

#### What You'll Learn

- ▶ **Identify** the importance of adaptations.
- ▶ **Compare** two kinds of adaptations.
- ▶ **Describe** three of the causes of extinction.

#### Why It's Important

Understanding how organisms adapt to environmental change and the causes of extinction may help us preserve species that are threatened.

#### Vocabulary

structural adaptation  
camouflage  
mimicry  
behavioral adaptation  
extinct

#### Review Vocabulary

**habitat:** a place an organism lives (Grade 6)

# Adaptation and Extinction

**Main Idea** Adaptations are traits that help an organism survive and reproduce in a particular environment, and the inability to adapt can lead to extinction.

**Real-World Reading Connection** Have you ever thought about why giraffes have such long necks? It makes sense if you consider that giraffes are the only plant eaters in Africa that can reach the top of the tallest trees. Such adaptive traits can be explained by Darwin's theory of natural selection.

## Adaptations

Humans are very skilled at changing their environment. We have buildings, heaters, and air conditioners to make our environment more comfortable. Other organisms are not able to change their environment to meet their needs. Plants cannot walk into a greenhouse when the weather gets cold. Organisms that do have unique characteristics, or adaptations, to live in their specific environments have evolved them over time by the process of natural selection.

### Understanding Adaptations

Recall that adaptations are inherited traits that increase an organism's chance of surviving and reproducing in a particular environment. The night-dwelling tarsier shown in **Figure 10** has large eyes that are adapted for seeing in dim light.



**Figure 10** An adaptation of some nocturnal animals is larger eyes. This improves their ability to see at night.





**ACADEMIC VOCABULARY**  
**interpret (in TUR pruht)**  
*(verb)* to explain the meaning of  
*The job of the navigator is to interpret the map.*

**Figure 11** Notice how the mottled coat of the jackrabbit helps it blend in with the desert.



## Natural Selection in Action

Sometimes things change. A prey species might be devastated by disease. A natural disaster like a hurricane or a tsunami might affect a local area, or a volcano spewing ash into the atmosphere might affect the whole Earth. These changes may kill off some individuals, but the survivors can repopulate the species. But what about longer lasting changes in climate, or physical features? These will require organisms to adapt to match the changes. Can we see natural selection happening? No, but we can see the results. Natural selection leads to adaptations in organisms.

**How do organisms adapt?** Many people misunderstand Darwin's theory of natural selection because they **misinterpret** the word *adaptation*. Adaptations are the final products of the long process of natural selection. Adaptations occur in groups of organisms when a trait is passed from one generation to another. The organisms receiving the trait are better suited to survive and reproduce.

Not all traits are adaptations. Recall from Chapter 4 that a chromosome has many genes that code for traits. In this way, some traits can be passed down because they are linked with other traits, whether they are beneficial to the organism or not. So, an undesirable trait might stay in the population because it is somehow linked to another more beneficial trait. Some traits might help an organism survive, while other traits might cause it to die off. Remember, adaptations are naturally selected, not intentionally chosen.

**One Example of Adaptation** There is an abundance of examples of adaptation in the natural world. For example, the desert rabbits in **Figure 11** have blotchy, brown coats that help them blend in with their environment. Desert rabbits also have long ears that help them stay cool as heat is released through the extensive system of blood vessels in the ears.

How might natural selection have shaped the ears of a rabbit? The population may have initially been made of rabbits with different-sized ears. Those rabbits with long ears would be better able to survive in higher temperatures than rabbits with small ears. So, rabbits with big ears would be more likely to live long enough to have offspring than those with smaller ears. Their offspring would probably have big ears, too. After many generations of rabbits, if it remains hot, it will be hard to find rabbits with small ears. This is because the small-eared rabbits will not have thrived and thus left fewer offspring. When the population shifts to mostly large-eared rabbits, the rabbit population has adapted to the environment, and thus evolved by natural selection.



**Figure 11** What other feature besides color helps the jackrabbit to escape predators?



## Types of Adaptations

There are many kinds of adaptations. Scientists divide adaptations into two main categories—structural and behavioral.

### Structural Adaptations

**Structural Adaptations** are inherited physical traits of a species that make its members better suited to their environment. You have already read about the desert rabbit's ears. The ears have lots of blood vessels and the blood carries body heat to the ears. The heat is given off to the air and helps the rabbit stay cool. An added advantage of large ears is that they help the rabbit hear any predator that might be sneaking up on it.

Other structural adaptations of the desert rabbit are its long back legs for running and jumping fast, its high-placed eyes that allow it to see almost 360° around, and its mottled appearance. The mottled fur color helps it blend in with its surroundings.

**Camouflage** Another type of structural adaptation is **camouflage**, or blending in with the surrounding environment. Some lizards have a coloration that matches their primary surrounding area, such as the lava lizards on the Galápagos Islands shown in **Figure 12**. Darwin probably observed many lava lizards. Those living on islands with black lava are difficult to see because they are of the same blackish color as the volcanic rocks on which they sunbathe. Other lava lizards match the color of the sandy beaches.

Darwin probably also saw Sally Lightfoot crabs on the Galápagos Islands. The adult crabs are not well camouflaged. They are very bright and colorful. However, their young are a dull-grey color and are well camouflaged among the volcanic rocks. This coloration helps protect vulnerable young crabs from being captured by predators.



How does the color of the young Sally Lightfoot crab help it survive?



**Figure 12** Lava lizards blend in with the color of the rocks.





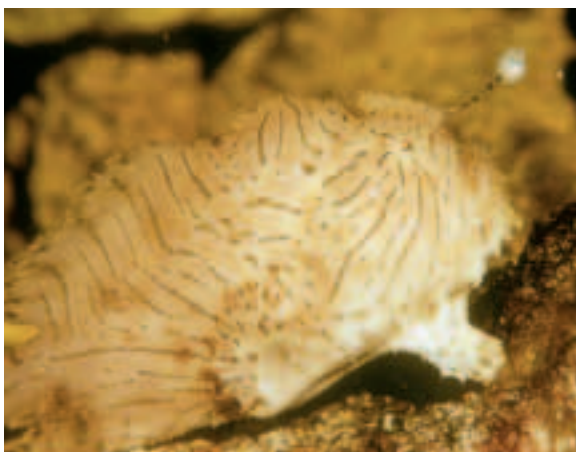
**Figure 13** The snake eel has an adaptation that mimics the venomous sea snake. Predators stay away from both. The frogfish has an adaptation that may look like a piece of food to another fish.



**Banded Sea Snake**



**Snake Eel**



**Frogfish**



**Figure 13** What feature of the snake eel tells you it is a fish?

**Mimicry** Another structural adaptation is **mimicry**, in which one species (the mimic) looks like another species (the model) so that a third species is deceived or fooled. There are several types of mimicry.

**Batesian Mimicry** In one type of mimicry, Batesian mimicry, the model organism is dangerous or venomous, and the mimic is not dangerous. For example, the harmless snake eel looks like the venomous black and white banded sea snake. Because the snake eel looks like the banded sea snake, predators stay away from both organisms. Notice the similarities between the two in **Figure 13**.

**Mullerian Mimicry** In a second type of mimicry, called Mullerian mimicry, two different species that are either venomous or distasteful have evolved to look like one another. Unlike Batesian mimicry, in which only the mimic species benefits from the mimicry, Mullerian mimicry is beneficial to both the mimic species and the model species. An example of a Mullerian mimic and model pair is the monarch and viceroy butterflies. Both butterflies have an orange and black color pattern, and both species are distasteful to birds. However, a bird needs to eat only one member of either species to learn to avoid orange and black butterflies. More members of both species will ultimately survive.



How is Mullerian mimicry beneficial to a species?

**Self Mimicry** In another type of mimicry, self mimicry, a species fools its prey by looking inviting or familiar. As shown in **Figure 13**, frogfish display this type of mimicry by using a small body part like a lure. This attracts other smaller fish looking for food. Unfortunately for the deceived animals, when they get close, the frogfish eats them.



**Figure 14** On the left is a clapper rail in its marshland habitat. At the right a male bower bird decorates its nest to attract females.



**Clapper rail**



**Male bower bird**

## Behavioral Adaptations

In addition to natural selection of physical traits, natural selection of inherited behaviors can also occur. **Behavioral adaptations** are inherited behaviors of a species that make its members better suited to their environment.

Scientists sometimes call them instinctive or inborn behaviors. These adaptations enhance survivorship and reproduction. For example, as shown in **Figure 14**, an endangered bird called the clapper rail lives in muddy, brackish, salt marshes. Twice a day, high tides cover this habitat with water and the low tides leave it exposed. As an adaptive trait, the clapper rail builds its nest in tall, grassy marsh plants. Thus, when the water rises, the nests float up, but the plants keep the nest from drifting away. When the tide is low, the nests slide back onto the wetland mud.



**Reading  
Check**

What behavior has the clapper rail adapted to nesting?

Many behavioral adaptations are designed to attract mates. The satin bower bird in **Figure 14** uses berries, saliva, and blue scraps to decorate its nest. This technique attracts females for mating, which makes it possible for him to pass along his genes to the next generation.

**Herding Instinct** You might have gone for a ride in the country and driven by a farm where you saw a herd of cows. If you go to a national park you will likely see a herd of bison or elk. Many grass-eating mammals live in large groups or herds. They instinctively know that a group is less likely to be attacked by a predator than one animal alone. The herding instinct is a behavioral adaptation. Prey animals can band together to frighten or chase away a group of predators.



## Extinction

When all the individuals of a particular species die off, that species becomes **extinct**. Natural selection can lead to extinction if the conditions of the environment change in a way that none of the organisms of a species can survive. Climate change, volcanoes, and earthquakes are some of the environmental factors associated with extinction.

There have been several major extinction events in the history of Earth. For example, some scientists have proposed that a meteorite collided with Earth about 65 million years ago causing the extinction of the dinosaurs. It has been suggested that when this large meteorite hit Earth, it caused so much dust in the atmosphere that the plants did not receive enough sunlight to grow. Thus, the dinosaurs all starved. You will read more about extinctions in a later chapter.



What is one theory for dinosaur extinction?

## Causes of Extinction

There are many causes for extinction. They include habitat destruction, loss of genetic diversity, and the introduction of exotic species. Most species are not able to withstand these factors as well as other severe environmental changes.

**Loss of Habitat** Extinction rates for individual species are on the rise. One important reason is that habitats for plants and animals are shrinking in size as humans develop and occupy more space and use more resources. **Figure 15** shows some effects human activities may have on natural habitats. With diminishing natural habitat, fewer organisms can survive.

**Figure 15** Clear cutting a forest changes the habitat from forest to grassland.

**Think Critically** What happens to the forest dependent organisms?







**Loss of Genetic Diversity** The fewer the number of individuals left of a species, the less genetic variability there is in the population. Species need genetic variability to increase the likelihood that some individuals will have the right gene combinations to survive different environmental conditions and for evolution to occur. If there are only a few individuals or if the individuals have limited genetic variability, it is much easier for a change in environmental conditions to lead to extinction.

We designate some species as threatened if they are likely to become endangered in the near future within much of its range. Cheetahs are threatened because they have little genetic diversity. In fact, related individuals share 99 percent of the same genes. This has led to low survivorship, low fertility, and disease in the remaining cheetah populations.

**Competition with Exotic Species** Sometimes competition between organisms is caused by the introduction of a new species to the habitat, known as an exotic species. Humans are constantly introducing new species of plants to their environment because of their uniqueness or beauty. If there is no known consumer of a species in the new environment, it may be able to outcompete the native species and push them toward extinction. Introduction of natural consumers or disease-causing agents may reduce the numbers of the invading species.

The kudzu plant was introduced in the southern United States in the 1930s to help prevent erosion. The vine grows so well there that it can grow up to 30 cm per day. However, it shades out forests and kills the trees that are its climbing base. The plant grows naturally in Japan where cool weather, diseases, and consumers help keep it under control. **Figure 16** shows some kudzu taking over a tree line.



### SCIENCE USE V. COMMON USE threatened



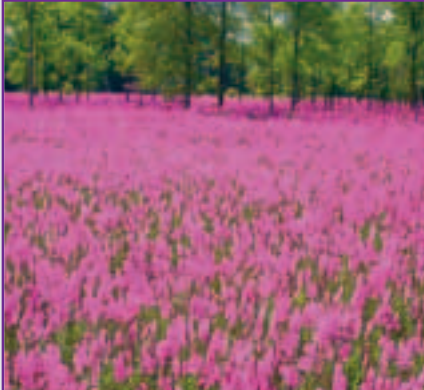
**Science Use** likely to become an endangered species. *The cheetah is a threatened species of cat.*

**Common Use** to utter threats against. *The boy was threatened by the sound of the growling dog.*

**Figure 16** Kudzu grows so rapidly it can outcompete the native species.



**Table 1** Causes of Slow Extinction

Organism	Cause	Details
	Loss of habitat	One of the first insects placed on the endangered species list, this rare Schaus butterfly depends on the semi-shade of tropical hardwood trees. As these forests were cleared in southern Florida, the butterfly populations were pushed back into the Florida Keys. Hurricane Andrew in 1992 left only 70 individuals, but captive breeding allowed reintroduction to help the population survive.
	Loss of genetic diversity	Cheetahs have an unusually low genetic diversity. Their original range was from India to Saudi Arabia and the grassland areas of Africa. Today there are only small pockets of cheetahs in Iran and eastern, sub-Saharan Africa. There are as few as 50 animals in Iran, and the African animals are on preserves. The remainder of the species is in captivity in zoos.
	Exotic species competition	Found mainly in Eurasia, the purple loosestrife has been introduced into the United States. Purple loosestrife adapts readily to natural and disturbed wetlands. It outcompetes and replaces the native grasses, sedges, and other flowering plants that provide a higher quality nutrition source for wildlife. It also reduces habitat for waterfowl.

**Inability to Adapt** Another possible reason that species become extinct is their inability to adapt. If a climate changes suddenly, a species might not have any individuals with genetic traits that will allow them to adapt. Over time the population becomes smaller and the individuals become less able to reproduce. For example, there are so few cheetahs on Earth that inbreeding is resulting in the appearance of recessive traits that are harmful to the species. Inbreeding is mating between closely related individuals and occurs in small populations. Should a rapid environmental change occur, the species could become extinct. The potential causes of slow extinction are summarized in **Table 1**.

## Darwin's Conclusions Today

Just as extinction does not always happen at the same rate or in the same way, new species formation occurs at different rates, too. Because the environment is always changing natural selection is always acting on organisms. Most of the environmental changes are small and localized, leading to very slow changes among populations over many generations. Think about a large environmental change that would affect many species at the same time. Whether the species lives or becomes extinct depends on whether it has adapted to the change. In the next chapter you will read about evidence that has helped to reinforce Darwin's ideas.

## LESSON 2 Review

### Summarize

Create your own lesson summary as you design a **study web**.

1. **Write** the lesson title, number, and page numbers at the top of a sheet of paper.
2. **Scan** the lesson to find the **red** main headings.
3. **Organize** these headings clockwise on branches around the lesson title.
4. **Review** the information under each **red** heading to design a branch for each **blue** subheading.
5. **List** 2–3 details, key terms, and definitions from each **blue** subheading on branches extending from the main heading branches.



ELA7: W 2.5



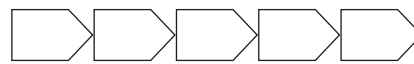
### Standards Check

#### Using Vocabulary

1. Using your own words, define *structural adaptation*. **3.e**
2. **Explain** what it means when a species becomes *extinct*. **3.e**
3. **Compare and contrast** *mimicry* and *camouflage*. **3.a**

#### Understanding Main Ideas

4. Use the graphic organizer to diagram how loss of genetic diversity can lead to extinction. Use as many arrows as you need. **3.e**



5. **Explain** the statement: Not all traits are adaptations. **3.e**
6. **Describe** how kudzu became a pest species in the United States. **3.a**

7. Which of the following is not a physical adaptation? **3.e**

- A. long necks for reaching food in high places
- B. grasping tails to aid in climbing
- C. large ears to aid in cooling body temperatures
- D. creative nest construction to attract mates

#### Applying Science

8. **Develop** a plan to limit the possibility of habitat destruction in the building of a large apartment complex. **3.a**
9. **Evaluate** the effects of small, common changes in the environment versus the effects of large, rare changes on the same population in terms of species adaptation. **3.e**

**Science**  **online**

For more practice, visit **Standards Check** at [ca7.msscience.com](http://ca7.msscience.com).



## How can your species have the strongest, longest-lasting survivors?

When a species survives through several generations, it has traits that allow it to live and grow, avoid its predators, and reproduce in the environment in which it lives. Use the principles of natural selection to help assemble a model population.

### Procedure

1. Read and complete a lab safety form.
2. With your lab group, use items such as **small craft sticks**, **toothpicks**, **clay**, **cotton balls**, and **markers** to assemble as many members of a population in the time allotted to you.
3. Use **twine** to mark a habitat on the grass approximately  $5\text{ m} \times 5\text{ m}$ . Place your population throughout the habitat.
4. Select two students from each group to be predators. For 30 s let them pick up prey from the other student groups.
5. Count the remainder of your population.

### Analysis

1. **Use the number** of your original population and the number of the remainder to record your survivors as a ratio.
2. **Evaluate** Did your organisms meet natural selection criteria?
  - simple part combinations = large numbers of organisms
  - combinations that camouflage the organism
  - non-eaten organisms pass on their traits
  - passed on traits increase survivor numbers



### Science Content Standards

**3.a** Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms.

**7.a** Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.

## How many bird species live near you?

Every winter there is a national bird counting event. Volunteers from every state count the number of bird species they see on one day in their neighborhood. The data below are from a recent bird count from locations in California.

### Data

Bird Species Counted in California		
Area Name	Number of Volunteers	Number of Bird Species Counted
Big Sur	13	136
China Lake	15	84
Death Valley	7	59
Redding	18	108
Yosemite	23	58
Yreka	9	120

California Audubon Society

### Data Analysis

1. **Calculate** the average number of species counted per volunteer.
2. **Calculate** the number of species counted per volunteer for each area. Which area had the highest number of species counted per volunteer?
3. **Infer** which area might have the greatest diversity of bird species. Assume that all volunteers counted for equal numbers of hours during the same time of day and had equivalent observation skills. Explain your inference.



Science Content Standards



MA7: NS 1.3

**7.c** Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.

## Use the Internet: **Can you apply the principles of natural selection to island species?**

### Materials

information packets  
from Channel  
Islands National  
Park  
research books that  
contain pictures  
and documentation  
about living  
organisms  
internet access



### Science Content Standards

**3.b** Students know the reasoning used by Charles Darwin in reaching his conclusions that natural selection is the mechanism of evolution.

**7.b** Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.

**7.c** Communicate the logical connection among hypothesis, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.

There are five islands off the coast of southern California that are known as the Channel Islands. These islands include San Miguel Island, Santa Barbara Island, Santa Rosa Island, Santa Cruz Island, and East Anacapa Island. These islands have animals and plants that live on one or more of them, but not anywhere else. The species are diverse and include reptiles, birds, plants, mammals, and others.

### Form a Hypothesis

You will be given the name of one species that lives on one or more of the Channel Islands. How can you explain why this species survives there and if it will continue to survive?

### Collect Data and Make Observations

1. **Research** your assigned species at [ca7.msscience.com](http://ca7.msscience.com), keeping the following data in mind: appearance, where it lives, how it moves, what it eats, how it eats, and other data.
2. **Draw** a picture of your species and describe its habitat.
3. **List** characteristics of your species and identify any known adaptations.
4. **Apply** each principle of natural selection to prove that your species is able to fulfill all the principles.



## Analyze and Conclude

1. **Explain** Did you discover if the species you researched is extinct or endangered? Explain.
2. **Conclude** After you evaluated your species according to the principles of natural selection, what conclusions can you make in relation to its survival?
3. **Determine** Was your species native to the island habitat you studied, or did humans bring the animal onto the island?
4. **Decide** What is the impact of animals that are introduced into island ecosystems?
5. **Explain** Is your species a possible cause for extinction of another species on your island?
6. **Infer** If you moved your species to the continent, could it survive? Explain.
7. **Evaluate** How can you evaluate the future of your species when you consider how it reproduces?

## Communicate

**WRITING in**

**Science**



**ELA7: LS 2.3**

Make a power point presentation of your findings that includes all the characteristics; color pictures of the species; adaptations, habitat, and your outline of proof that the species has what it needs to survive as an individual and as a species.



# Real World Science

## Science & Career



## You can be an evolutionary biologist!

Evolutionary biology is the study of the origin and descent of species, as well as their changes over time. Evolutionary biology includes many different fields, such as ornithology, the study of birds, or herpetology, the study of reptiles. Scientists use those organisms as systems to answer general questions about evolution. It also includes paleontologists who use fossils to answer questions about when and over how long a period evolution occurred.

The biologists in the photo have their hands full weighing a black caiman, a species of crocodile found in South America. Visit [ca7.msscience.com](http://ca7.msscience.com) to learn more about biology and evolution careers. Write a 500-word paper describing another area of biology and how it relates to evolutionary biology.

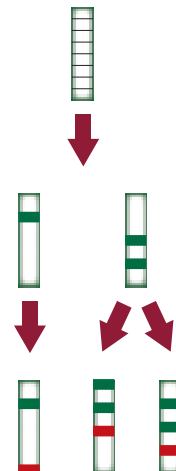


## A MOLECULAR CLOCK

Mutations, changes in DNA, can be harmful, lead to adaptations, or have no effect on the organism. Scientists can sequence sections of DNA to see whether or not a mutation has occurred. Molecular clocks are a way to compare DNA sequences from different species. Scientists compare mutation locations to estimate how long the species have been evolving since they shared a common ancestor. The figure on the right shows three species that have some mutations in common and some mutations that are unique to that species. Scientists consider these data and the fossil record to estimate how long species have been evolving apart from each other.

Some scientists think that a clock is not a good analogy for the model described above. Visit **Technology** at [ca7.msscience.com](http://ca7.msscience.com) to learn more about how scientists calibrate molecular clocks. Discuss some other analogies for the model that might be more accurate.

## Science & Technology





## Counting Coprolites

When you think of paleontologists, you might think of someone who studies bones and rocks. Karen Chin is a paleontologist who studies dung. That's right—she is one of the world's experts on fossilized dinosaur dung, called a coprolite (KAH pruh lyt). When a suspected coprolite is found, chemical tests are performed to confirm its identity. Other clues, such as other fossils found with it, the presence or lack of bones, and the size of the coprolite, help Chin to determine which dinosaur species made it. One of Chin's most famous coprolites belonged to a *Tyrannosaurus rex*. Coprolites provide information about what dinosaurs ate and how they interacted with their environment.

Visit **History** at [ca7.msscience.com](http://ca7.msscience.com) to learn more about paleontology. With a partner, create a time line highlighting major events in paleontology in the past 100 years.



## Habitat Degradation and Extinction



Extinction is a natural phenomenon, and it is estimated that more than 99 percent of all species that have ever lived are now extinct. However, many people are concerned about species extinction due to habitat destruction caused by humans. Many scientists are searching for ways to combat human-induced extinction. For example, the desert tortoise population is declining. This is an indicator that the health of California's desert habitat is also declining. Conservationists and the government are investigating the causes of this decline and are working towards its recovery.

To find out more about extinction and habitat degradation, visit **Society** at [ca7.msscience.com](http://ca7.msscience.com). What are some human factors that influence habitat degradation? Write a short article on one factor and a California habitat that it affects. Make sure to use proper spelling, punctuation, grammar, and capitalization.



**The BIG Idea**

Genetic changes occurring in populations can result in new species, the extinction of species, and organisms suited for different environments.

**Lesson 1 Natural Selection**

3.a, 3.b, 7.c

**Main Idea** Charles Darwin developed a theory of how organisms with the same ancestors can look and behave differently over time.

- Naturalist Charles Darwin developed his theory of evolution by natural selection based on a voyage of the HMS *Beagle*.
- Darwin first saw evidence of natural selection while collecting specimens in the Galapagos Islands off the coast of South America.
- Selective breeding of many animals brings out different characteristics, but does not lead to a new species.
- Darwin didn't know about genetic variation, so his observations were confusing to him.
- The steps of natural selection are overproduction of offspring to ensure survival; variation of characteristics and passing the inherited characteristics on to the next generation; and the survivability of those organisms with the traits.
- Diversity is the key to survival of a species.

- adaptation (p. 216)
- evolution (p. 210)
- naturalist (p. 210)
- natural selection (p. 216)

**Lesson 2 Adaptation and Exinction**

3.a, 3.e, 7.a, 7.b, 7.c

**Main Idea** Adaptations are traits that help an organism survive and reproduce in a particular environment, and the inability to adapt can lead to extinction.

- Traits that help an organism within a species to survive are adaptations.
- Adaptations start out as changes in the DNA that create some advantage to the organism in the environment.
- Adaptations may be structural (long ears in desert rabbits) or behavioral (building nests that float).
- Camouflage is a structural adaptation that lets the organism blend into the surroundings.
- Mimicry helps avoid predation or helps the predator to attract its prey.
- Organisms that cannot adapt may become extinct.
- The causes of extinction hinge on loss of habitat, lack of genetic diversity, competition with other species including exotic species, and the inability to adapt.

- behavioral adaptation (p. 223)
- camouflage (p. 221)
- extinct (p. 224)
- mimicry (p. 222)
- structural adaptation (p. 221)

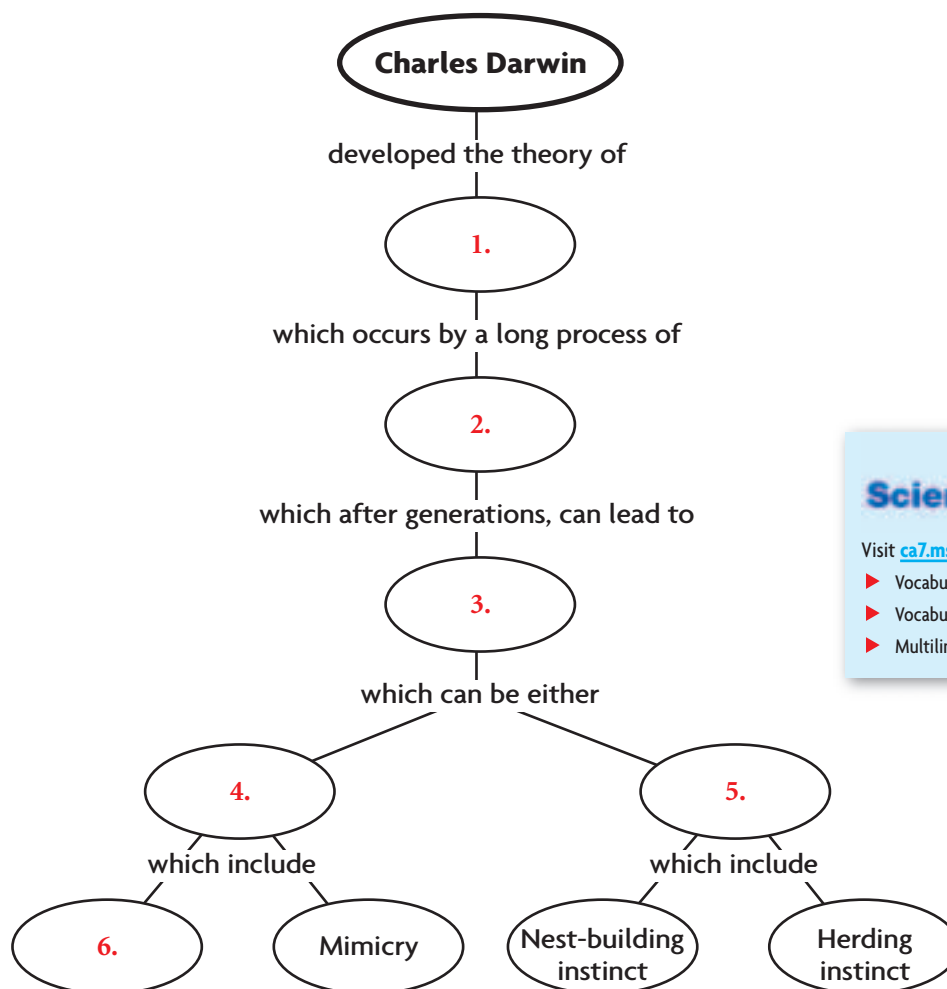


Download quizzes, key terms, and flash cards from [ca7.msscience.com](http://ca7.msscience.com).



## Linking Vocabulary and Main Ideas

Use the vocabulary terms on page 234 to complete the concept map.



## Using Vocabulary

Fill in each blank with the correct vocabulary term.

7. An octopus uses \_\_\_\_\_ to hide in its surroundings.
8. \_\_\_\_\_ adaptations include nesting habits and courting.
9. Isolation on the Galápagos Islands allowed \_\_\_\_\_ by natural selection to develop 13 finch species.
10. A frogfish exhibits one kind of \_\_\_\_\_ to catch food.
11. A(n) \_\_\_\_\_ is a person who studies rocks, plants, and animals.
12. A(n) \_\_\_\_\_ is a trait that helps an organism survive in its habitat.
13. The long process of \_\_\_\_\_ has created the diversity of life we see on Earth today.
14. Organisms that are unable to adapt to a changing environment might become \_\_\_\_\_.



## Understanding Main Ideas

Use the image below to answer questions 1 and 2.



- Which is likely to be true of the offspring of this pigeon, according to Darwin's theory?
  - All will look the same.
  - All will have a fantail.
  - All will survive to adulthood.
  - All will have the best traits.

**3.b**
- Which is the human influenced process by which this pigeon developed a fantail?
  - evolution
  - overproduction
  - selective breeding
  - natural selection


**3.b**
- Which was true of Darwin's experiences while in the Galápagos?
  - Darwin realized that the birds were all new species.
  - Darwin noticed that the mockingbirds varied.
  - Darwin understood how species could change over time.
  - Darwin saw that the tortoises showed variation of characteristics.

**3.b**
- Which is a requirement of the process of evolution by natural selection?
  - genetic variation
  - environmental variation
  - species remain unchanged
  - all offspring survive

**3.b**
- What is likely to happen to a tree species that cannot adapt to frequent fires?
  - mutation
  - overproduction
  - extinction
  - variation

**3.e**
- Which would NOT be an adaptation to cold weather?
  - long hair
  - hibernation
  - migration
  - brown fur

**3.a**
- Which is not available to a single-celled, asexual organism as a way to respond to environmental change?
  - natural selection
  - genes from two parents
  - beneficial mutations
  - changes in DNA

**3.a**
- What is the end result of species change over time?
 
  - overproduction
  - diversity of a species
  - inherited variation
  - natural selection

**3.a**





### Applying Science

9. **Discuss** how unlimited food would affect the process of natural selection. **3.b**
10. **Infer** Discuss why an individual organism does not evolve by natural selection. **3.b**
11. **Predict** Choose a species alive today and predict how it might evolve through natural selection. Be sure to explain how the traits that increase are advantageous. **3.b**
12. **Hypothesize** what would be the result of natural selection if organisms of a species did not vary. **3.e**
13. **Describe** how the snapdragons in the photo below use color variation to avoid extinction. **3.a**



14. **Infer** how a population of mammals that fed on fruit on the ground and on the trees might change as the trees evolved to be increasingly tall. **3.e**
15. **Predict** how the extinction of a predator would affect the other species in the environment. Consider the prey of the predator and the things that the prey eats. **3.e**

### WRITING in Science

16. **Write** the inside details for a pamphlet on natural selection in the Galápagos Islands. Pick your topic from tortoises, finches, or iguanas.

### Applying Math

Use the formula below to answer questions 17–21.

$$\frac{(a + b)}{2} \times c = \text{area of a trapezoid}$$

17. A corner hutch has shelves shaped like a trapezoid. The front of the shelf is 64 cm wide, while the back of the shelf is 50 cm. The depth is 60 cm. What is the area of each shelf?
18. The top shelf of the hutch is ornamental and measures 20 cm across the back and 34 cm across the front. The depth is 45 cm. What is its area?
19. Find the area of a trapezoid whose bases are 25 cm and 35 cm and whose length is 4 cm.
20. Find the area of a pair of trapezoids that have the same depth (24 cm) and one base length (24 cm). The other bases are different. One trapezoid has a short base of 12 cm, and the other one has a short base of 16 cm.
21. Find the area of a stop sign that is 60 cm tall. Each edge of the stop sign is 24.8 cm. (Hint: Divide the sign into a rectangle and two trapezoids. The height of each trapezoid is 17.5 cm)

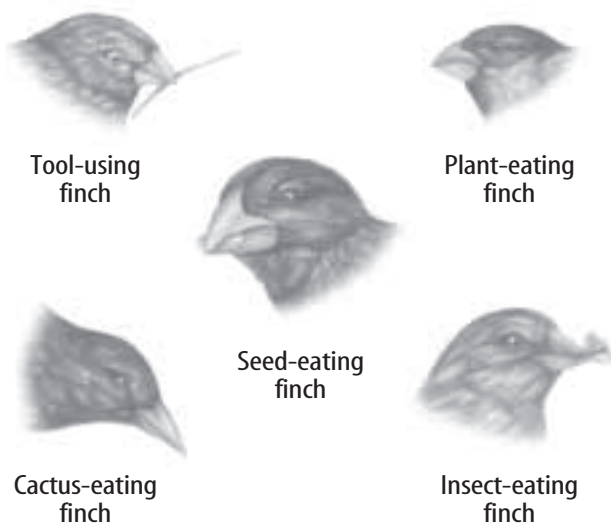


1 What is an example of adaptation?

- A a fossil
- B gradualism
- C camouflage
- D embryo

3.e

Use this diagram to answer questions 2 and 3.



2 A series of helpful variations in a species result in

- A adaptation.
- B fossils.
- C embryology.
- D climate change.

3.e

3 What, besides competition for food, contributed to the evolution of the species of Darwin's finches?

- A predation
- B natural disaster
- C DNA
- D variation in beak shapes

3.a

4 Some harmless species imitate a poisonous species as a means for increased survival. This an example of what?

- A camouflage
- B mimicry
- C variation
- D geographic isolation

3.e

5 Which is NOT a way that humans influence the rate of species extinction?

- A mining
- B farming
- C volcanic eruptions
- D construction

3.e

6 What explains all the different breeds of dogs and cats?

- A phenotype
- B genes and the environment
- C dominant alleles
- D selective breeding

3.a

7 Having a body part that looks like food to another organism is an example of what?

- A camouflage
- B mimicry
- C behavioral adaptation
- D exotic species

3.b



- 8 Which is the process by which adaptations are more likely to be inherited while traits that are not advantageous are less likely to be inherited?

A selective breeding  
B natural selection  
C behavioral adaptation  
D natural adaptation

3.b

- 9 Which is an expected outcome of natural selection?

A extinction  
B common ancestors  
C diversity of life  
D mutations

3.b

- 10 Which is a behavioral adaptation?

A mimicry of coloration  
B camouflage  
C analogous structures  
D building specialized nests

3.e

- 11 How would environmental conditions have to change to give this albino lemur a chance for survival?



A Volcanic ash covers the forest.  
B The climate gets cold enough to snow.  
C A city dump moves nearby.  
D An earthquake lifts the land 2 meters.

3.e

- 12 What do we call an organism on the brink of extinction?

A threatened  
B selected  
C exotic  
D adapted

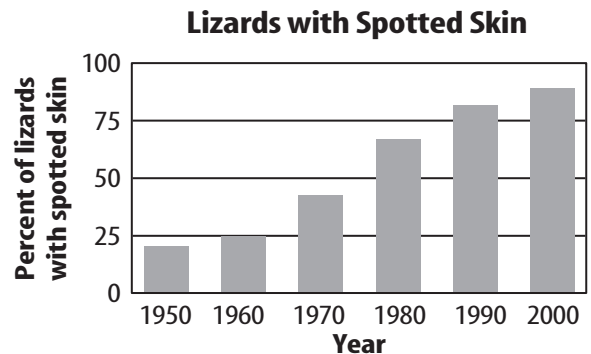
3.e

- 13 Which is an example of a structural adaptation?

A long ears of a desert rabbit  
B tool use of finches  
C herd of elk  
D nest-building of a clapper rail

3.b

- 14 A population of lizards has been studied for the last 50 years.



Which conclusion can be drawn from the graph?

A Spotted skin is increasing in the population.  
B Loss of habitat is occurring.  
C Exotic species are outcompeting the lizards.  
D Spotted skin is declining in the population.

3.b