SECTION 3

Natural Selection in Action

Key Concept Natural selection explains how populations become adapted to changes in their environment and why some species become extinct.

What You Will Learn

- Genetic variation and environmental factors affect evolution by natural selection.
- Separation, adaptation, and reproductive isolation can produce new species.
- Extinction occurs when the adaptations of a species are insufficient for survival in a changing environment.

Why It Matters

Natural selection accounts for the great diversity of living things.

Vocabulary

- speciation
- extinct

READING STRATEGY

Prediction Guide Before reading this section, write each heading from this section in your **Science Journal.** Below each heading, write what you think you will learn.

A unique insect species lives on a particular island. A storm carries a few members of a bird species to the island. Will the birds survive in their new environment? Will the insect species survive if the birds prey on the insects?

Many factors determine if a population will survive in its environment or become extinct. Over time, a population may evolve new adaptations, which enable it to survive in its environment. The theory of evolution by natural selection explains how a population can change in response to its environment.

Changes in Populations

For natural selection to occur, a population must have genetic variation and thus a variety of traits. Environmental factors determine which traits in a population are favorable and which are unfavorable.

Genetic Variation

Genetic differences are responsible for the differences between species and between members of the same population. The *genetic variation* of a population is a measure of how much individuals in a population differ genetically. In a population that has high genetic variation, members have different *alleles,* or forms of their genes. As a result, the population will have a large variety of traits. The individuals in a population that has low genetic variation have many of the same alleles. Therefore, the population has a small variety of traits.

Genetic variation is important for the survival of a species. For example, populations of cheetahs, as shown in **Figure 1,** and other endangered species, have a low genetic variation. Populations with a low genetic variation are less likely than populations that have a high genetic variation to adapt to changes in their environment. For example, if some members of a population cannot naturally resist a disease, the species is less likely to survive a major outbreak.

Figure 1 *Cheetah populations have low genetic variation, which puts cheetahs at risk of extinction.*

Environmental Factors

Individuals in a population often have different traits. But which traits are favorable, and which traits are unfavorable? The answer depends on environmental factors. *Environmental factors* are the conditions in an environment that affect the organisms that live there.

Different environments have different environmental factors. For example, organisms that live in a desert need to be able to survive in an area that receives little water. And organisms that live near coral reefs need to be able to survive in salt water. Also, organisms living near a coral reef have different food sources and different predators than organisms in deserts do.

Certain traits are better in certain environments. For example, a snake that lives in tall, green grass may benefit from being green. In this environment, a green snake will be able to hide from predators more easily than a brown snake will. Therefore, green snakes will survive and reproduce more than brown snakes will. But being brown may be more beneficial if the snake lives on a forest floor that has a large amount of dead leaves. On a forest floor, a brown snake will probably survive and reproduce more than a green snake will.

Standards Check What are environmental factors? 7.3.a

7.3.a Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms.
7.3.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.
7.4.f Students know how movements of Earth's continental and oceanic plates through time, with associated changes in climate and geographic connections, have affected the past and present distribution of organisms.

Quick Lab

Adaptations of Bird Beaks

7.3.a
7.3.e
7.7.c

The shape of a bird's beak is adapted to the way that the bird usually obtains food. In this activity, you will observe how some beak shapes are more favorable than other beak shapes based on the type of food that a bird eats.

Try It!

1. Your teacher will provide you with a **tray of small objects,** such as nuts and rice. These objects represent different types of seeds.
2. You will also select different **tools,** such as pliers and tweezers. The tools represent different types of bird beaks.
3. Use the tools to pick up the different objects. Record which tool works best to pick up each object.

Think About It!

4. Imagine an island on which all of the plants that produce small seeds are killed by a drought. Which type of bird is most likely going to be able to survive and reproduce on this island: birds that have small beaks or birds that have large beaks?
5. For the situation described in question 4, what is the important environmental factor?
6. Imagine returning to the island after many years and observing that plants that produce small seeds no longer exist. Would you expect to find more small-beaked birds or more large-beaked birds?

20 min

Figure 2 *After squirrel populations by the Grand Canyon became separated, they formed two species: the Kaibab squirrel (left) and the Abert squirrel (right).*

Forming a New Species

Sometimes, drastic changes that can form a new species take place. A new species may form after a group becomes separated from the original population. This group forms a new population. Over time, the new population becomes adapted to its new environment. Over time, both populations evolve different adaptations. The two populations differ so greatly that they can no longer mate successfully. The new population may then be considered a new species.

The formation of a new species as a result of evolution is called **speciation.** **Figure 2** shows two species of squirrels that live on opposite sides of the Grand Canyon. At one time, these squirrels were probably part of one population. As the Grand Canyon became larger, the population became separated and evolved into two species.

speciation (SPEE shee AY shuhn) the formation of new species as a result of evolution

Separation

Speciation often begins when a part of a population becomes separated from the rest. The process of separation can happen in many ways. For example, a newly formed canyon, mountain range, or lake can divide a population as **Figure 3** shows. Movements of Earth's continental and oceanic plates can also affect the distribution of organisms.

Figure 3 *Populations can become separated in a variety of ways.*

Adaptation

After two groups have separated, natural selection continues to act on the groups. Over many generations, the groups may evolve different sets of traits. If the environmental conditions for each group differ, the groups' adaptations will differ. For example, a population of birds may become separated into two groups living on two different islands. The birds living on the island that has bigger, tougher seeds will probably evolve different adaptations for eating than the birds living on the island that has small, soft seeds will.

Reproductive Isolation

Natural selection can cause two separated groups to become very different. If the groups are reunited and cannot interbreed anymore, the groups have undergone *reproductive isolation*. If they cannot interbreed, the two groups are no longer the same species. **Figure 4** shows how species of Galápagos finches may have evolved through separation, adaptation, and reproductive isolation.

Standards Check What are the three parts of speciation? 7.4.f

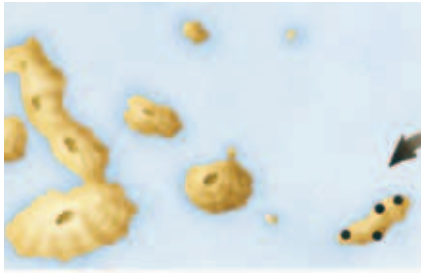
INTERNET ACTIVITY

Environment and Evolution

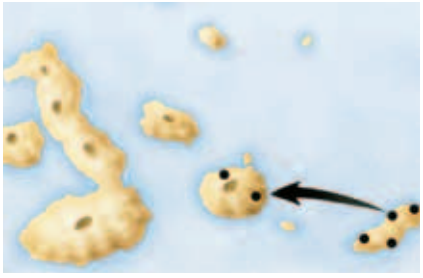
Can you balance the need for food with the needs of the environment? Argue for or against the use of insecticides. Go to **go.hrw.com,** and type in the keyword HY7EVOW.

Figure 4 The Evolution of Species of Galápagos Finches

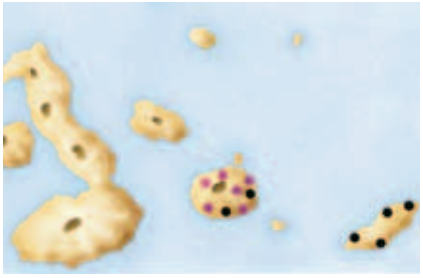
1 Some finches left the mainland and reached one of the islands (separation).



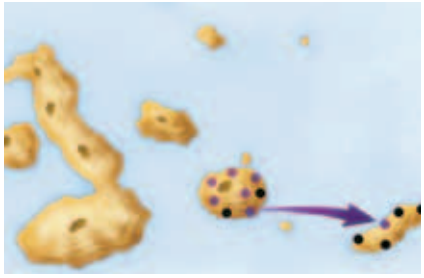
2 The finches reproduced and adapted to the environment (adaptation).



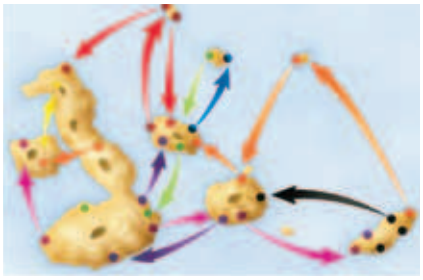
3 Some finches flew to a second island (separation).



4 These finches reproduced and adapted to the second island's environment (adaptation).



5 Some finches flew to the first island but could not interbreed with the finches there (reproductive isolation).



6 This process may have occurred over and over again as the finches flew to the other islands.

SCHOOL to HOME

Caring For A New Pet

If you could have one extinct animal to keep as a pet, which would you choose? With a family member, select an extinct animal to research. You will want the food and habitat that you provide for your pet to be similar to what the animal had before it went extinct. In your **Science Journal,** describe how you will care for your new pet.

ACTIVITY

Extinction

Organisms have adaptive characteristics that help them survive in their environment. But what happens when the environmental factors change? Sometimes organisms can survive and reproduce after the environment has changed. However, if the adaptations of a species are not sufficient for organisms to survive, the species may become extinct. A species is **extinct** when all individuals of the species have died. Increased competition, new predators, and the loss of habitat are examples of environmental conditions that can lead to extinction.

Increased Competition

Resources such as food, water, shelter, space, or sunlight are in limited supply in the environment. Populations of different species often compete for resources. When the quantity of resources in an environment decreases, competition for the remaining resources increases. If the members of a species cannot gather the resources that they need, the species may become extinct.

New Predators

Sometimes, a new species enters an area. The new species may come from a nearby area or may be introduced by humans. For example, the European red fox, shown in **Figure 5,** was introduced to Australia by humans. Species in Australia, such as the numbat in **Figure 5,** do not have adaptations to escape foxes. So, foxes prey on numbats and have caused the population of numbats to decrease. Many species in Australia are endangered because of the introduction of new predators.

Standards Check **How can a new predator cause a species to go extinct?** 7.3.e

extinct (ek STINGKT) describes a species that has died out completely

Figure 5 *Since European red foxes (left) were introduced to Australia, they prey on many animals, such as numbats (right).*

Loss of Habitat

Most species get the food, water, and shelter that they need from the habitat in which they live. What happens if a habitat is destroyed? Pollution can damage a habitat so that organisms can no longer live there. Habitats can also be destroyed by natural disasters, such as floods, storms, and forest fires.

When a population loses its habitat, it may move to a new area. Sometimes, the population may not have adaptations that allow it to live in nearby environments. As a result, species may go extinct.

SECTION Review

7.3.a, 7.3.e, 7.4.f

Summary

- A population that has high genetic variation will have many individuals with different sets of traits.
- Environmental factors determine which traits are favorable and which traits are unfavorable.
- Natural selection explains how one species evolves into another.
- Separation, adaptation, and reproductive isolation can lead to speciation.
- If environmental conditions change, a species may not be able to survive and may go extinct.
- Environmental conditions that can lead to extinction of species include increased competition, new predators, and loss of habitat.

Using Vocabulary

1 Write an original definition for *genetic variation*.

Understanding Concepts

2 **Describing** Describe how the introduction of a new predator can cause a species to go extinct.

3 **Identifying** What environmental factors may affect an organism that lives on a rocky beach?

4 **Describing** Describe how new species of Galápagos finches may have formed.

5 **Describing** Explain how genetic variation and environmental factors affect evolution by natural selection.

Critical Thinking

6 **Forming Hypotheses** Suppose that the distance between some islands is small enough for birds to fly frequently between all of the islands. Is this situation likely to lead to speciation? Explain.

7 **Making Inferences** Mass extinctions are periods in Earth's history when many species have become extinct. Some evidence suggests that major environmental changes occurred during mass extinctions. Explain how changes in the environment could be related to mass extinctions.

Challenge

8 **Forming Hypotheses** When dinosaurs were alive, most of the mammals were small. After the dinosaurs became extinct, mammals evolved into many different forms, such as cats and elephants. Explain how the extinction of dinosaurs may be related to the increase in the number of species of mammals.

Internet Resources

For a variety of links related to this chapter, go to www.scilinks.org

Topic: Species and Adaptation

SciLinks code: HY71433