

11.6 Patterns in Evolution

KEY CONCEPT Evolution occurs in patterns.

VOCABULARY

convergent evolution
divergent evolution
coevolution
extinction
punctuated equilibrium
adaptive radiation

MAIN IDEAS

- ▶ Evolution through natural selection is not random.
- ▶ Species can shape each other over time.
- ▶ Species can become extinct.
- ▶ Speciation often occurs in patterns.

Connect to Your World

People adapt their behavior to their situation. As you go through school, you are likely to change how you dress, talk, and study. When you learn something that makes your life better, you hold on to that new skill. On a genetic level and over multiple generations, species hold onto traits that benefit them in their environment. Natural selection is the process that preserves these adaptive traits in a population. However, sudden changes in an environment can wipe out a species quickly. The rise and fall of species over time reveal clear evolutionary patterns.

▶ MAIN IDEA

Evolution through natural selection is not random.

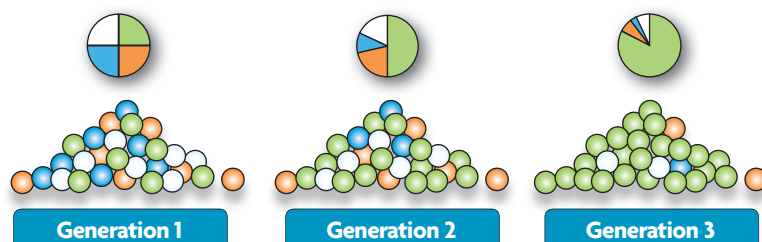
In science, the terms *chance* and *random* relate to how easily an outcome can be predicted. Because mutations and genetic drift cannot be predicted, they are called random events. These random events are sources of genetic diversity. However, natural selection, which acts on this diversity, is not random. Individuals with traits that are better adapted for their environment have a better chance of surviving and reproducing than do individuals without these traits.

You have learned about directional, stabilizing, and disruptive selection. In each of these modes of selection, the effects of natural selection add up over many generations. In other words, natural selection pushes a population's traits in an advantageous direction. As you can see in **FIGURE 6.1**, alleles associated with these traits add up in the population's gene pool.

Remember, however, that having direction is not the same as having purpose or intent. The environment controls the direction of natural selection. When the environment changes, different traits may become advantageous. The response of species to environmental challenges and opportunities is not random.

FIGURE 6.1 PATTERNS IN NATURAL SELECTION

In this hypothetical population, green body color is favored by natural selection. With each generation, alleles associated with green body color increase in frequency. Over time, more and more individuals in the population will have the advantageous phenotype.



Convergent Evolution

Different species often must adapt to similar environments. Evolution toward similar characteristics in unrelated species is called **convergent evolution**. Analogous structures, such as wings on birds and insects, are common examples of convergent evolution. Another example is the tail fin of fish and marine mammals, as shown in **FIGURE 6.2**. Sharks, which are fish, and dolphins, which are mammals, are separated by about 300 million years of evolution. Separately, they have both evolved similar tail fins to propel themselves through the water. However, the tail fins of sharks and other fish are vertical, while those of dolphins are horizontal.

Divergent Evolution

When closely related species evolve in different directions, they become increasingly different through **divergent evolution**. The evolution of the red fox and the kit fox is an example of this trend. Though closely related, the two species have different appearances that are the result of adapting to different environments. The red fox lives in temperate regions, usually in forests. Its dark reddish coat helps it to hide from predators. The sandy-colored coat of the kit fox allows it to blend in with its desert surroundings. Kit foxes also have large ears relative to their body size. This adaptation helps them to keep cool in the desert heat.

Infer Are the shells of turtles and snails examples of convergent or divergent evolution? Explain.

FIGURE 6.2 Convergent and Divergent Evolution

Natural selection is not random. It can have direction, and its effects are cumulative through generations.

CONVERGENT EVOLUTION

Dolphins, which are mammals, and sharks, which are fish, have evolved similar tail fins, as each has adapted to similar environmental conditions.



Dolphin



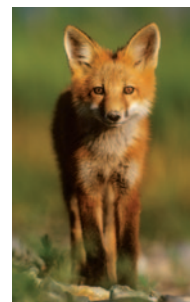
Shark

DIVERGENT EVOLUTION

The kit fox and the red fox evolved from a common ancestor while adapting to different environments.

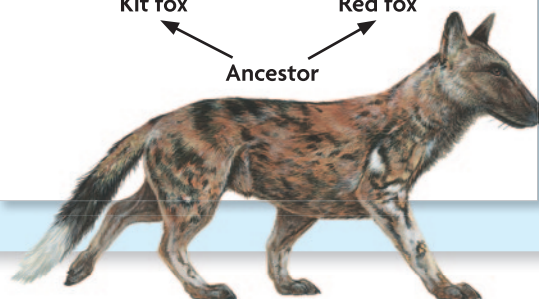


Kit fox



Red fox

Ancestor



Analyze How do convergent and divergent evolution illustrate the directional nature of natural selection?