

# 19.2 Patterns and Processes of Evolution

## Lesson Objectives

-  Identify the processes that influenced survival or extinction of a species or clade.
-  Contrast gradualism and punctuated equilibrium.
-  Describe adaptive radiation and convergent evolution.
-  Explain the evolutionary characteristics of coevolving organisms.

## Lesson Summary

**Speciation and Extinction** **Macroevolutionary patterns** are grand transformations in anatomy, phylogeny, ecology, and behavior that usually take place in clades larger than a single species.

- ▶ If the rate of speciation in a clade is equal to or greater than the rate of extinction, the clade will continue to exist. If the rate of extinction in a clade is greater than the rate of speciation, the entire clade will eventually become extinct.
- ▶ **Background extinction** is extinction caused by the slow process of natural selection. **Mass extinctions** affect huge numbers of species over a relatively short time.

**Rate of Evolution** Evidence shows that evolution has occurred at different rates for different organisms at different times.

- ▶ The idea that evolution occurs slowly and gradually is called **gradualism**.
- ▶ In **punctuated equilibrium**, long periods of little or no change are interrupted by short periods of rapid change.

**Adaptive Radiation and Convergent Evolution** **Adaptive radiation** is the process in which a single species evolves into diverse species that live in different ways. **Convergent evolution** is the process in which unrelated species come to look alike because they have evolved similar adaptations in response to similar environments.

**Coevolution** **Coevolution** is the process by which two species evolve in response to changes in each other over time. For example, plants evolved poisons that protected them from insects. In response, insects evolved ways of protecting themselves from the poisons.

## Speciation and Extinction

*For Questions 1–4, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.*

- \_\_\_\_\_ 1. Large-scale evolutionary changes that usually take place over long periods of time are referred to as speciation.
- \_\_\_\_\_ 2. Many species disappear rapidly during a background extinction.
- \_\_\_\_\_ 3. The rate of speciation in a clade must be equal to or greater than the rate of extinction in order for a clade to survive.
- \_\_\_\_\_ 4. Immediately after a mass extinction, biodiversity is dramatically reduced.

5. What are possible causes of mass extinction?

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6. What effects have mass extinctions had on the history of life?

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## Rate of Evolution

7. Horseshoe crabs have changed little in structure from the time they first showed up in the fossil record. Which pattern of evolution do horseshoe crabs likely follow—gradualism or punctuated equilibrium? Explain your answer.

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8. Why does rapid evolution occur more often in small populations?

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9. Use the Venn diagram below to compare punctuated equilibrium with gradualism.



