16.1 Darwin's Voyage of Discovery

Key Questions

What was Charles Darwin's contribution to science?

What three patterns of biodiversity did Darwin note?

Vocabulary

evolution
fossil

Taking Notes

Preview Visuals Before you read, look at **Figure 16–1.** Briefly summarize the route the *Beagle* took.

BUILD Vocabulary

RELATED WORD FORMS In biology, the noun **evolution** means "the process by which organisms have changed over time." The verb *evolve* means "to change over time."

THINK ABOUT IT If you'd met young Charles Darwin, you probably wouldn't have guessed that his ideas would change the way we look at the world. As a boy, Darwin wasn't a star student. He preferred bird-watching and reading for pleasure to studying. His father once complained, "You will be a disgrace to yourself and all your family." Yet Charles would one day come up with one of the most important scientific theories of all time—becoming far from the disgrace his father feared he would be.

Darwin's Epic Journey

What was Charles Darwin's contribution to science?

Charles Darwin was born in England on February 12, 1809—the same day as Abraham Lincoln. He grew up at a time when the scientific view of the natural world was shifting dramatically. Geologists were suggesting that Earth was ancient and had changed over time. Biologists were suggesting that life on Earth had also changed. The process of change over time is called **evolution.** **Darwin developed a scientific theory of biological evolution that explains how modern organisms evolved over long periods of time through descent from common ancestors.**

Darwin's journey began in 1831, when he was invited to sail on the HMS *Beagle*'s five-year voyage along the route shown in **Figure 16–1.** The captain and his crew would be mapping the coastline of South America. Darwin planned to collect specimens of plants and animals. No one knew it, but this would be one of the most important scientific voyages in history. Why? Because the *Beagle* trip led Darwin to develop what has been called the single best idea anyone has ever had.

If you think evolution is just about explaining life's ancient history, you might wonder why it's so important. But Darwin's work offers vital insights into today's world by showing how the living world is constantly changing. That perspective helps us understand modern phenomena like drug-resistant bacteria and newly emerging diseases like avian flu.

In Your Notebook *Using what you know about ecology, explain how the ideas of a changing Earth and evolving life forms might be related.*

Observations Aboard the *Beagle*

What three patterns of biodiversity did Darwin note?

A collector of bugs and shells in his youth, Darwin had always been fascinated by biological diversity. On his voyage, the variety and number of different organisms he encountered dazzled him. In a single day's trip into the Brazilian forest, he collected 68 species of beetles, and he wasn't particularly looking for beetles!

Darwin filled his notebooks with observations about the characteristics and habitats of the different species he saw. But Darwin wasn't content just to describe biological diversity. He wanted to explain it in a scientific way. He kept his eyes and mind open to larger patterns into which his observations might fit. As he traveled, Darwin noticed three distinctive patterns of biological diversity: (1) Species vary globally, (2) species vary locally, and (3) species vary over time.

Species Vary Globally Darwin visited a wide range of habitats on the continents of South America, Australia, and Africa and recorded his observations. For example, Darwin found flightless, ground-dwelling birds called rheas living in the grasslands of South America. Rheas look and act a lot like ostriches. Yet rheas live only in South America, and ostriches live only in Africa. When Darwin visited Australia's grasslands, he found another large flightless bird, the emu. **Darwin noticed that different, yet ecologically similar, animal species inhabited separated, but ecologically similar, habitats around the globe.**

Darwin also noticed that rabbits and other species living in European grasslands were missing from the grasslands of South America and Australia. What's more, Australia's grasslands were home to kangaroos and other animals that were found nowhere else. What did these patterns of geographic distribution mean? Why did different flightless birds live in similar grasslands across South America, Australia, and Africa, but not in the Northern Hemisphere? Why weren't there rabbits in Australian habitats that seemed ideal for them? And why didn't kangaroos live in England?

Quick Lab GUIDED INQUIRY

Darwin's Voyage

1. Using a world map and **Figure 16–1,** count the number of lines of 10° latitude the *Beagle* crossed.
2. Using the biome map from Chapter 4 as a reference, identify three different biomes Darwin visited on his voyage.

Analyze and Conclude

1. **Infer** How did the geography of Darwin's voyage give him far greater exposure to species variability than his fellow scientists back home had?

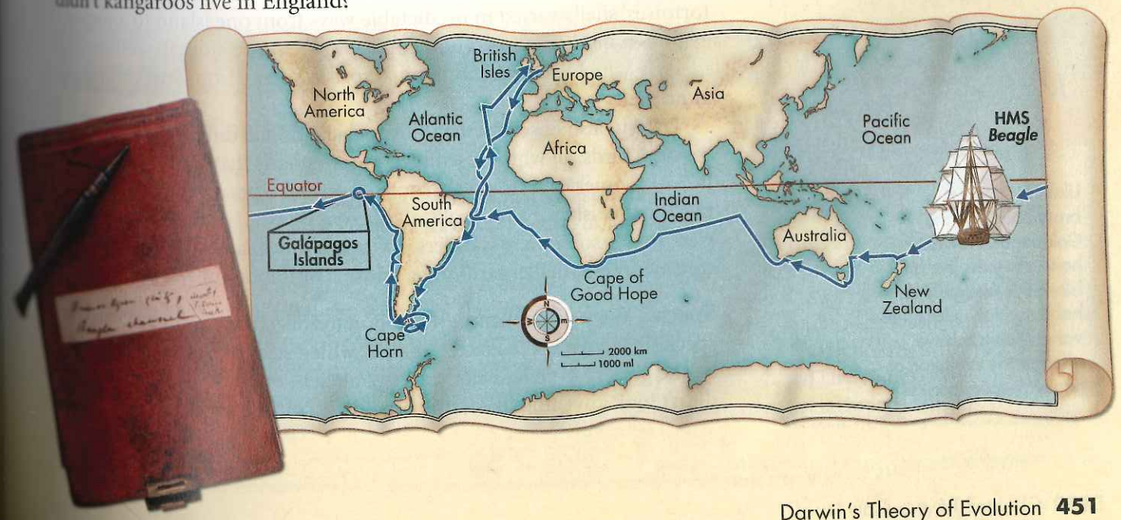
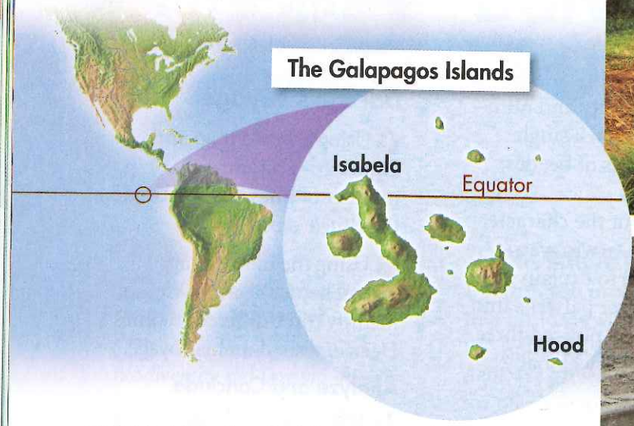


FIGURE 16–1 Darwin's Voyage On a five-year voyage aboard the *Beagle,* Charles Darwin visited several continents and many remote islands. **Draw Conclusions** ***Why is it significant that many of the stops the Beagle made were in tropical regions?***



Isabela Island Tortoise
Tortoises from Isabela Island have dome-shaped shells and short necks. Vegetation on this island is abundant and close to the ground.

Hood Island Tortoise
The shells of Hood Island tortoises are curved and open around their long necks and legs. This enables them to reach the island's sparse, high vegetation.

FIGURE 16–2 Tortoise Diversity Among tortoises in the Galápagos Islands, shell shape corresponds to different habitats. Isabela Island has high peaks, is rainy, and has abundant vegetation. Hood Island, in contrast, is flat, dry, and has sparse vegetation.

Species Vary Locally There were other puzzles, too. For example, Darwin found two species of rheas living in South America. One lived in Argentina's grasslands and the other in the colder, harsher grass and scrubland to the south. **Darwin noticed that different, yet related, animal species often occupied different habitats within a local area.**

Other examples of local variation came from the Galápagos Islands, about 1000 km off the Pacific coast of South America. These islands are close to one another, yet they have different ecological conditions. Several islands were home to distinct forms of giant land tortoises. Darwin saw differences among the tortoises but didn't think much about them. In fact, like other travelers, Darwin ate several tortoises and tossed their remains overboard without studying them closely! Then Darwin learned from the islands' governor that the tortoises' shells varied in predictable ways from one island to another, as shown in **Figure 16–2.** Someone who knew the animals well could identify which island an individual tortoise came from, just by looking at its shell.

Darwin also observed that different islands had different varieties of mockingbirds, all which resembled mockingbirds that Darwin had seen in South America. Darwin also noticed several types of small brown birds on the islands with beaks of different shapes. He thought that some were wrens, some were warblers, and some were blackbirds. He didn't consider these smaller birds to be unusual or important—at first.

Species Vary Over Time In addition to collecting specimens of living species, Darwin also collected **fossils,** which scientists already knew to be the preserved remains or traces of ancient organisms. Some fossils didn't look anything like living organisms, but others did.

MYSTERY CLUE

Like the small brown birds on the Galápagos, Hawaiian honeycreepers live on islands with slightly different habitats. How might these varied habitats have affected the evolution of honeycreeper species?

Darwin noticed that some fossils of extinct animals were similar to living species. One set of fossils unearthed by Darwin belonged to the long-extinct glyptodont, a giant armored animal. Currently living in the same area was a similar animal, the armadillo. You can see in **Figure 16–3** that the armadillo appears to be a smaller version of the glyptodont. Darwin said of the organisms: "This wonderful relationship in the same continent between the dead and the living, will, I do not doubt, hereafter throw more light on the appearance of organic beings on our earth, and their disappearance from it, than any other class of facts." So, why had glyptodonts disappeared? And why did they resemble armadillos?

Putting the Pieces of the Puzzle Together On the voyage home, Darwin thought about the patterns he'd seen. The plant and animal specimens he sent to experts for identification set the scientific community buzzing. The Galápagos mockingbirds turned out to belong to three separate species found nowhere else! And the little brown birds that Darwin thought were wrens, warblers, and blackbirds were actually all species of finches! They, too, were found nowhere else, though they resembled a South American finch species. The same was true of Galápagos tortoises, marine iguanas, and many plants that Darwin collected on the islands.

Darwin was stunned by these discoveries. He began to wonder whether different Galápagos species might have evolved from South American ancestors. He spent years actively researching and filling notebooks with ideas about species and evolution. The evidence suggested that species are not fixed and that they could change by some natural process.

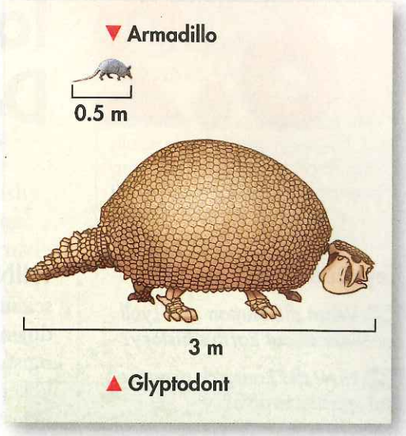


FIGURE 16–3 Related Organisms? Despite their obvious differences, Darwin wondered if the armadillo might be related to the ancient glyptodont. **Compare and Contrast** *What similarities and differences do you see between these two animals?*

16.1 Assessment

Review Key Concepts

1. a. **Review** What is evolution?
   b. **Apply Concepts** What ideas were changing in the scientific community at the time of Darwin's travels? How might those new ideas have influenced Darwin?
2. a. **Review** What three kinds of variations among organisms did Darwin observe during the voyage of the *Beagle?*
   b. **Infer** Darwin found fossils of many organisms that did not resemble any living species. How might this finding have affected his understanding of life's diversity?

Apply the Big idea

Interdependence in Nature

3. You have learned that both biotic and abiotic factors affect ecosystems. Give some examples of each, and explain how biotic and abiotic factors could have affected the tortoises that Darwin observed on the Galápagos Islands.

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