

Darwin's Theory of Evolution

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CHAPTER 1

Darwin's Theory of Evolution

Lesson Objectives

- State Darwin's theory of evolution by natural selection.
- Describe Darwin's voyage on the *Beagle*.
- Identify other influences on Darwin.
- Explain how Darwin arrived at his theory.

Lesson Vocabulary

- Darwin
- evolution
- Galápagos Islands
- natural selection
- theory of evolution by natural selection

Introduction

Charles Darwin is one of the best-known scientists of all time. **Figure 1.1** shows Darwin as a young man in the 1830s. Why is Darwin so famous? His theory of evolution was a major leap forward in human understanding. It explains and unifies all of life science.

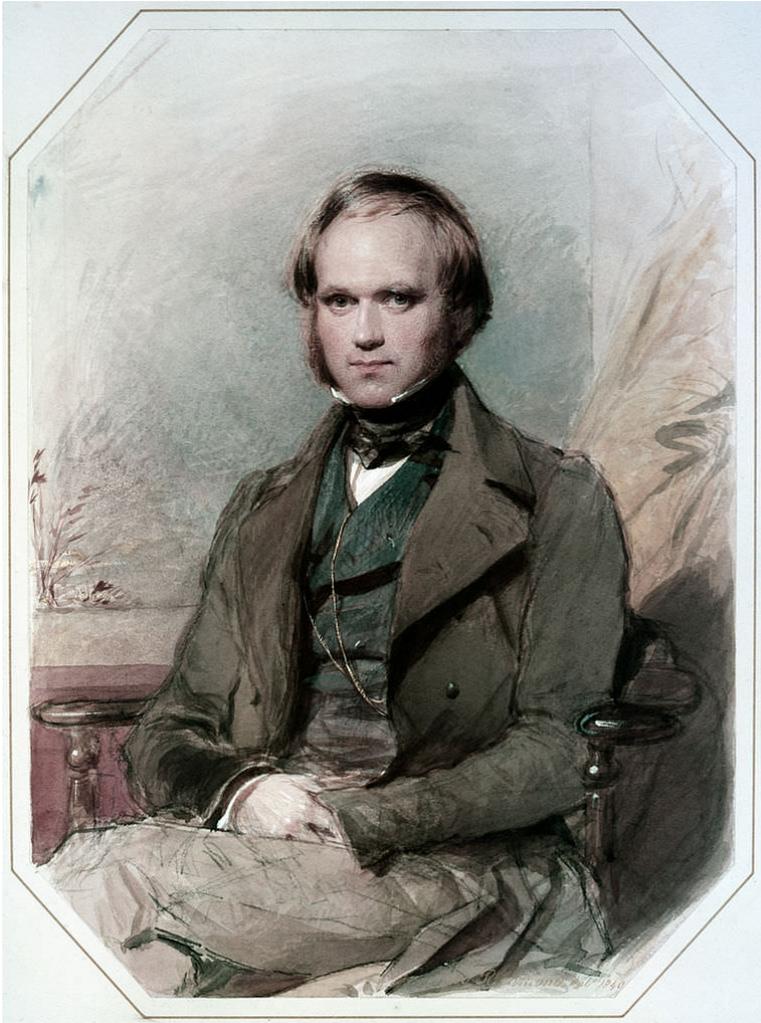
Darwin's Theory in a Nutshell

Darwin's **theory of evolution by natural selection** contains two major ideas:

- One idea is that evolution happens. **Evolution** is a change in the inherited traits of organisms over time. Living things have changed as descendants diverged from common ancestors in the past.
- The other idea is that evolution occurs by natural selection. **Natural selection** is the process in which living things with beneficial traits produce more offspring. As a result, their traits increase in the population over time.

Voyage of the

How did Darwin come up with the theory of evolution by natural selection? A major influence was an amazing scientific expedition he took on a ship called the *Beagle*. Darwin was only 22 years old when the ship set sail. The

**FIGURE 1.1**

Charles Darwin as a young man in the 1830s

trip lasted for almost five years and circled the globe. **Figure 1.2** shows the route the ship took. It set off from Plymouth, England in 1831. It wouldn't return to Plymouth until 1836. Imagine setting out for such an incredible adventure at age 22, and you'll understand why the trip had such a big influence on Darwin.

Darwin's job on the voyage was to observe and collect specimens whenever the ship went ashore. This included plants, animals, rocks, and fossils. Darwin loved nature, so the job was ideal for him. During the long voyage, he made many observations that helped him form his theory of evolution. Some of his most important observations were made on the Galápagos Islands.

The 16 **Galápagos Islands** lie 966 kilometers (about 600 miles) off the west coast of South America. (You can see their location on the map in Figure 7.2.) Some of the animals Darwin observed on the islands were giant tortoises and birds called finches. Watch this video for an excellent introduction to Darwin, his voyage, and the Galápagos:

<http://www.sciencechannel.com/video-topics/earth-science/galapagos-beyond-darwin-charles-darwin.htm>

Giant Tortoises

The Galápagos Islands are still famous for their giant tortoises. These gentle giants are found almost nowhere else in the world. Darwin was amazed by their huge size. He was also struck by the variety of shapes of their shells. You can see two examples in **Figure 1.3**. Each island had tortoises with a different shell shape. The local people even



FIGURE 1.2

Route of the Beagle

could tell which island a tortoise came from based on the shape of its shell.



Tortoise with saddle-shaped shell



Tortoise with dome-shaped shell

FIGURE 1.3

Giant tortoises on the Galápagos Islands varied in shell shape, depending on which island they inhabited.

Darwin wondered how each island came to have its own type of tortoise. He found out that tortoises with dome-shaped shells lived on islands where the plants they ate were abundant and easy to reach. Tortoises with saddle-shaped shells, in contrast, lived on islands that were drier. On those islands, food was often scarce. The saddle shape of their shells allowed tortoises on those islands to reach up and graze on vegetation high above them. This made sense, but how had it happened?

Darwin's Finches

Darwin also observed that each of the Galápagos Islands had its own species of finches. The finches on different islands had beaks that differed in size and shape. You can see four examples in **Figure 1.4**.

Darwin investigated further. He found that the different beaks seemed to suit the birds for the food available on their island. For example, finch number 1 in **Figure 1.4** used its large, strong beak to crack open and eat big, tough seeds. Finch number 4 had a long, pointed beak that was ideal for eating insects. This seemed reasonable, but how had it come about?

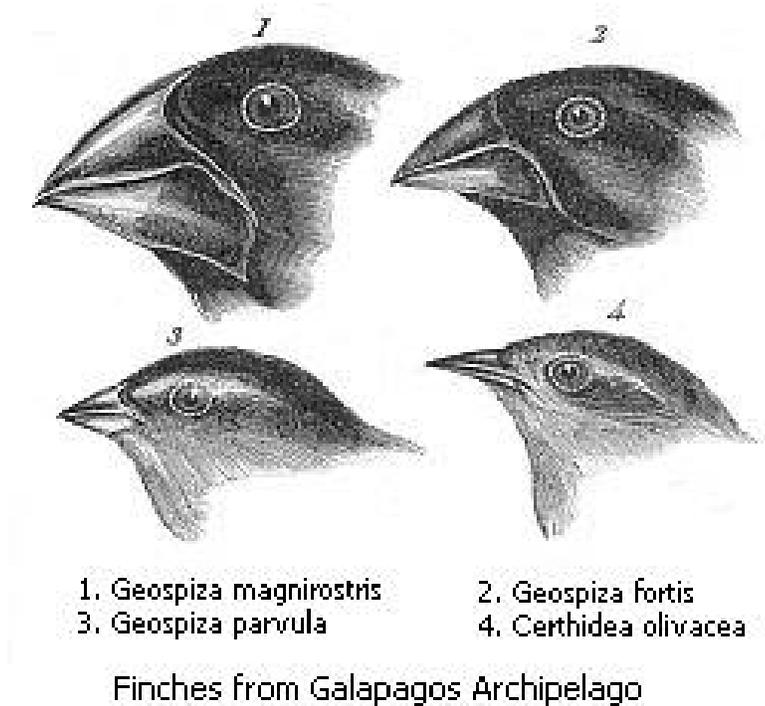


FIGURE 1.4

Variation in beak size and shape in Galápagos finches

More Influences on Darwin

Besides his observations on the *Beagle*, other influences helped Darwin develop his theory of evolution by natural selection. These included his knowledge of plant and animal breeding and the ideas of other scientists.

Plant and Animal Breeding

Darwin knew that people could breed plants and animals to have useful traits. By selecting which individuals were allowed to reproduce, they could change an organism's traits over several generations. Darwin called this type of change in organisms artificial selection. You can see an example in **Figure 1.5**. Keeping and breeding pigeons was a popular hobby in Darwin's day. Both types of pigeons in the bottom row were bred from the common rock pigeon at the top of the figure.

Other Scientists

There were three other scientists in particular that influenced Darwin. Their names are Lamarck, Lyell, and Malthus. All three were somewhat older than Darwin, and he was familiar with their writings.

- Jean Baptiste Lamarck was a French naturalist. He was one of the first scientists to propose that species change over time. In other words, he proposed that evolution occurs. Lamarck also tried to explain how it happens, but he got that part wrong. Lamarck thought that the traits an organism developed during its life time could be passed on to its offspring. He called this the inheritance of acquired characteristics.
- Charles Lyell was an English geologist. He wrote a famous book called *Principles of Geology*. Darwin took the book with him on the *Beagle*. Lyell argued that geological processes such as erosion change Earth's surface



Common Rock Pigeon



Carrier Pigeon



Fantail Pigeon

FIGURE 1.5

Variation in pigeons as a result of artificial selection

very gradually. To account for all the changes that had occurred on the planet, Earth must be a lot older than most people believed.

- Thomas Malthus was an English economist. He wrote a popular essay called “On Population.” He argued that human populations have the potential to grow faster than the resources they need. When populations get too big, disease and famine occur. These calamities control population size by killing off the weakest people.

Putting It All Together

Darwin spent many years thinking about his own observations and the writings of Lamarck, Lyell, and Malthus. What did it all mean? How did it all fit together? The answer, of course, is the theory of evolution by natural selection.

Evolution of Darwin's Theory

Here's how Darwin thought through his theory:

- Like Lamarck, Darwin assumed that species evolve, or change their traits over time. Fossils Darwin found on his voyage helped convince him that evolution occurs.
- From Lyell, Darwin realized that Earth is very old. This meant that living things had a long time in which to evolve. There was enough time to produce the great diversity of living things that Darwin had observed.
- From Malthus, Darwin saw that populations could grow faster than their resources. This “overproduction of offspring” led to a “struggle for existence,” in Darwin's words. In this struggle, only the “fittest” survive.

- From Darwin's knowledge of artificial selection, he knew how traits can change over time. Breeders artificially select the traits that they find beneficial. These traits become more common over many generations.
- In nature, Darwin reasoned, individuals with certain traits might be more likely to survive the "struggle for existence" and have offspring. Their traits would become more common over time. In this case, nature selects the traits that are beneficial. That's why Darwin called this process natural selection. Darwin used the word fitness to refer to the ability to reproduce and pass traits to the next generation

Darwin's Book

Darwin finally published his theory of evolution by natural selection in 1859. He presented it in his book *On the Origin of Species*. The book is very detailed and includes a lot of evidence for the theory. Darwin's book changed science forever. The theory of evolution by natural selection became the unifying theory of all life science.

Lesson Summary

- Darwin proposed the theory of evolution by natural selection. Evolution is a change in the inherited traits of organisms over time. Natural selection is the process by which living things with beneficial traits produce more offspring, so their traits become more common over time.
- During Darwin's voyage on the *Beagle*, he made many observations that helped him form his theory of evolution. Some of his most important observations were made on the Galápagos Islands. They included observations of giant tortoises and finches.
- Darwin was also influenced by his knowledge of artificial selection and the ideas of Lamarck, Lyell, and Malthus.
- Darwin spent many years working on a book about his theory of evolution by natural selection. He finally published *On the Origin of Species* in 1859.

Lesson Review Questions

Recall

1. State Darwin's theory of evolution by natural selection.
2. Identify three scientists who influenced Darwin and their contributions to his theory.

Apply Concepts

3. Apply the concept of artificial selection to explain how new dog breeds come about.

Think Critically

4. Explain how Darwin's observations on the Galápagos Islands helped him form his theory of evolution by natural selection.

Points to Consider

On his voyage, Darwin saw fossils of ancient organisms. They showed him that living things had changed over time.

- What are fossils?
- How do fossils form?

References

1. George Richmond. Portrait of Charles Darwin. Public Domain
2. Christopher Auyeung. Route of the Beagle. CC BY-NC 3.0
3. Saddle-shell: Catriona MacCallum; Dome-shell: Nicolas de Camaret. Saddle-shell: http://commons.wikimedia.org/wiki/File:Saddle-shell_nigra.png; Dome-shell: http://www.flickr.com/photos/ndecam/6215265502/">Giant tortoises on the Galápagos Islands. Saddle-shell: CC BY 2.5; Dome-shell: CC BY 2.0
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