

EVOLUTIONARY THEORY

Developing a Theory

Section 16-1

A Theory To Explain Change Over Time

Key Idea: Modern **evolutionary** theory began when **Darwin** presented evidence that **evolution** happens and offered an **explanation** of how **evolution happens**.

Evolution is the process by which species may change over time.

A Theory to Explain Change Over Time

- In science, a *theory* is a broad explanation that has been scientifically tested and supported.
- Like most scientific theories, evolutionary theory keeps developing and expanding.

Darwin's Ideas From Experience

Key Idea: Darwin's experiences provided him with evidence of **evolution at work**.

Artificial selection is when breeders simply select individuals that have desirable traits to be the parents of each new generation.

The word **insight** means a clear understanding of something

The Voyage of the *Beagle*

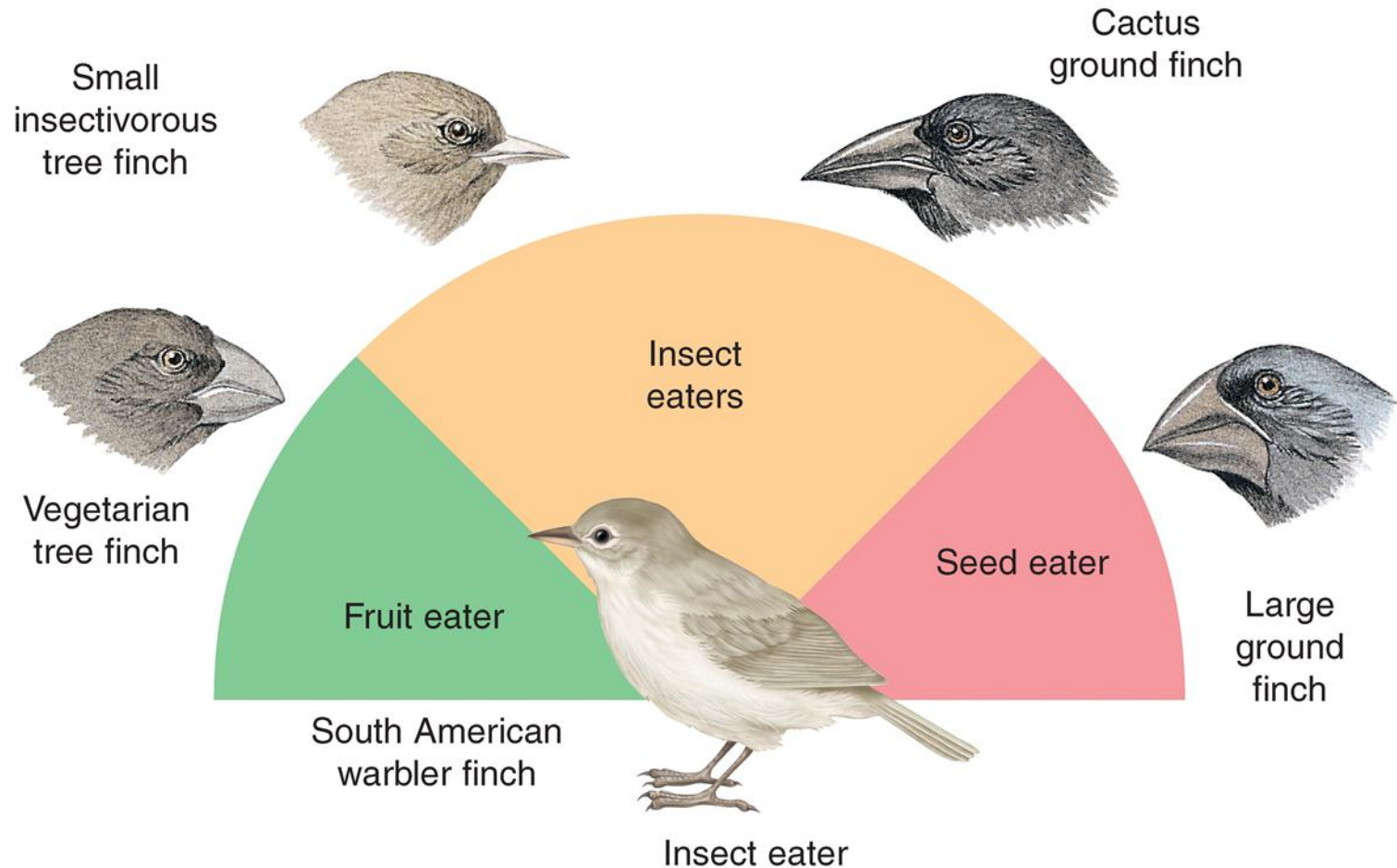
- Darwin's first evidence was gathered during a global voyage on a ship called the *Beagle*.
- As part of his work as a naturalist, Darwin collected natural objects from each place that he visited.
- Darwin collected fossils and noticed that they were similar to, but not the same as, living organisms.

Darwin's Route



- Darwin also visited the Galápagos Islands in the Pacific Ocean.
- There, he collected several different species of birds called *finches*.
- Each of the finches are very similar, but differences can be seen in the size and shape of the bill (or beak).
- Each finch has a bill that seems suited to the finch's usual food.

Darwin's Finches



- Darwin suggested that all of the finch species descended from one ancestral finch species that migrated from South America.
- The descendant finches were modified over time as different groups survived by eating different types of food.
- Darwin called such change *descent with modification*. This idea was a key part of his theory.

Years of Reflection

- After returning from his voyage at the age of 27, Darwin spent years studying his data.
- Darwin did not report his ideas about evolution until much later. Instead, he took time to gather more data and to form a strong explanation for how evolution happens.

Breeding and Selection

- Darwin took interest in the practice of breeding, especially the breeding of exotic pigeons.
- He bred pigeons himself and studied the work of those who bred other kinds of animals and plants, such as dogs, orchids, and food crops.
- Eventually, Darwin gained a new insight: breeders take advantage of natural variation in traits within a species.

- If a trait can be inherited, breeders can produce more individuals that have the trait.
- The selection is done by humans and not by natural causes.



Darwin's Ideas From Others

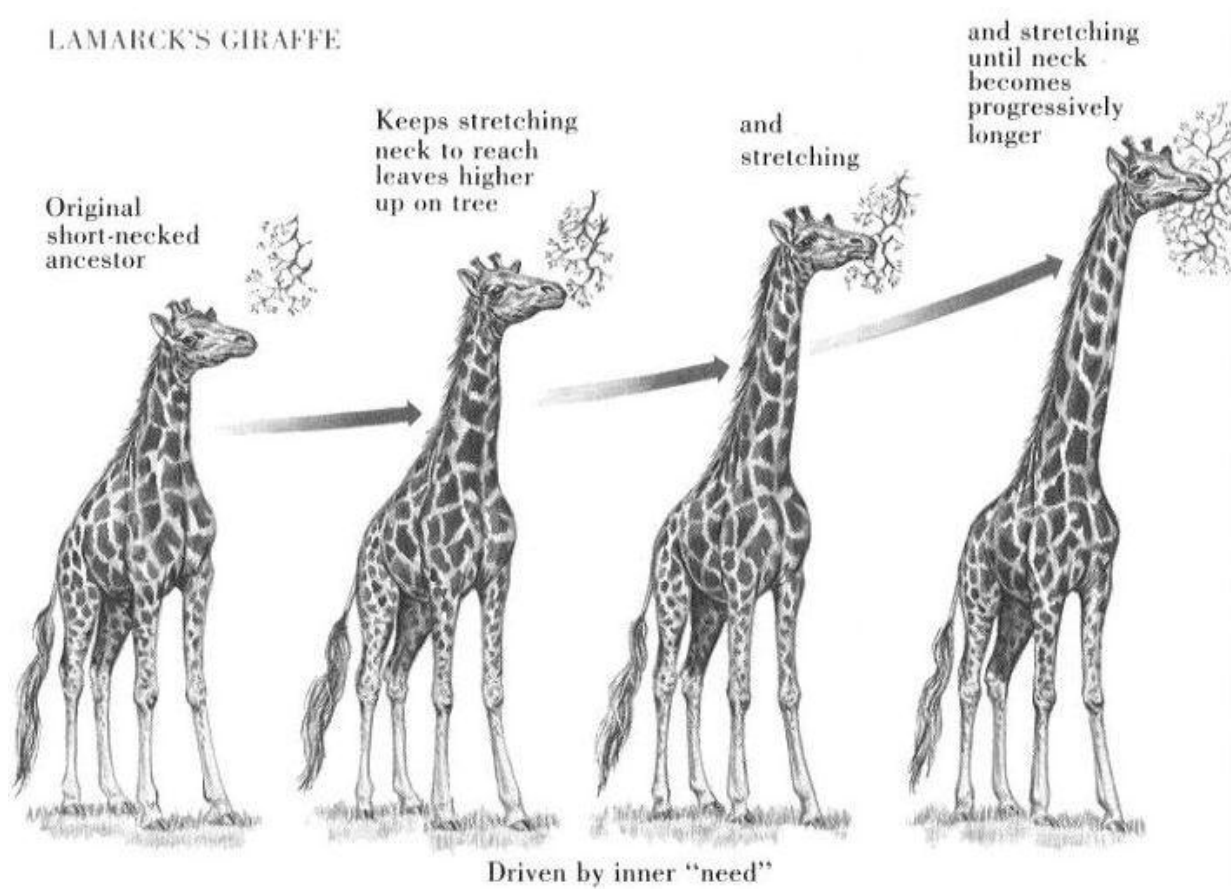
Key Idea: Darwin was influenced by ideas from the fields of **natural history**, **economics**, and **geology**.

- In Darwin's time, most people—including scientists—believed that each species was created once and stayed the same forever.
- But this view could not explain fossils of organisms that no longer exist, such as dinosaurs.

Lamarckian Inheritance

- In 1809, the French scientist Jean Baptiste Lamarck proposed an explanation for how organisms may change over generations.
- He proposed that organisms change over time as they adapt to changing environments.
- However, Lamarck had an incorrect idea about inheritance. He proposed that changes due to use or disuse of a character would be passed on to offspring.

- He believed that offspring inherited these kinds of changes.



Population Growth

- Another key influence on Darwin's thinking about evolution was an essay by Thomas Malthus.
- In 1798, this English economist observed that human populations were increasing faster than the food supply.
- Malthus pointed out that food supplies were increasing *linearly*. More food was being produced each year, but the amount by which the food increased was the same each year.

- In contrast, the number of people was increasing *exponentially*. More people were added each year than were added the year before.
- Darwin simply applied Malthus's idea to all populations.
- Darwin saw that all kinds of organisms tend to produce more offspring than can survive. So, all populations must be limited by their environments.

Geology and an Ancient Earth

- In Darwin's time, scientists had become interested in the study of rocks and landforms, and thus began the science of *geology*.
- In particular, scientists such as Georges Cuvier, James Hutton, and Charles Lyell studied fossils and rock layers.
- Cuvier argued that fossils in rock layers showed differences in species over time and that many species from the past differed from those of the present.

- Hutton and Lyell, on the other hand, thought that geologic processes—such as those that wear away mountains and form new rocks and fossils—work gradually and constantly.
- Lyell's ideas fit well with Darwin's observations and showed that Earth's history was long enough for species to have evolved gradually.