

## Discovering How Populations Change

1 The theory of evolution by natural selection describes a mechanism for species change over time. That species change had been suggested and debated well before Darwin. The view that species were static and unchanging was grounded in the writings of Plato, yet there were also ancient Greeks that expressed evolutionary ideas.

2 In the eighteenth century, ideas about the evolution of animals were reintroduced by the naturalist Georges-Louis Leclerc, Comte de Buffon and even by Charles Darwin's grandfather, Erasmus Darwin. During this time, it was also accepted that there were extinct species. At the same time, James Hutton, the Scottish naturalist, proposed that geological change occurred gradually by the accumulation of small changes from processes (over long periods of time) just like those happening today. This contrasted with the predominant view that the geology of the planet was a consequence of catastrophic events occurring during a relatively brief past. Hutton's view was later popularized by the geologist Charles Lyell in the nineteenth century. Lyell became a friend to Darwin and his ideas were very influential on Darwin's thinking. Lyell argued that the greater age of Earth gave more time for gradual change in geology, and the process provided an analogy for gradual change in species.

3 In the early nineteenth century, Jean-Baptiste Lamarck published a book that detailed a mechanism for evolutionary change that is now referred to as inheritance of acquired characteristics. In Lamarck's theory, modifications in an individual caused by its environment, or the use or disuse of a structure during its lifetime, could be inherited by its offspring and, thus, bring about change in a species. While this mechanism for evolutionary change as described by Lamarck was **discredited**, Lamarck's ideas were an important influence on evolutionary thought. The inscription on the statue of Lamarck that stands at the gates of the Jardin des Plantes in Paris describes him as the "founder of the doctrine of evolution."

4 The actual mechanism for evolution was independently conceived of and described by two naturalists, Charles Darwin and Alfred Russell Wallace, in the mid-nineteenth century. Importantly, each spent time exploring the natural world on expeditions to the tropics. From 1831 to 1836, Darwin traveled around the world on *H.M.S. Beagle*, visiting South America, Australia, and the southern tip of Africa. Wallace traveled to Brazil to collect insects in the Amazon rainforest from 1848 to 1852 and to the Malay Archipelago from 1854 to 1862. Darwin's journey, like Wallace's later journeys in the Malay Archipelago, included stops at several island chains, the last being the Galápagos Islands (west of Ecuador). On these islands, Darwin observed species of organisms on different islands that were clearly similar, yet had distinct differences. For example, the ground finches inhabiting the Galápagos Islands comprised several species that each had a unique beak shape. He observed both that these finches closely resembled another finch species on the mainland of South America and that the group of species in the Galápagos formed a graded series of beak sizes and shapes, with very small differences between the most similar. Darwin imagined that the island species might be all species modified from one original mainland species. In 1860, he wrote, "Seeing this gradation and diversity of structure in one small, **intimately** related group of birds, one might really fancy that from an original paucity of birds in this archipelago, one species had been taken and modified for different ends."

5 Wallace and Darwin both observed similar patterns in other organisms and independently conceived a mechanism to explain how and why such changes could take place. Darwin called this mechanism natural selection. Natural selection, Darwin argued, was an inevitable outcome of three principles that operated in nature. First, the characteristics of organisms are inherited, or passed from parent to offspring. Second, more offspring are produced than are able to survive; in other words, resources for survival and reproduction are limited. The capacity for reproduction in all organisms **outstrips** the availability of resources to support their numbers. Thus, there is a competition for those resources in each generation. Both Darwin and Wallace's understanding of this principle came from reading an essay by the economist Thomas Malthus, who discussed this principle in relation to human populations. Third, offspring vary among each other in regard to their characteristics and those variations are inherited. Out of these three principles, Darwin and Wallace reasoned that offspring with inherited characteristics that allow them to best compete for limited resources will survive and have more offspring than those individuals with variations that are less able to compete. Because characteristics are inherited, these traits will be better represented in the next generation. This will lead to change in populations over generations in a process that Darwin called "descent with modification."

6 Demonstrations of evolution by natural selection can be time consuming. One of the best demonstrations has been in the very birds that helped to inspire the theory, the Galápagos finches. Peter and Rosemary Grant and their colleagues have studied Galápagos finch populations every year since 1976 and have provided important demonstrations of the operation of natural selection. The Grants found changes from one generation to the next in the beak shapes of the medium ground finches on the Galápagos island of Daphne Major. The medium ground finch feeds on seeds. The birds have inherited variation in the bill shape with some individuals having wide, deep bills and others having thinner bills. [ 1 ] Large-billed birds feed more efficiently on large, hard seeds, whereas smaller billed birds feed more efficiently on small, soft seeds. [ 2 ] During 1977, a drought period altered vegetation on the island. After this period, the number of seeds declined dramatically: the decline in small, soft seeds was greater than the decline in large, hard seeds. [ 3 ] The year following the drought when the Grants measured beak sizes in the much-reduced population, they found that the average bill size was larger. [ 4 ] This was clear evidence for natural selection (differences in survival) of bill size caused by the availability of seeds. The Grants had studied the inheritance of bill sizes and knew that the surviving large-billed birds would tend to produce offspring with larger bills, so the selection would lead to evolution of bill size. **Subsequent** studies by the Grants have demonstrated selection on and evolution of bill size in this species in response to changing conditions on the island. The evolution has occurred both to larger bills, as in this case, and to smaller bills when large seeds became rare.

**SOURCE:**

OpenStax College, Concepts of Biology. OpenStax CNX. 25 Şub 2014 <http://cnx.org/contents/b3c1e1d2-839c-42b0-a314-e119a8aafbdd@8.24>.

Download for free at <http://cnx.org/contents/b3c1e1d2-839c-42b0-a314-e119a8aafbdd@8.24>.

1. According to paragraph 2, which of the following is true about James Hutton?

- a) He proposed that evolution of animals was a gradual change over time
- b) His ideas about geological change contradicted the prevailing perspective of the time
- c) He was a friend of Charles Lyell, who helped make Hutton's ideas more popular
- d) He ignored the relatively little changes that accumulated throughout history

2. The word “**discredited**” in paragraph 3 is closest in meaning to

- a) disfavored
- b) disclosed
- c) corroborated
- d) replicated

3. According to paragraph 3, Lamarck believed that modifications on an individual

- a) would be offset in their offspring
- b) would hardly translate to changes within a species
- c) could impair the species' ability to reproduce
- d) could be passed from generation to generation

4. According to paragraph 4, a similarity between the expeditions by Charles Darwin and by Alfred Russel Wallace is that

- a) both observed the same species over vast areas
- b) both visited archipelagos
- c) both spent time in the Malay Archipelago
- d) both followed the same route

5. Which of the following statements about the ground finches in the Galápagos Islands is supported by paragraph 4?

- a) They were similar to another species from outside the islands
- b) Their beak sizes and shapes were indiscriminately similar
- c) Darwin believed that they had evolved from a diversity of species
- d) They were rather distinct from the finch species on the mainland of South America

6. The word “**intimately**” in paragraph 4 is closest in meaning to

- a) instantly
- b) actually
- c) closely
- d) functionally

7. Which of the following is **not** mentioned in paragraph 5 as a factor that underlies natural selection?

- a) the inheritance of characteristics
- b) lack of abundant resources
- c) the limited capacity for reproduction
- d) variations among the youth of an individual

8. The word “**outstrips**” in paragraph 5 is closest in meaning to

- a) confines
- b) boosts
- c) surpasses
- d) limits

9. Which of the sentences below best expresses the essential information in the highlighted sentence in paragraph 5? Incorrect choices change the meaning in important ways or leave out essential information.

- a) Darwin and Wallace agreed that, in order to survive, the offspring that are able to compete for limited resources will feed on those which lack the ability to compete
- b) According to Darwin and Wallace, the survival and reproduction capacity of the offspring depends on their inherited ability to compete for limited resources
- c) The principles on which Darwin and Wallace based their theory were incompatible with the fact that the offspring with the ability to compete for limited resources usually have better chances of survival
- d) The characteristics that allow offspring to compete for limited resources also allow them to survive and have more offspring provided that the offspring inhabit a favorable environment

10. In paragraph 6, why does the author mention the drought period during 1977?

- a) to argue that droughts are influential in evolution
- b) to exemplify natural disasters that decrease some species' chances of survival
- c) to emphasize that evolution is tied to catastrophic events
- d) to illustrate an event in which natural selection was operative

11. The word “**subsequent**” in paragraph 6 is closest in meaning to

- a) successful
- b) later
- c) detailed
- d) specific

12. The organization of the passage can best be described as

- a) an introductory statement followed by a discussion of particular aspects of the phenomenon
- b) the presentation of an argument followed by evidence for and against it
- c) an explanation of a fact followed by a detailed discussion of its implications
- d) an introduction to origins of a theory followed by a historical account of related research

13. Look at the four number ( [ 1 ] , [ 2 ] , [ 3 ] , [ 4 ] ) that indicate where the following sentence can be added to the passage.

**Thus, the large-billed birds were able to survive better than the small-billed birds.**

Where would the sentence best fit?

- a) [ 1 ]
- b) [ 2 ]
- c) [ 3 ]
- d) [ 4 ]

14. An introductory sentence for a brief summary of the passage is provided below. Complete the summary by selecting the THREE answer choices that express the most important ideas in the passage. Some sentences do not belong in the summary because they express ideas that are not presented in the passage or are minor ideas in the passage. This question is worth 2 points.

**Ideas related to evolution can be traced back to a period long before Darwin, to ancient Greece.**

- 
- 
- 

A- In the 18<sup>th</sup> and 19<sup>th</sup> centuries, various scientists came up with ideas about gradual evolution and the inheritance of characteristics

B- James Hutton's view of geological change was popularized by the geologist Charles Lyell in the 19<sup>th</sup> century

C- Charles Darwin and Alfred Russell Wallace made independent expeditions and put forward the actual mechanism of evolution

D- Darwin's observations at the Galápagos Islands preceded the expeditions of Alfred Russell Wallace

E- The Grants observed that the bill sizes of the finch populations decreased after the drought in 1977

F- Peter and Rosemary Grant observed actual instances of natural selection in their prolonged research

ANSWER KEY:

1- B

2- A

3- D

4- B

5- A

6- C

7- C

8- C

9- B

10- D

11- B

12- D

13- C

14- A/C/F