

about the evolution of a characteristic, it is best to think about the change of the characteristic in the population over time. For example, natural selection does not cause individual bill-size of adult finches to change within their lifetime. If one measures the average bill size among all individuals in the population at one time, and then measures the average bill size in the population several years later after there has been a strong selection pressure, this average value may be different as a result of evolution. Note the changes are observed in the population, not just one individual.

### **Misconception 3 - Evolution Explains the Origin of Life**

It is a common misunderstanding that evolution explains the origin of life. The theory of evolution explains how populations change over time and how life diversifies, not how life came to exist. It does not explain how life began or how the first cells originated. How life first originated on Earth is very difficult to address because it occurred a very long time ago, and the event most likely only occurred once. The early stages of life most likely included the formation of organic molecules such as carbohydrates, amino acids, or nucleotides. The early stages of life also would have included complex accumulations of molecules into enclosed structures. A boundary, like the cell membrane, would have formed at some point allowing for an internal environment to be separated from the external conditions.

Once DNA or RNA, a mechanism of inheritance, formed within a cell or within a pre-cell, these cells would have been subject to natural selection. More effective reproducers would increase in frequency. While evolution does not explain the origin of life, it may have contributed to why some metabolic processes exist in living cells.

### **Misconception 4 - Organisms Evolve on Purpose**

Statements such as “populations will evolve in response to a change in an environment,” are quite common. This statement is misleading for two different reasons. First, some interpret the statement to mean that evolution is somehow intentional. When environmental changes occur, some individuals in the population may be more successful than others based on their phenotype. Evolution does not intentionally favor one phenotype or another; rather individuals with phenotypes that provide the most beneficial properties will survive better and produce proportionately more offspring. Assuming the phenotype is a result of heritable genes, overtime the frequency of those genes will change in the population.

The second misunderstanding is the idea that evolution will automatically occur, if needed. It is important to understand that natural selection works on variation that already exists in a population. Variation does not arise in response to an environmental change. For example, exposing a population of bacteria to antibiotics will, over time, select for bacteria that are antibiotic resistant. The resistance, which is caused by a gene, did not arise by mutation because of the application of the antibiotic. The gene for resistance was already present in the gene pool of the bacteria, likely at a low frequency. The antibiotic, which kills the bacterial cells without

the resistance gene, strongly selects for individuals that have the gene and are therefore resistant. Experiments have demonstrated that mutations for antibiotic resistance do not arise as a result of antibiotic application.

In a larger sense, evolution is also not goal directed. Species do not become “better” over time. Organisms best suited for an environment have adaptations that maximize their reproduction in that particular environment at that particular time. Evolution has no goal of making faster, bigger, more complex, or even smarter species. What characteristics are selected for is a function of the genetic variation present in the population and the environment that they live in. Both genetics and the environment are constantly changing in a non-directional way. What trait is beneficial in one environment at one time may later be fatal.

### **Misconception 5 - Evolution Is Thought to Be Controversial among Scientists**

The theory of evolution was controversial when it was first proposed in 1859, yet within 20 years virtually every biologist had accepted evolution as the explanation for the diversity of life. The rate of acceptance was extraordinarily fast, partly because Darwin had amassed an impressive body of evidence. The early controversies involved both scientific arguments against the theory and arguments from the general public. The number of scientists who reject the theory of evolution, or question its validity, is small. A Pew Research poll in 2009 found that 97 percent of the 2500 scientists polled believe species evolve.<sup>5</sup> The support for the theory is reflected by the fact that there are no experimental results that have been found to contradict the theory of evolution. There are also no peer-reviewed articles published in scientific journals that refute the theory of evolution. Evolution has been supported with both evidence and data and as a result it is accepted by the scientific community. The arguments of scientists were resolved relatively quickly. Through education and communication, the arguments from the general public are decreasing.

**CONCEPTS IN ACTION** – This [website](#) addresses some of the main misconceptions associated with the theory of evolution.

### **Footnotes**

- <sup>5</sup> Pew Research Center for the People & the Press, *Public Praises Science; Scientists Fault Public, Media* (Washington, DC, 2009), 37.

## Section Summary

The theory of evolution by natural selection describes the mechanism for genetic changes in a population over time. There are critics of the theory of evolution and several misconceptions about evolution exist. The factual nature of evolution is often challenged by wrongly associating the scientific meaning of a theory with the vernacular meaning. Evolution is sometimes mistakenly interpreted to mean that individuals evolve, when in fact only populations can evolve as their gene frequencies change over time. Evolution is often assumed to explain the origin of life, which it does not speak to. It is often spoken in goal-directed terms by which organisms change intentionally. Evolution is often characterized as being controversial among scientists; however, it is accepted by the vast majority of scientists.

## Exercises

1. Which of the following is true?
  - a. Evolution is intentional.
  - b. Evolution is not well supported by the scientific community.
  - c. There are no experimental results that have been found to contradict the theory of evolution.
  - d. Evolution is just a theory therefore not well supported.
2. Evolution explains the origin of life.
  - a. True
  - b. False

## Answers

1. (c)
2. (b)

## Glossary

**hypothesis:** a testable explanation to a scientific question

**theory:** a thoroughly tested and confirmed explanation for observations or phenomena