

## Molecular Biology

Like anatomical structures, an organism's genetic material also reflects descent with modification. Evidence of a common ancestor for all of life is reflected in the universality of DNA as the genetic material, the near universal genetic code, similar enzymes used in all DNA replication, and the expression of genes. Fundamental divisions in life between the three domains are reflected in major structural differences. However, some structures such as ribosomes and the structures of membranes have been conserved in all cells. In general, the relatedness of groups of organisms is reflected in the similarity of their DNA sequences.

DNA sequences shed light on some of the mechanisms of evolution. For example, it is clear that the evolution of new functions for proteins commonly occurs after gene duplication events. These duplications are a kind of mutation in which an entire gene is added as an extra copy in the genome. These duplications allow one copy to be modified by mutation, selection, and drift, while the second copy continues to produce a functional protein. Due to evolutionary forces, the duplicated copy may at some point result in a new or unique function.

### Check your knowledge

In anatomy and physiology, you will learn that humans have 7 neck bones called cervical vertebrae. Based on the concept of homologous structures, how many do you think mice and giraffes have?

Explain why many mammals and birds in Northern Illinois are brown?

*Answers: Both mice and giraffes also have 7 vertebrae. Obviously MUCH different in size and even function but humans, giraffes, and mice are all mammals with homologous structures. Many organisms in Illinois are brown because the environment put similar pressures on them. Much of the environment is brown so animals camouflage in the brown landscape.*

## Section Summary

The evidence for evolution is supported by fossils. Fossils provide evidence for the evolutionary change through now extinct forms that led to modern species. The anatomy of species and the embryological development of that anatomy reveal common structures in divergent lineages that have been modified over time by evolution. The geographical distribution of living species reflects the origins of species in particular geographic locations and the history of continental movements. The structures of molecules, like anatomical structures, reflect the relationships of living species and match patterns of similarity expected from descent with modification.

## Exercises

1. The wing of a bird and the arm of a human are examples of \_\_\_\_\_.?
  - a. Vestigial structure
  - b. Molecular structure
  - c. Homologous structure
  - d. Analogous structure
2. The fact that DNA sequences are more similar in more closely related organisms is evidence of what?
  - a. Fossils
  - b. Optimal design of organisms
  - c. Decent from a common ancestor with modification
  - d. Mutation
3. Explain how homologous structures support the theory of evolution.

## Answers

1. (c)
2. (c)
3. That similarity of homologous structures results from a shared common ancestor. Over time, evolution led to changes in the shapes and sizes of structures in different species. However, they have maintained the same overall layout, evidence of descent from a common ancestor.

## Glossary

**embryology:** the study an organism's development from a zygote to its adult form

**fossils:** mineralized or preserved remains of organisms found in the past

**homologous structure:** a structure that is similar because of descent from a common ancestor

**vestigial structure:** a physical structure present in an organism but that has no apparent function and appears to be from a functional structure in a distant ancestor

## 11.4 Misconceptions about Evolution

### Learning objectives

By the end of this section, you will be able to:

- *Identify common misconceptions about evolution*
- *Identify common criticisms of evolution*
- *Be prepared to define and explain all bolded terms*

The theory of evolution initially generated some controversy. However, within 20 years of the publication of *On the Origin of Species* by Charles Darwin, the theory of evolution was almost universally accepted by biologists. Although the theory of evolution has been repeatedly supported by vast amounts of data, misconceptions still exist. In addition, there are those that reject it as an explanation for the diversity of life.

### **Misconception 1 - Evolution Is Just a Theory**

Critics of the theory of evolution dismiss its importance by purposefully trying to confuse people. Critics have stated that evolution is “just a theory.” The everyday common usage of the word “theory” by individuals not in science means a guess or suggested explanation for something. This meaning is more akin to the concept of a “hypothesis” used by scientists. Recall a **hypothesis** is a tentative testable explanation to a scientific question. When critics of evolution say evolution is “just a theory,” they are implying that there is little evidence supporting it and that it is still in the process of being rigorously tested. This is a mischaracterization.

In science, a “**theory**” is understood to be a concept that has been extensively tested and supported with a lot of data over time. Several theories exist including the evolution theory, cell theory, the theory of gravity, and the theory of relativity. Each of these theories have been rigorously tested and describe what scientists understand at this time to be true about each of these concepts. A theory in science has survived significant efforts to discredit it. It is a culmination of the work done by many different scientists and the conclusions drawn have been verified and repeated numerous times. While theories can sometimes be overturned or revised, this does not lessen their weight but simply reflects the constantly evolving state of scientific knowledge.

### **Misconception 2 - Individuals Evolve**

An individual is born with a specific set of genes; these genes do not change as the individual ages. Therefore, an individual cannot evolve. Evolution is the change in genetic makeup of a *population* over time, specifically over generations. Evolution results from differential reproduction of individuals with certain alleles. Individuals do change over their lifetime, but this is called development. Development involves changes programmed by the set of genes the individual acquired at birth in coordination with the individual’s environment. When thinking