Charles Darwin made a number of observations while sailing around the world on the HMS Beagle in the 1830's, which led to his *theory of evolution by natural selection* (published in 1859), and which can be summarized as follows:

1. The **reproductive potential** of animal species is staggering;
2. However, **populations** typically remain **relatively stable**;
3. Therefore, there is a **struggle for existence**, and most of the young animals die without reproducing;
4. **Variation** exists in the traits of the members of most species;
5. Some of the variation among individuals is **heritable**;
6. Because of their **inherited attributes**, some individuals are likely to cope better with predators, parasites, climatic pressures, and competition for food and/or mates;
7. As a result, these individuals will tend to **survive longer** and **leave more offspring**--with their **adaptive characteristics**--than will others of their species that have different and less successful inherited traits. This is called **differential reproduction**.

**NATURAL SELECTION** is the difference in the number of surviving, reproducing offspring produced by individuals that is caused by variation in their anatomy, physiology, behavior, and cognition, etcetera.

**EVOLUTIONARY CHANGE** within a reproducing group will occur as the **heritable characteristics** of those that survive and reproduce best--the most **successful** individuals--spread throughout the **population** over succeeding generations. In contrast, the traits associated with reproductive failure, in the less successful individuals, will be eliminated.

Hence, organisms will **evolve traits** that promote **individual reproductive success** (including survivability), as measured by the number of offspring that live to reproduce themselves.

The **intensity of natural selection**, and hence **evolution**, is greater under **changing environmental conditions** than under constant conditions.

Importantly, the **speciation** that occurs through evolution has the appearance, when diagramed, of a **tree or bush**, rather than that of a ladder--i.e., there is **adaptive radiation/divergence** rather than simply the replacement of one species by another.

**Evolution by natural selection** is recognized as **one of the most important ideas** of Western culture. This is because of its simplicity, its predictive value, and its vast scope of application to biological matters. It is a **logical inevitability**, and it serves as a **major organizing principle** for all of biology, and should be for psychology as well.
Modern Evolutionary Theory

Darwin's theory was developed before the discovery of the role of genes in heredity:

1. **Genes** are present in the **nuclear chromosomes** (and elsewhere, e.g., mitochondria) of all living things, and are made up of sequences of 4 varieties of **DNA (or RNA) nucleotides**, which when transcribed in triplets (known as codons) contain the coded information for **protein synthesis** from sequences of 20 different **amino acids**;

2. Many genes occur in two or more alternative forms known as **alleles**, which results in the production of slightly different forms of a given protein (which is either structural or functional, most being enzymes—catalysts of biochemical reactions);

3. **Gene alleles are heritable**, i.e., transmitted reproductively from parent to offspring;

4. If one allele produces effects, through its variant protein, that routinely causes its bearers to **reproduce** its alleles more often than other individuals with different alleles, then the "successful" allele will become more common in the population;

5. **Selective pressure** will favor alleles that are unusually good at promoting the **survival and propagation** of these same alleles.

It can be concluded that, biologically, **individuals** are first and foremost "machines" for promoting the **survival and propagation** of their **gene alleles**. A human and an ant are each primarily a gene's way of making more copies of itself!

We now know that **evolution** occurs by **natural selection** acting on **chance mutations** of genes (e.g., due to replication error and radiation) and **recombinations** that produce new alleles and combinations, respectively, only some of which are advantageous, i.e., **adaptive for survival and reproductive success**.

Natural selection thus **complements** mutation and recombination as primary factors of evolution—hence **evolution is more than just a random process of chance!**

**Process** of evolution by natural selection of gene alleles can be **summarized** as follows:

1. Modification of the **proportion/prevalence of different traits** in a **species population** over successive generations;

2. As a function of the **differential transmission** of copies of **alternative gene alleles** for **characteristics** to the next and succeeding generations;

3. Due to differences in the number of **surviving, reproducing offspring** produced by **individuals**, i.e., due to **differential reproductive success**;

4. As a result of **heritable genetic variation** (due to gene mutations and recombinations) for anatomy, physiology, behavior, and cognition;

5. Where such variation is fairly consistently associated with **differential adaptiveness** with respect to, e.g., coping with predators, parasites, and climatic conditions, as well as competing for food and/or mates.