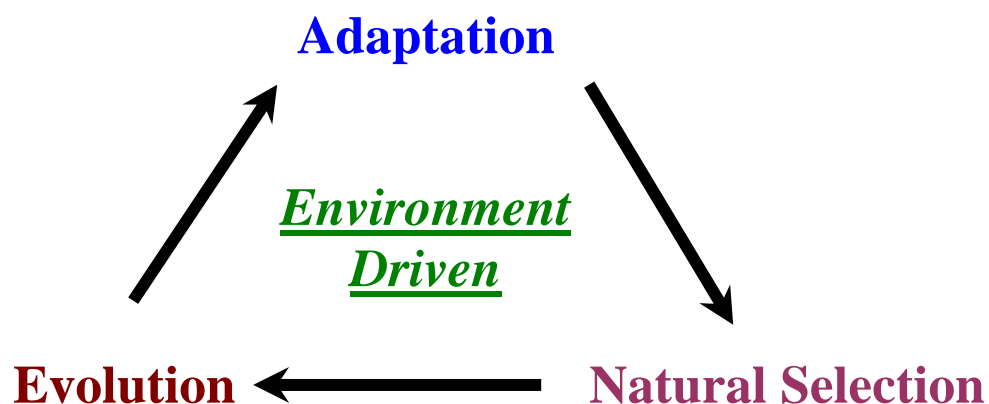


## Evolution, Natural Selection, and Adaptation

- ➔ The principal mechanism for evolution is natural selection
- ➔ The key factor in natural selection is the **environment**
  - Environment selects which organisms will survive and reproduce more often – which organisms are better adapted
  - Traits possessed by these organisms become more common – over many generations, then, there is a change in genetic make up – it evolves! 😊
- ➔ Adaptation is the process by which a species becomes better suited to its environment
  - Can also refer to any change in a trait that increases the likelihood that an organism will survive or reproduce



Let's look at an example of how [adaptation](#), [natural selection](#), and [evolution](#) are related:

<b>Step</b>	<b>Explanation</b>	<b>Example</b>
<b>Variation is the raw material for natural selection.</b>	Every species contains genetic variation – individuals differ because they carry different alleles for certain traits. Mutation can be the source for new variation. In addition, sexual reproduction and crossing-over produce individuals with unique combinations of alleles.	Giraffes were born with alleles for varying neck lengths. Some had longer necks than others.
<b>Living things face a constant struggle for existence.</b>	Organisms produce more offspring than can survive. These offspring emerge into a hostile world where they must evade predators and compete with other individuals for limited supplies of food and living space.	Giraffes with longer necks could reach the leaves in tall trees. Those with shorter necks could not.
<b>Only some individuals survive and reproduce.</b>	Some individuals are better able to survive the challenges of life than others. These individuals are more likely to survive and produce offspring.	The giraffes with longer necks were better at getting food than were giraffes with shorter necks. Consequently, long-necked giraffes produced more offspring than did giraffes with short necks.
<b>Natural selection results in genetic change.</b>	Each generation consists of the offspring of individuals that successfully reproduced. This results in an increased proportion of individuals with traits that promote survival and reproduction over generations.	Since more long-necked than short-necked giraffes were being born, long-necked giraffes became more common, and short-necked giraffes became rarer. The average neck length increased. Eventually long-necked giraffes replaced short-necked giraffes.
<b>Species adapt to their environment.</b>	Selection tends to make a population better suited to its environment. The environment determines the direction of genetic change. An allele favored in one environment may not be favored in another.	Long-necked giraffes are well suited for browsing on the foliage of tall trees, which is out of the reach of most other animals.

# Types of Adaptations

Structural Adaptations – those involving structure or anatomy

- ➔ Some of these types of adaptations are for obtaining food
  - Structure of a birds beak
  - Woodpecker's tongue
- ➔ Some are internal
  - Strong muscular walls of the heart
  - Long, thin nerve cells

Physiological Adaptations – associated with functions in organisms

- ➔ Usually have a chemical basis
  - Enzymes needed for digestion
  - Poison venom of a snake

Behavioral Adaptations – associated with an organisms various responses to its environment

- Migration of birds in search of food
- Tracking of prey by wolves

## Early Systems of Classification

Taxonomy – branch of biology that names and groups organisms according to their characteristics and evolutionary history.

History of Taxonomy:

- ☺ Organisms first classified more than 2,000 years ago
- ☺ Classified by Greek philosopher Aristotle
- ☺ Aristotle classified living things as either *plants* or *animals*

As more and more new organisms were being discovered, Aristotle's categories were not adequate. More organization was required.

- ☺ Swedish naturalist Carolus Linnaeus (1707-1778) devised a system of grouping organisms into hierarchical categories
  - Used organisms morphology – form and structure
  - Devised a nested hierarchy of seven different levels of organization:

**Kingdom** – largest category  
**Phylum** – subsets within kingdoms  
**Class** – subsets within phylums  
**Order** – subsets within classes  
**Family** – subsets within orders  
**Genus** – subsets within families  
**Species** – a single organism type

# Binomial Nomenclature

In Linnaeus's system:

- ➔ Scientific name of an organism has 2 parts:
  - 1<sup>st</sup> part of the name is the Genus to which an organism belongs
    - Latin word
    - Noun
    - Capitalized
    - Underlined or written in italics
  - 2<sup>nd</sup> part of the name is the species
    - Latin word
    - Adjective
    - Underlined or written in italics
- ➔ Because species names are Latinized, they are the same in every language

## Two Modern Systems of Classification

### 1. Six-Kingdom System:

Kingdom	Cell Type	Number of Cells	Nutrition
Archaeobacteria	Prokaryotic	Unicellular	Autotrophy and heterotrophy
Eubacteria	Prokaryotic	Unicellular	Autotrophy and heterotrophy
These 2 kingdoms used to be known together as <u>Kingdom Monera</u> . But during the last decade, studies of DNA have revealed fundamental differences between the two groups of bacteria, that scientists decided to split them into separate kingdoms.			
Protista	Eukaryotic	Unicellular and multicellular	Autotrophy and heterotrophy
Fungi	Eukaryotic	Unicellular and multicellular	Heterotrophy
Plantae	Eukaryotic	Multicellular	Autotrophy and (rarely) heterotrophy
Animalia	Eukaryotic	multicellular	Heterotrophy

#### Kingdom Archaeobacteria:

- ☑ Biochemical & genetic properties that differ from all other kinds of life
- ☑ Reproduce by binary fission
- ☑ Many live in harsh environments (hot springs, salty lakes, anaerobic environments)
- ☑ Very ancient – directly descended from first organisms on earth
- ☑ Evolved before oxygen filled the atmosphere
- ☑ Fewer than 100 species have been recognized
- ☑ Believed to be ancestors of the protists, the 1<sup>st</sup> eukaryotes

#### Kingdom Eubacteria:

- ☑ Contain most of the common bacteria that affect your life
- ☑ Extremely diverse group (autotrophic & heterotrophic)
- ☑ Approximately 5000 species have been characterized
- ☑ Believed to be ancestors of mitochondria & chloroplasts
- ☑ Reproduce by binary fission

- ☺ These 2 kingdoms include the greatest number of living things on earth!
- ☺ They have evolved more ways to obtain nutrients than have all eukaryotic organisms combined
- ☺ It is thought that they evolved from a common ancestor about 4 billion years ago

#### Kingdom Protista:

- ☑ Made up of mostly single-celled organisms
- ☑ Contains all eukaryotes that are not plants, animals, or fungi
- ☑ Plants, animals, and fungi probably descended from ancient protists
- ☑ Euglena and the amoebas are common types of unicellular protists

#### Kingdom Fungi:

- ☑ Have no roots, stems, and leaves
- ☑ Do not contain chloroplasts and cannot photosynthesize
- ☑ Are made of thin filaments that penetrate soil or decaying organisms
- ☑ Fungi absorb nutrients rather than ingesting them the way some protists do
- ☑ Over 100,000 species of fungi, including mushrooms, puffballs, rusts, mildews, molds and yeast

#### Kingdom Plantae:

- ☑ These organisms are recognized as the “plants”
- ☑ Include mosses, ferns, flowers, and trees
- ☑ All except for a few parasitic forms are autotrophic and use photosynthesis as a source of energy
- ☑ Most live in land
- ☑ Over 350,000 species have been identified

#### Kingdom Animalia:

- ☑ Has about 1 million known species
- ☑ First members evolved from the ocean
- ☑ Most animals have symmetrical body organization
- ☑ Most have some kind of nervous system
- ☑ Most move about their environment
- ☑ Almost all have a standard sexual cycle that uses meiosis for gene recombination

## 2. Three-Domain System

The science of molecular biology has led to an alternative to the six-kingdom system:

- ◆ Based on comparisons of sequences of ribosomal RNA
- ◆ Because all organisms have ribosomes, the rRNA molecule can be used to study the degree of relationship between any two living things
- ◆ Living things seem to fall naturally into 3 broad groups, or **domains**:
  - **Domain Archaea** – known in the 6 kingdom system as kingdom Archaeobacteria
  - **Domain Bacteria** – known in the 6 kingdom system as kingdom Eubacteria
  - **Domain Eukarya** – consists of the protists, the fungi, and the plants and animals