CONCEPT: EVOLUTION OF THE CELL

Tree of life

● **Evolution** is the process that has created all biological organisms that exist today

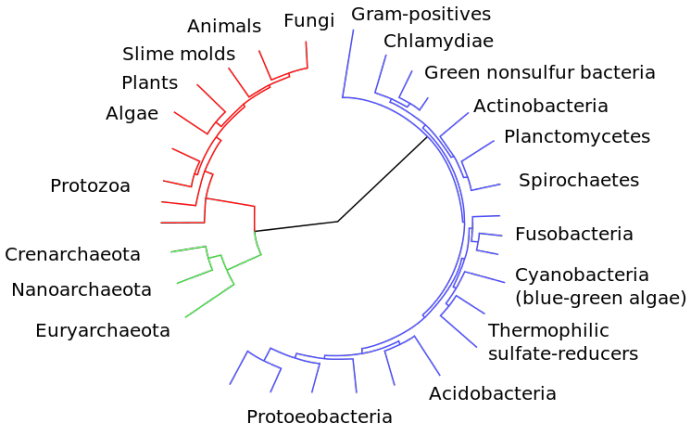
□ All organisms came from an original _____ cell

□ Support for evolution is found by comparing molecular mechanisms between organisms

- Similarities: genetics, metabolism, signaling,

□ Evolution occurs through small changes made in the _____ of a cell or organism

EXAMPLE: Tree of life demonstrates biological diversity



● There are three domains of life: **Archaea, Bacteria** (Eubacteria)**, and Eukaryota** (Eucaryota)

● **Phylogenetic Trees** are used to present the relationships and evolution of organisms

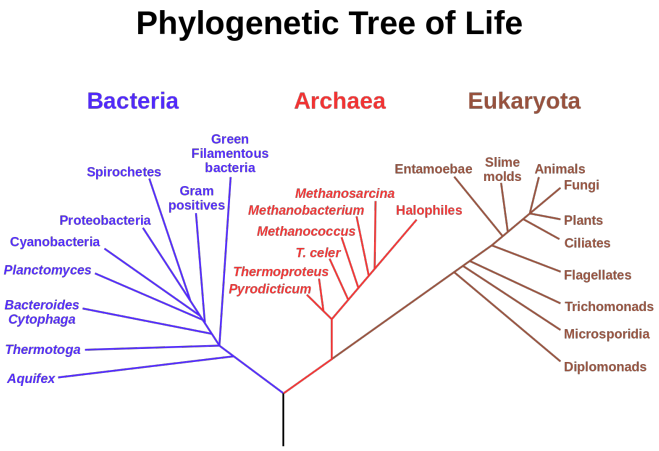
- For most Eukaryotes classification is performed through visual cues
- For **Prokaryotes** (Archaea and Bacteria), this requires the DNA sequence

● *Carl Woese* studied ribosomal RNA (rRNA) sequences to classify organisms

● The **endosymbiont theory** explains how _____ cells gained certain organelles

- Smaller prokaryotic cells took up residence in larger prokaryotic cells
- They escaped destruction and became organelles (Mitochondria/Chloroplast)

EXAMPLE: Phylogenetic tree highlights three domains of life



Some evolutionary mechanisms

● Mechanisms of species evolution is present within the organism's genome

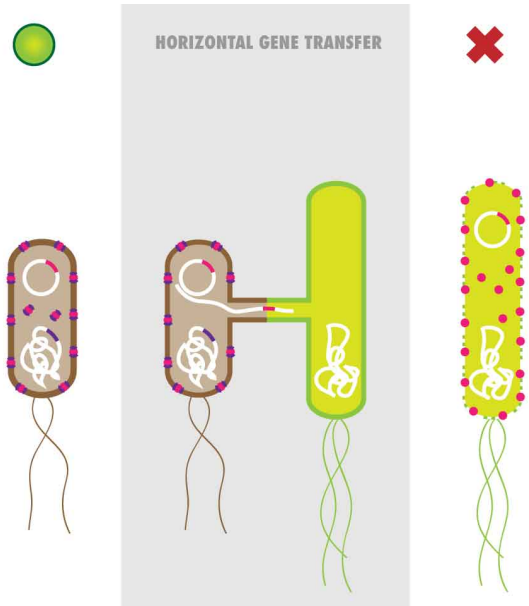
1. Sexual Reproduction is a main driver of evolution

2. **Horizontal (Lateral) Gene Transfer** allows for _____ gene transfer between organisms

□ E. *coli*: ~20% of genes come from other organisms (234 gene transfers)

□ Viruses have genetic elements that can insert into the host genomes

EXAMPLE: Horizontal Gene Transfer



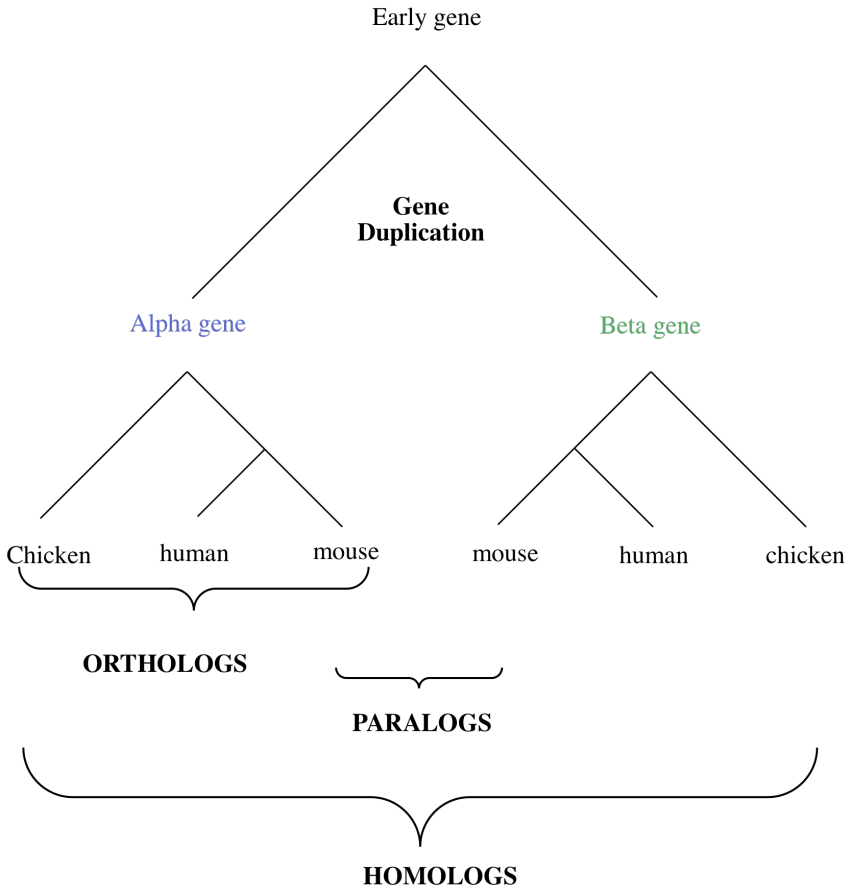
3. **Mutations** or other changes in the DNA can promote evolution

□ **Highly Conserved** genes have a lower rate of mutation due to their important nature

□ **Gene Duplication** is a major source of genetic _____

- **Homolog:** Two genes that are related by descent from a common ancestral DNA sequence
- **Ortholog:** A homolog that diverged in two or more species. Has same function.
- **Paralog:** A homolog that diverged due to gene duplication *within* a genome. Has new function.

EXAMPLE: Comparisons of orthoogs, paralogs, and homologs



● **Gene families**, which are a set of similar genes, are the result of _____

□ There are 4873 known protein coding gene families

- 200 are common to the three primary branches
- 63 are found in each examined living organism

PRACTICE:

1. Which of the following is not an evolutionary mechanism responsible for organismal diversity?
    a. Sexual Reproduction
    b. Mutations
    c. Endosymbiont theory
    d. Horizontal Gene Transfer

2. Which of the following terms describes two genes that diverged in two or more species?
    a. Homolog
    b. Ortholog
    c. Paralog
    d. Metalog

3. Which of the following is not classified as a Prokaryote?
    a. Archaea
    b. Bacteria
    c. Eukaryota