Lecture Outline 7: Phylogeny and Systematics

I. The Evolutionary History of Organisms can be Traced by Looking at Fossils
   A. How Fossils are Formed

   B. The Fossil Record is Incomplete

   C. The Fossil Record is Biased

II. The Evolutionary Relationships among Organisms can be Determined by Morphological and Molecular Similarities

   A. Homologies

   B. Analogies/ Homoplasies

   C. Molecular Homologies
III. Phylogenetic Systematics: Connecting Classification with Evolutionary History

A. Taxonomy

1. Carolus Lineaus

2. Scientific Names for Organisms

3. Hierarchical classification: Domain -> species

B. Phylogeny

1. Systematics and Phylogenetic Trees

2. Darwin and Phylogenetics
C. How Phylogenetic Trees are Constructed
   1. Cladistics
   2. Shared derived characters
   3. Shared primitive characters
   4. Outgroups vs. Ingroups

D. Cladograms vs. Phylogenetic Trees

E. Problems encountered While Constructing Phylogenetic Trees
   1. Monophyletic Trees
   2. Paraphyletic Trees
   3. Polyphyletic Trees
IV. Other types of Trees
   A. Phylograms
   B. Ultrameric trees

V. Parsimony
   A. Maximum parsimony
   B. Maximum likelihood

VI. Molecular Systematics
   A. Advantages of Molecular systematics
B. Gene Duplications

1. Orthologous Genes

2. Paralogous Genes

3. Molecular Clocks and The Neutral Theory

4. Concerns about Molecular Clocks
VII. There is a universal tree of life

A. Evidence for a Common Ancestor for all Forms of Life

B. The Three Domains of Life

1. Bacteria

2. Archaea

3. Eukarya