Chapter 4
Classification & Phylogeny of Animals
???? organisms

1,500,000 animal & plant species described

- 422,000 plant species
- 30,800 unicellular protists
- 1,078,000 animal species  98% invertebrates
  - 751,000 insects  ? close to 30,000,000 undescribed tropical
  - 46,700 vertebrates
    - 23,000 fish
    - 4,200 amphibians
    - 6,000 reptiles
    - 9,000 birds
    - 4,500 mammals

Figure 10.01

**Current Classification Scheme**

Hierarchical System
- ascending series of groups of ever-increasing inclusiveness
- taxon/taxa  major categories into which organisms grouped
- binomial nomenclature
  - two latinized name underline/italicized

**Genus species**

- blue crab
  - *Callinectes sapidus*
  - beautiful swimmer

Carolus Linnaeus (1707-1778)
### Table 10.1

<table>
<thead>
<tr>
<th>Linnaean Rank</th>
<th>Human</th>
<th>Gorilla</th>
<th>Southern Leopard Freq</th>
<th>Katydid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom</td>
<td>Animalia</td>
<td>Animalia</td>
<td>Animalia</td>
<td>Animalia</td>
</tr>
<tr>
<td>Phylum</td>
<td>Chordata</td>
<td>Chordata</td>
<td>Chordata</td>
<td>Arthropeoda</td>
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<tr>
<td>Subphylum</td>
<td>Vertebrata</td>
<td>Vertebrata</td>
<td>Vertebrata</td>
<td>Urmirida</td>
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<tr>
<td>Class</td>
<td>Mammalia</td>
<td>Mammalia</td>
<td>Mammalia</td>
<td>Insecta</td>
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<tr>
<td>Subclass</td>
<td>Eutheria</td>
<td>Eutheria</td>
<td>Eutheria</td>
<td>Pterygota</td>
</tr>
<tr>
<td>Order</td>
<td>Primates</td>
<td>Primates</td>
<td>Primates</td>
<td>Orthoptera</td>
</tr>
<tr>
<td>Suborder</td>
<td>Anthropoidea</td>
<td>Anthropoidea</td>
<td>Anthropoidea</td>
<td>Ensifera</td>
</tr>
<tr>
<td>Family</td>
<td>Hominidae</td>
<td>Hominidae</td>
<td>Hominidae</td>
<td>Tettigoniidae</td>
</tr>
<tr>
<td>Subfamily</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Phaneroptera</td>
</tr>
<tr>
<td>Genus</td>
<td>Homo</td>
<td>Gorilla</td>
<td>Homo sapiens</td>
<td>Scudderia</td>
</tr>
<tr>
<td>Species</td>
<td>Homo sapiens</td>
<td>Gorilla</td>
<td>Gorilla gorilla</td>
<td>Scudderia furcata</td>
</tr>
<tr>
<td>Subspecies</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Scudderia furcata furcata</td>
</tr>
</tbody>
</table>

The hierarchical system of classification applied to four species (human, gorilla, Southern leopard freq, and katydid). Higher taxa generally are more inclusive than lower-level taxa, although taxa at two different levels may be equivalent in content. Closest related species are united at a lower point in the hierarchy than are distantly related species. For example, humans and gorillas are united at the level of the family (Hominidae) and above; they are united with the Southern leopard freq at the subphylum level (Vertebrata) and with the katydid at the kingdom level (Animalia). Mandatory Linnaean ranks are shown in bold type.

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**Species Criteria**

- common descent
- small distinct groupings
- reproductive community

1) Typological Species Concept

- type specimen
- labeled/deposited in museum
- represent ideal form/morphology of species
- based on “only” morphological features

**variation**
2) Biological Species Concept

a) based on Darwinian evolutionary theory

1937-Dobzhansky: Genetics and the Origin of Species
1990-inclusion into Great Books of the Western World along with Darwin’s The Origin of Species & Descent of Man

b) natural selection differential survival & reproduction
c) stress here on reproductive continuity-genes rather morphological features

1982-Mayr defined biological species
is a reproductive community of populations (reproductively isolated from others) that occupies a specific niche in nature
3) Evolutionary Species Concept
   a) built upon the biological species concept by adding an evolutionary component
   b) address the fossil record & incorporate the fossil specimens

   1940 – Simpson, paleontologist-extinct mammals
   1944 - Tempo and Mode in Evolution
   1945 - Principles of Classification and a Classification of Mammals
   “a single lineage of ancestor-descendant populations that maintains its identity from other such lineages & that has its own evolutionary tendencies & historical fate”

c) applies to both sexually & asexually reproducing species

d) Abrupt changes in diagnostic features mark boundaries of different species in evolutionary time

4) Phylogenetic Species Concept
   “irreducible (basal) grouping of organisms diagnosably distinct from other such groupings & within which there is a parental pattern of ancestry & descent”

   a) phylogenetic species-single population lineage with no detectable branching

   b) emphasis on recognition as separate species the smallest groupings of organisms that have undergone independent evolutionary change
Cladogram
nested hierarchy of clades representing branching diagram

**Characters**  organismal characters present in common ancestor shared by group

**Clades**  organisms/species share derived characters states from subsets within study group

**Synapomorphy**  derived character shared by members of a clade

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**Monophyletic grouping**  
most recent common ancestor of all members of the group & all of its descendants

**Paraphyletic grouping**  
most recent common ancestor of all members of the group & some but not all of its descendants

**Polyphyletic grouping**  
not most recent common ancestor of all members of the group
Figure 10.05

Inferred nitrogenous based substitutions in the gene coding for cytochrome C