This is NOT Your Family Tree

Great Grandfather, Grandfather, Father, You

This is NOT Evolution

Fish, Salamander, Cat, You

This is Your Family Tree

Second Cousins, Cousins, Siblings, You

Parents

Grandparents

Great Grandparents

This is Evolution

Fishes, Amphibians, Mammals

Common Ancestor of All Vertebrates

Common Ancestor of Four-Legged Vertebrates

Common Ancestor of Mammals

Cartoon by Matthew Borman of Macomb, IL, with kind permission of Florida Citizens for Science, Sept. 2010
Speciation - Macroevolution

1.

2.

3.
Allopatric speciation

Vicariance:

Two wrasse species

Isthmus of Panama

3 million years ago

(a) Blue-headed wrasse (Thalassoma bifasciatum) from the Atlantic side of the Isthmus of Panama and (b) Cortez rainbow wrasse (T. lucasanum) from the Pacific side. The fishes apparently are related by descent from a common ancestral population that split when geologic forces created the Isthmus. As is common among reef fishes, these individuals of the same species differ in body coloration and patterning.
Allopatric speciation

Harris’s antelope squirrel on the canyon’s south rim
White-tailed antelope squirrel on the north rim
Parapatric speciation

A population at the periphery of a population adapts to a different environment but remains in contact with the original population

*Anthoxanthum odoratum*
Sympatric Speciation

• Crater lake cichlids - monophyletic - 12 species
Sympatric Speciation by *polyploidy*

Failure during meiosis to reduce $2N$ to $N$
If two $2N$ individuals mate, a new $4N$ species can form

Rose species
14, 28, 35, 42 chromosomes
Hybridization can lead to speciation

- Occasionally hybrids are fertile

Ex. sunflowers

- *H. annuus* (parent)
- *H. petiolarus* (parent)
- *H. anomalus* (hybrid)
Reinforcement

Natural selection for traits that isolate populations

Isolating mechanisms

2 types:
Premating isolation

habitat or seasonal

spiderworts
Behavioral Isolation

*Hyla versicolor*  
48 chromosomes

*Hyla chyroscelis*  
24 chromosomes
Diploid parent (Two copies of each chromosome)

Meiosis

Haploid gametes (One copy of each chromosome)

Mating

Diploid gametes (Two copies of each chromosome)

Tetraploid parent (Four copies of each chromosome)

Triploid zygote (Three copies of each chromosome)

Meiosis

When these gametes combine, most offspring have incorrect number of chromosomes.
Mechanical isolation

Sage (*Salvia*)

Damselfly
Postmating isolation:

- Gamete mortality
- Zygote mortality (hybrid inviability)
- Hybrid sterility
Reduced hybrid viability

- Genes of different parent species may interact & impair the hybrid’s development
Hybrid Sterility
Hybrid breakdown
I think

Then, between A & B, various law & relation, C & B. The first predation, B & D rather greater with other. Then some would be formed. - breeding relation
Linnean Classification

Myrmecophaga tridactyla

- Taxon - each unit of classification
Linnean Classification

**Categories**
- SUPERKINGDOM
- KINGDOM
- PHYLUM
- CLASS
- ORDER
- FAMILY
- GENUS
- SPECIES

**Taxa**
- Protista
- Metazoa (multicellular animals)
- Metaphyta (plants)
- Fungi
- Prokaryotes
- Eukaryotes

**Taxonomy Tree**

- **Drosophila melanogaster**
- **Homo sapiens**
  - Diptera
  - Insecta
  - Arthropoda
  - Chordata
  - Mammalia
  - Primates
  - Hominidae
  - Homo
  - Metazoa (multicellular animals)
  - Protista
  - Metaphyta (plants)
  - Fungi
  - Eukaryotes
Objectives of classification

1) *Originally*: largely based on morphology.

2) *More Recently:*

   - Phylogeny -