

Evolution and the Origin of New Species

The Species Concept

A. Taxonomy

1. The science of classifying organisms based on their relationships with one another

B. Species

1. A population or group of populations whose members can interbreed in nature to produce fertile offspring
 - a. members may be separated by great distance
 - b. members may differ greatly in appearance
 - (1) "Polymorphism"
2. Some species may interbreed and produce fertile offspring
 - a. may be geographically separated
 - b. may be behaviorally incompatible

grizzly bears + polar bears

domestic dogs + coyotes

domestic dogs + wolves

Horses + donkeys = mules (normally infertile offspring. See pg. 94)

Classification and Homologies

A. Homologies

1. Similarities in structures that may indicate related ancestry

B. Anatomical Similarities

1. Easily observed
2. Evidence also exists in fossils

C. Chemical Similarities

1. Similarities in DNA and proteins are **very** indicative of close evolutionary relationships
2. Chemical comparisons can usually only be made among living organisms

Classification Hierarchies

A. Set of Hierarchical Divisions

1. Kingdom
2. Phylum
3. Class
4. Order
5. Family
6. Genus
7. Species

B. Binomial Nomenclature

1. Genus species
 - a. System first devised by the Swede Carolus Linnaeus
 - b. Names given in latin
 - c. Genus is Capitalized, species is not
 - d. Names are used worldwide

C. Examples of Classification

	<u>Man</u>	<u>Wolf</u>	<u>Housecat</u>
Kingdom	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata
Class	Mammalia	Mammalia	Mammalia
Order	Primates	Carnivora	Carnivora
Family	Homonidae	Canidae	Felidae
Genus	Homo	Canis	Felis
Species	sapiens	lupus	catus

The Galapagos Islands

A. History

1. Formed by volcanic eruption 3.3 million years ago
2. Never attached to South American mainland

B. Animal Life

1. Two species of mammals
2. Seven species of reptiles
3. Twenty species of birds

C. Origin of Animal Species

1. All must have swam, flown, or drifted from the mainland
 - a. Galapagos are 600 miles west of Equador

D. Darwin's Finches

1. Different species of finch that vary in appearance and diet
 - a. Darwin believed they were members of the same species
2. Beak adaptations
 - a. crushing nuts
 - b. catching insects
 - c. ground feeding on seeds

E. Ecological Niches

1. Place occupied by an organism in an ecosystem
 - a. Physically
 - b. In the food chain

F. Artificial Selection

1. Changes made in a species of domesticated animal by intentionally selecting the traits of mating couples
 - a. Pigeons
 - b. Livestock
 - c. Cats and Dogs

G. Natural Selection

1. Theory for how evolution occurs
2. Darwin's book was titled The Origin of Species by Means of Natural Selection

Population and Ecological Evidence

A. Peppered Moths

1. As soot accumulated on the trees of England, white moths become less common and dark moths more common
 - a. Light colored moths are easy for birds to see on dark trees
 - b. Dark colored moths are easy for birds to see on light trees

B. Mouse Study

1. Light and dark mice predated by barn owl on different soil shades
 - a. Easily seen mice were caught almost twice as often

C. Bacteria

1. Resistance develops to modern antibiotics

Genetic and Molecular Evidence

A. Darwin's Dilemma

1. Had evidence that variation was a tool of evolution
2. Had no explanation for how variation occurred
 - a. Didn't know about DNA, genes etc.

B. Origins of variation

1. Mutations
 - a. sometimes produce new alleles
2. Crossing over
 - a. Provides new combinations of alleles

Population Genetics

A. Definition

1. The study of allele frequencies within a population

B. Gene Pool

1. All of the genes of a population of organisms
2. Organisms that are successful at reproducing contribute most to the gene pool

C. Evolution

1. Any change in the frequency of any allele within a gene pool
 - a. Populations undergo evolution
 - b. Individuals do not undergo evolution

Allele Frequencies

- A. Factors Affecting the Allele Frequency
 - 1. Mutation
 - a. Especially important for organisms with short generation times
 - 2. Migration
 - a. Movement of organisms into or out of the population
 - 3. Genetic Drift
 - a. Random change in allele frequencies
 - (1) Occurs mostly in small, isolated populations
 - 4. Selection
 - a. Environmental pressures
 - b. Competition
 - c. Climate change
 - 5. Nonrandom mating
 - a. Preferences in selection of a mating partner
- B. Microevolution
 - 1. The changes that occur within populations and species
- C. Macroevolution
 - 1. Evolution that occurs above the species level
 - a. genus, family, order, class, phylum, kingdom

Speciation

- A. Speciation
 - 1. The evolution of new species through time
 - 2. Speciation occurs most rapidly in a small population
- B. Artificial Speciation
 - 1. New species have been developed by man
 - a. Intentional mutations
 - b. Cross breeding
 - c. Genetic engineering
- C. Natural Speciation by Isolation of Small Populations
 - 1. Geographical Isolation
 - a. Geographical barriers separate two populations
 - (1) Mountain ranges
 - (2) Deep canyons
 - 2. Ecological Isolation
 - a. Organisms of two populations require different habitats
- D. Behavioral Isolation
 - 1. Changes in habits that identify one population with another
 - a. Mating rituals
 - b. Methods of communication

Speciation (Continued)

E. Seasonal Isolation

1. Reproductive cycles do not coincide
 - a. Plants that flower at different times
 - b. Animals that mate or nest build at different times

F. Mechanical Isolation

1. Physical characteristics that keep organisms from interbreeding
 - a. Difference in size
 - b. Difference in reproductive anatomy
 - c. Inability of sperm to penetrate the egg

Questions About Evolutionary Mechanisms

A. Fossils (Paleobiology)

1. Vertebrate animals
 - a. Bones and teeth are easily fossilized
2. Plants
 - a. Leave imprints in mud/shale
3. Microorganisms
 - a. Some remains (microfossils) date back 3.5 billion years

B. Observations From the Fossil Record

1. Species often remain stable for millions of years with little or no noticeable change
2. Species may disappear rapidly and new species may appear just as fast

C. Punctuated Equilibria

1. Long periods of stability followed by short periods of rapid change
 - a. Probably caused by chromosomal rearrangements
2. Contradicts Darwin's theory of slow, gradual changes due to natural selection