I Evidence for Evolution

A. The natural classification of organisms

1. The natural classification of animals is hierarchical and based on similarities and differences

2. species -> genus -> family -> order -> class -> phylum

3. Classification of humans is: *sapiens*, *Homo*, Homonidae, Primatae, Mammalia, Chordata

4. divergence in DNA lineages -- DNA sequences are more similar between organisms more closely related in classification

B. Comparative structure and function of living organisms

1. Similar structures have been modified and used in different ways

a. basic plan (human example)

b. the horse

1) radius and ulna and tibia and fibula are fused

2) single metatarsal bone (canon)

3) have just one toe (hoof)

c. the horse embryo

1) "**atavistic**" horses can have extra toes

2) "**recapitulation**" (developing embryonic horses have three toes at one stage -- three toed horses show up in the fossil record)

d. Other examples:

1) newborn whales have hair, suggesting they came from ancestors with hair -- **recapitulation**

2) the wingless Kiwi bird of New Zealand has **vestigial** stumps for wings

3) the limbless boa constrictor has **vestigial** pelvic bones

4) Humans have **vestigial** tail bones, the coccyx -- consists of 4 reduced vertebrae attached to the sacrum

5) The human fetus in the tenth week develops a fleshy tail with 11 vertebrae and muscles that wag it (**recapitulation**). It is normally overgrown and resorbed. Occasionally infants are born with "**atavistic**" tails.

2. Evidence from the structure of molecules -- mammalian hemoglobin

a. made up of two proteins, a and b

b. combine to make the functioning hemoglobin molecule

c. there are 5 genes making the a protein and 7 genes making b protein, they are nearly, but not completely identical

d. these genes are located right next to each other on the chromosomes 16 (a) and 11 (b)

e. they are probably next to each other because of gene duplications resulting from accidents in recombination

f. expression of genes changes with development resulting in changes of oxygen binding properties, for example fetal hemoglobin has a higher affinity for oxygen

g. this demonstrates a history of gene duplication, mutation, and the subsequent alteration of duplicated genes into new functions.

C. The fossil record

1. Fossils are the remains of the hard parts of living organisms that were accidentally buried and preserved

a. fossils are preserved in sediment during subsidence

b. fossils are revealed with uplifting

c. these processes have continued since the origins of earth

2. The fossil record is incomplete

3. The record

a. ancestral types always appear before descendants

mammals and birds	248MYA/150MYA
Reptiles	320 MYA
Amphibians	408 MYA
Fishes	505 MYA

b. intermediate forms of present day animals

1) birds and reptiles have common features that suggest a common ancestor

2) Archaeopteryx -- 150 million year old fossil with reptilian dinosaur traits (bony tail, teeth, reptilian ankle joint) and feathers.

c. changes in specific traits over time -- fossil horses

1) Eohippus (Dawn horse) 54 MYA was size of a small dog with 4 toes and a separate radius and ulna forelimb

2) 38 MYA appears a larger horse-like animal with three toes and a fused radius and ulna

3) The fossil record shows a nice transition from the ancestral to the modern horse

D. Biogeography, the geographic distribution and relationships of living organisms

The more isolated plants and animals are from each other, the more distant they are from each other in the system of classification

1. Continental biogeography

a. Evidence for divergent evolution

1) Elephants of Africa and India are different genera, with different characteristics, but do apparently the same thing, they have diverged from a common ancestor because they are separated by distance and evolutionary history

2) Lions are found in Africa, Tigers in Asia, Jaguars in the New World. All of the same genus.

3) Caribou in North America and Reindeer in Europe are the same species, capable of interbreeding, but differ in many traits.

4) Human populations before we invented global mobility

b. Evidence for convergent evolution

1) Aardvark of Africa and the anteater of South America are from different orders, but have similar ecology and look strikingly similar

2) Australia -- animals are most unlike any others on earth, and most isolated continent. Dominated by marsupials -- but share many features in common with placental mammals found on other continents.

3. Island biogeography -- island populations resemble most closely the animals on the closest continental land mass. But, they are often divergent and convergent.

The Galapagos Islands --

1) 600 miles west of the coast of Ecuador

2) Five larger islands, nineteen smaller ones, of relatively recent volcanic origin

3) Animals on the island resemble those of nearby South America, but have distinct differences.

4) Marine iguanas

5) Giant tortoises

6) Darwin's finches -- are finches but have strongly diversified and are convergent in form and behavior with distantly related birds: (rare chance migration and diversification)

4. Behavioral ecology -- the fit of the behavior of organisms to their environments