Change Over Time

Evidence for evolution

1. **Fossils**
2. **Geographic Distribution of Living Things**
3. **Structural Adaptations**
4. **Physiological Adaptations**
5. **Anatomy**
6. **Biochemistry**

1. Fossils

- In biological terms a **fossil** can be defined as **evidence** of an **organism** that lived some time in the **past**.
- This gives an evolutionary picture of life on Earth and how species have changed over time.
- Also shows how organisms are related to each other
- Oldest fossils are in deepest layers/newer are in layers closer to surface

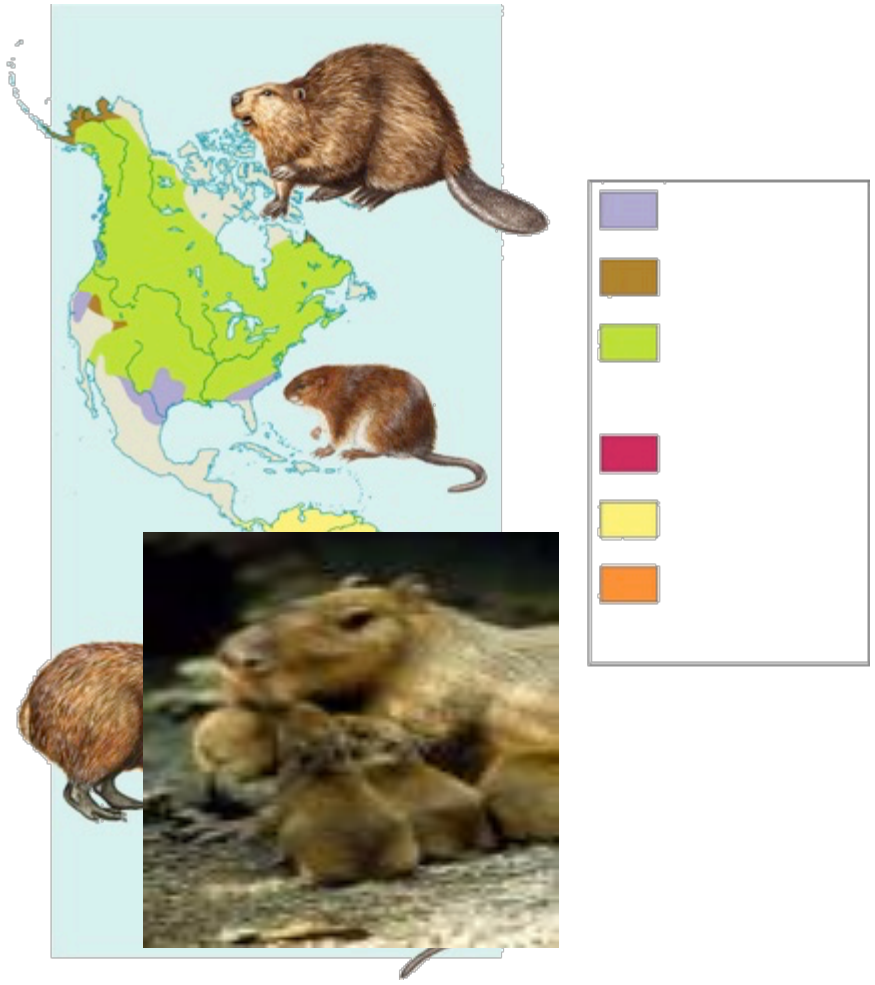
Fossil Layers

Evidence for Evolution – The Fossil Record

(a) Strata of sedimentary rock with fossils embedded

(b) Fossilized sea urchin, at least 65 million years old

Evidence of Evolution



- **Geographic Distribution of Living Things-**similar environments have similar types of organisms

Adaptations: evidence for Evolution

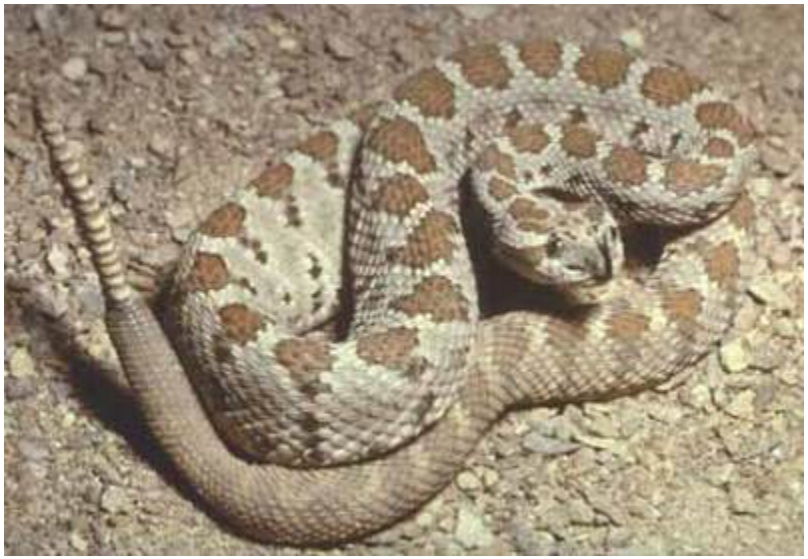
- An **adaptation** is any variation that aids an organism's chances of survival in its environment
- Adaptation in species **develop over MANY generations**

Structural Adaptations

A. Mimicry: A **structural** adaptation that protects an organism by **copying** the **appearance** of another species.

- harmless species mimics a harmful species
  - Example: **Gopher snake**
  - Two or more harmful species resemble each other
  - Predators learn to avoid organisms with that appearance
  - Example bees/wasps

Gopher Snakes?



The one on the left is a rattlesnake,
the one on the left is a gopher snake.

Structural Adaptations

- **Camouflage** – A structural adaptation that allows an organism to blend in with its environment.
- Because they are not easily found by predators, they survive to reproduce
- Example – snow shoe hare

Showshoe Hare

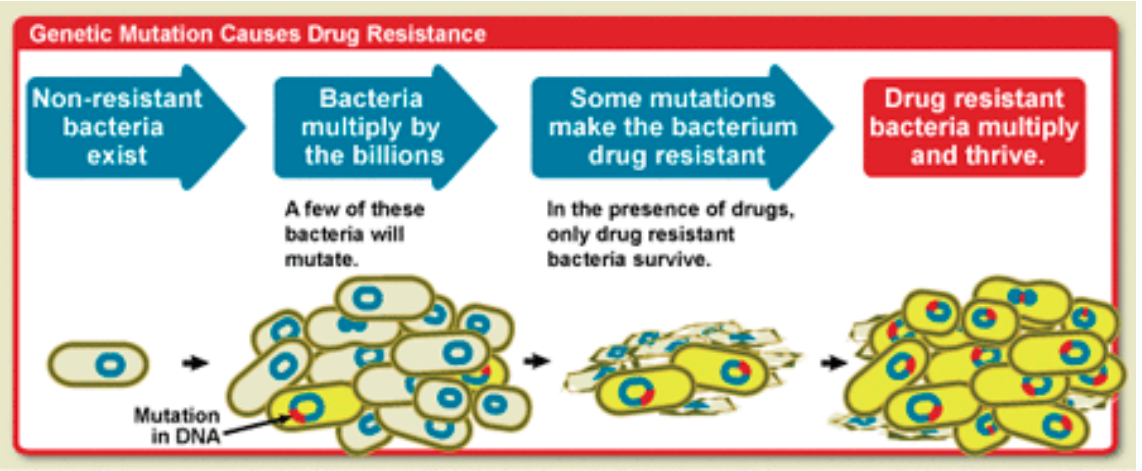
Summer

Winter


Piet Grobler 2009

Physiological Adaptations

- Physiological adaptations are change in an organism's metabolic processes (chemical reactions)
- Antibiotic resistance
- Pesticide resistance

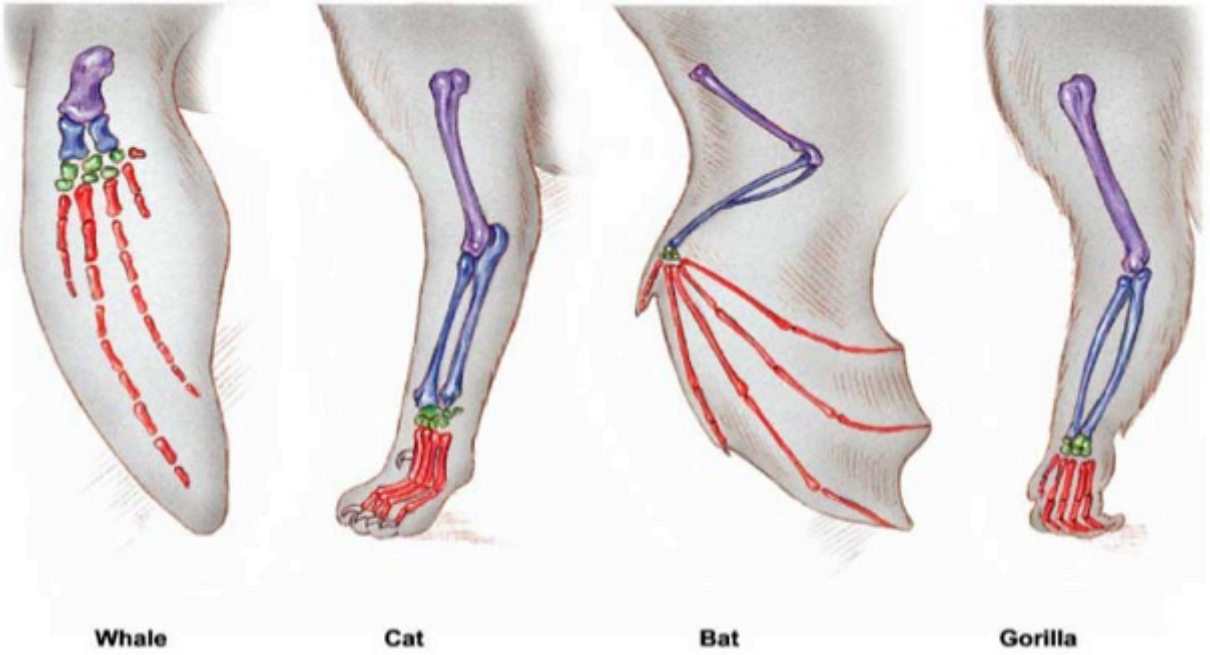


Are ALL adaptations structural?

- No! Some adaptations are ***behavioral adaptations***
- **Moving in large groups** is one example; it helps protect the members of the group from predators.
- Other types of behavioral adaptations:
- **Nocturnal**
- **Arboreal**
- **Burrowing**

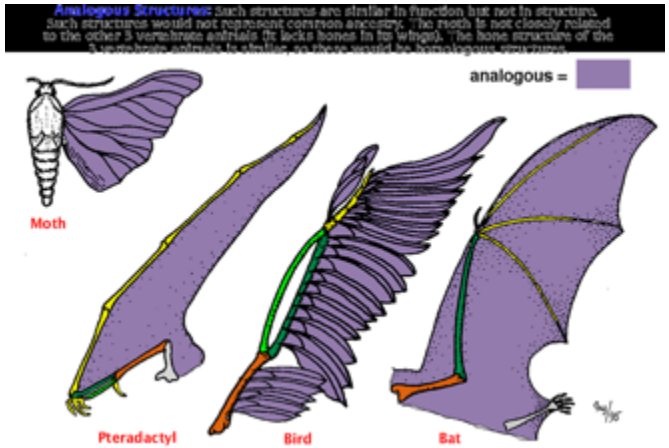
3. Comparative Anatomy

A. **Homologous Structures** – structural features with a **common** evolutionary origin – shared by related species. Ex: forelimbs of whale, cat,bat



Comparative Anatomy

B. **Analogous Structures** – Structural features which serve the same function in different species, but they evolved independently. Example: **Butterfly** wings, **Bat** wings **Bird** wings

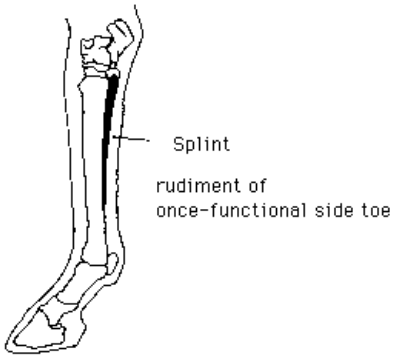


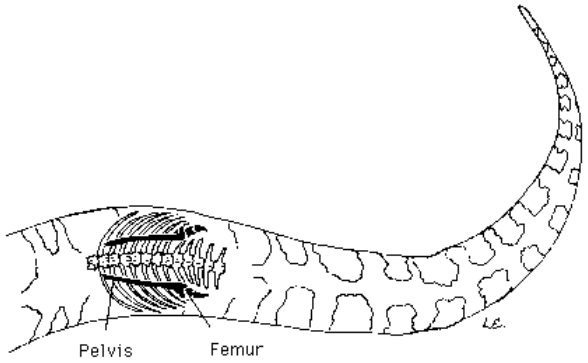
Comparative Anatomy

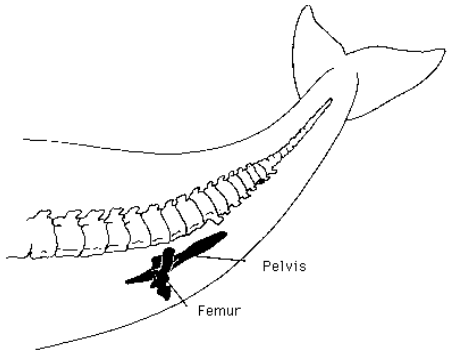
C. **Vestigial Structures** – structures that were present in ancestor, but are reduced in modern species.

Humans have a vestigial tailbone.

EX: Vestigial toes in the horse. Pelvic bones in whales and snakes.





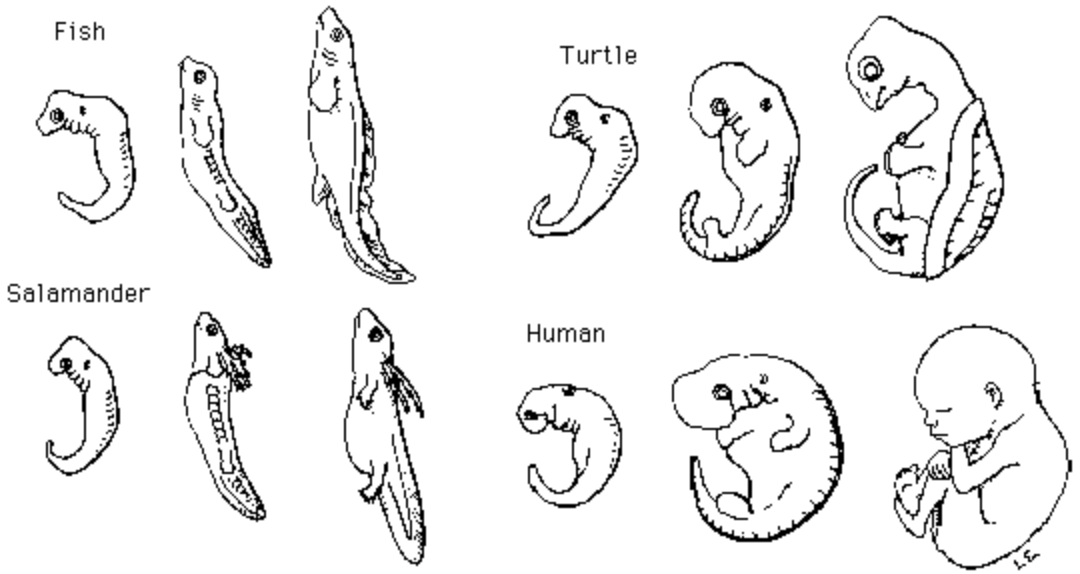


4. Comparative Embryology

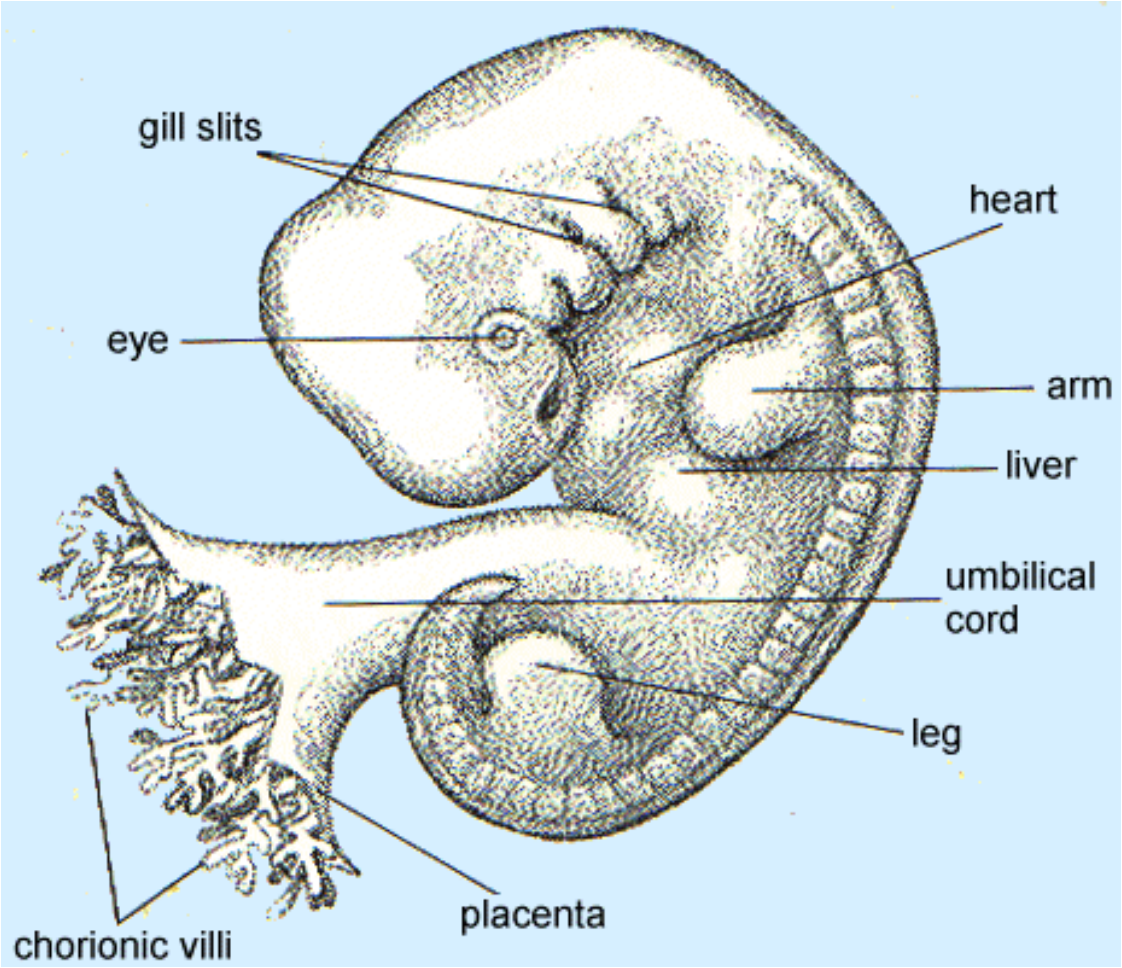
Embryology –

An embryo is the earliest stage of development of plant and animals

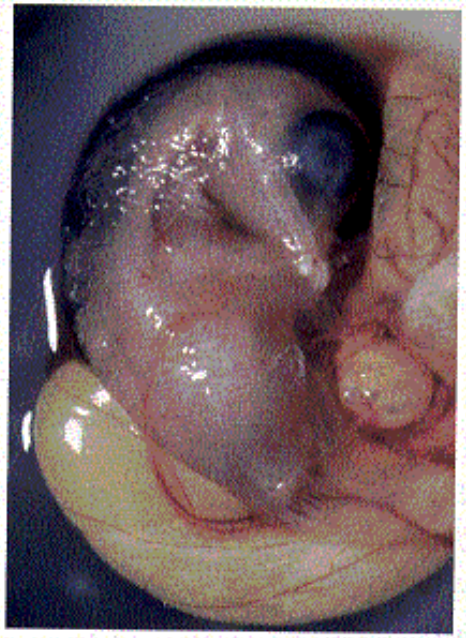
Early embryos of very **different** organisms **closely resemble** each other.



Human Fetus – 5 weeks



Chicken



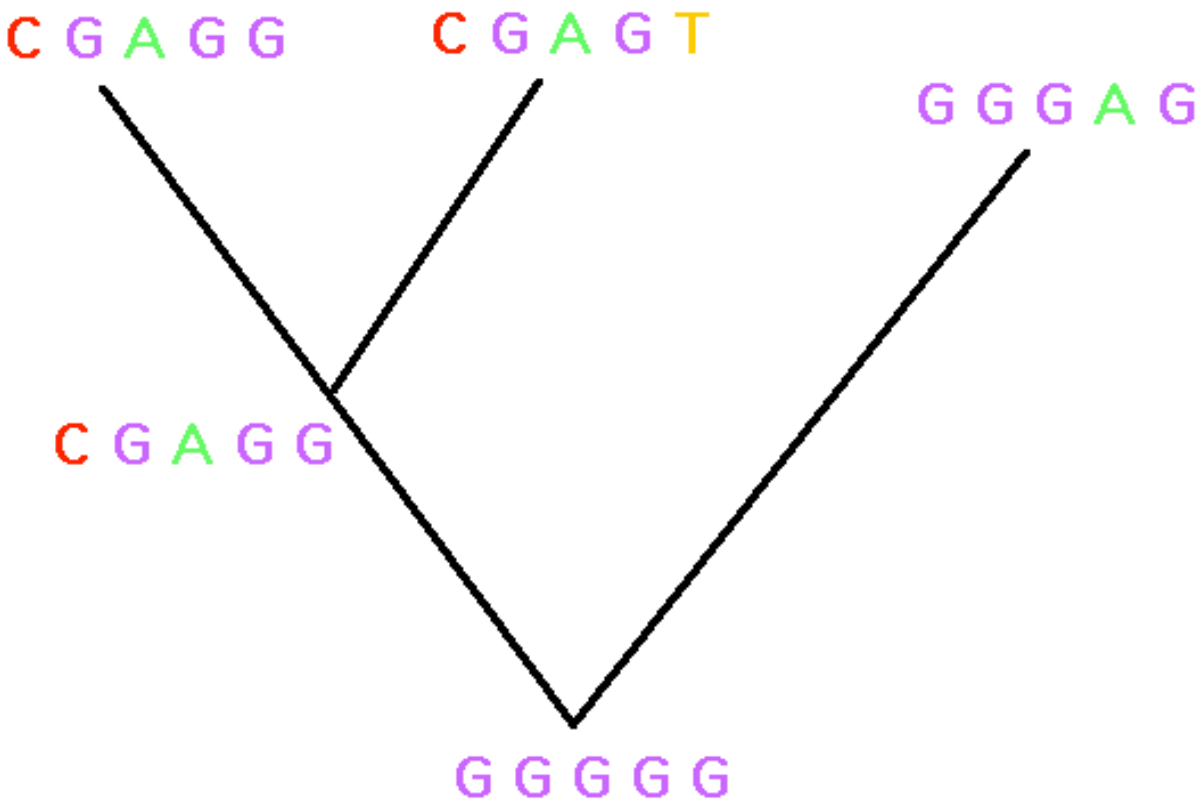
Turtle

Rat

5. Molecular biology

Biochemistry – (DNA/genes) The greater the number of gene/DNA sequence similarities, the closer related the two organisms are.

5. Biochemistry



OVERVIEW

- **The Struggle for Existence (compete for food, mates, space, water, etc.)**
- **Survival of the Fittest (most able to survive and reproduce)**
- **Descent with Modification (new species arise from common ancestor replacing less fit species)**

Mechanisms of Evolution

- POPULATIONS, not individuals, evolve
- Genes (inherited from parents) determines an individual's features of phenotype
- Individuals cannot evolve a new phenotype in response to its environment
- Natural selection acts on a range of phenotypes in a population

- A population – consists of all the members of the same species that live in a given area
- Each member has genes (pair of alleles) that characterize their traits
- All of the genes with in the population make up the gene pool
- Evolution occurs as a population's genes and their frequencies change over time

- Allelic Frequency – the percentage of any specific allele in the gene pool
- Genetic Equilibrium – frequency of alleles in a population remains the game over many generations

Changes in Genetic Equilibrium

- One mechanism for genetic change is mutation (radiation, chemicals, chance)
- Many mutations are lethal (do not survive) or null(not good or bad)
- Occasionally useful – new gene becomes part of the gene pool

Changes in Genetic Equilibrium

- Natural Selection is usually the most significant factor that causes changes in the gene pool
- Allelic frequencies change over generations due to natural selection of variations

Speciation

- Changes in the gene pool can lead to evolution of a new species over time
- Species = group of organisms that look alike and can interbreed to produce fertile offspring
- Speciation = evolution of a new species. Occurs when members of similar populations can no longer interbreed and produce offspring