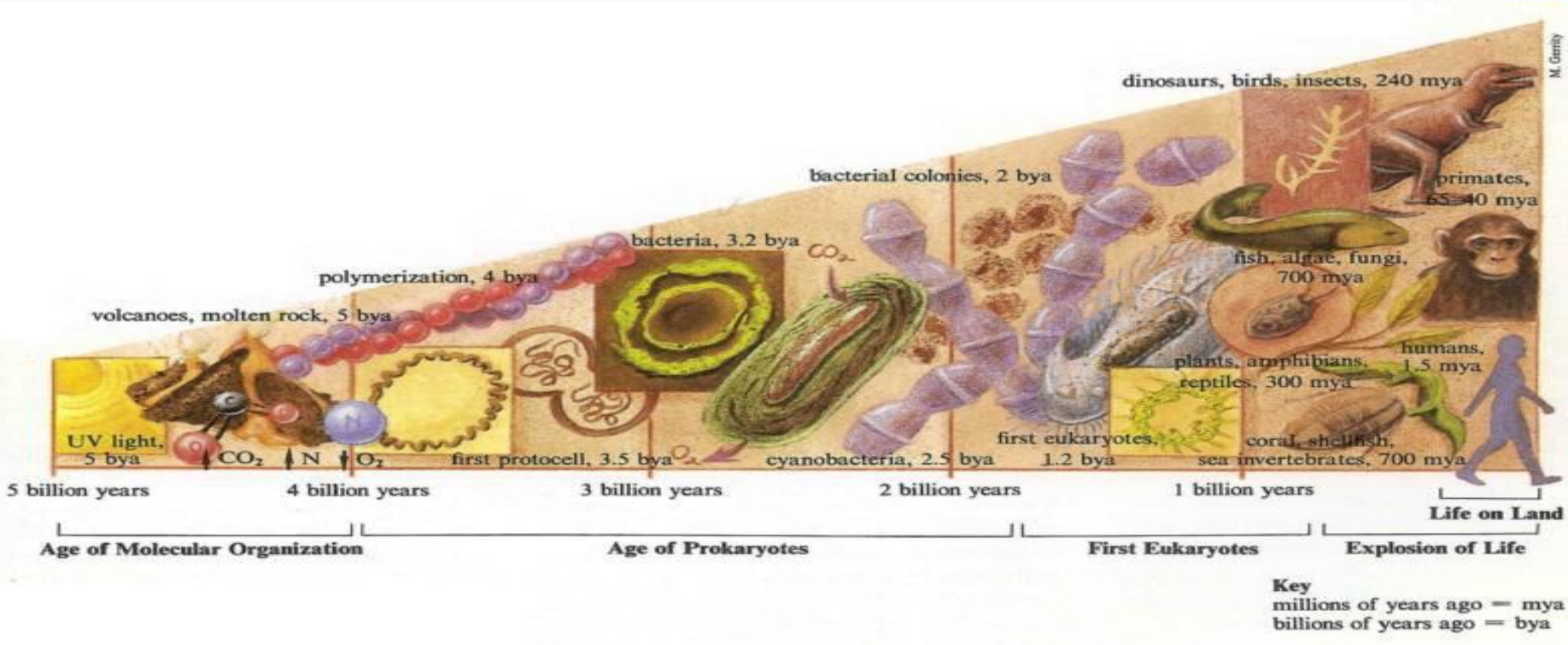
Evolution

Evolution

- Definition:
  - Gradual accumulation of adaptations over time.
  - People terms – Slowly changing for the better over time



Charles Darwin

- Sailed on a ship called **HMS Beagle** starting in 1831 – Famous for his study with **Finches on Galapagos Island.**
- He wrote the book, **The Origin of Species**.
- **Darwin's 3 main theories**
  - **All life on Earth has an earlier form**
  - Populations **accumulate** changes **over** time
  - All life is a **branching tree** and **shares common ancestors.**

Natural Selection

- Definition: process by which traits become more or less common in a population due to the ability of that trait to help an organism to survive.

- **<u>Four Components of Natural Selection</u>**

  - **Genetic Variation – Individuals have variation in their genes**
    Example – Better eye sight, can run faster, camouflage

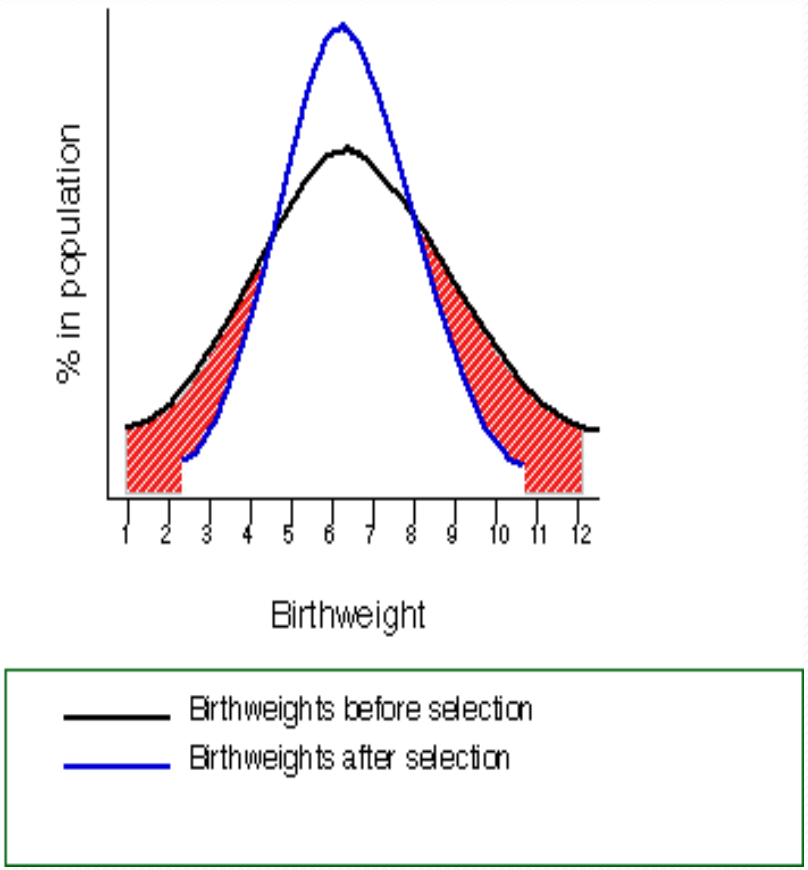
  - **Population produces more offspring than can survive.**

  - **Organisms better fit for the current environment survive.**

  - **The trait that makes the parent a better fit for the environment gets passed to the offspring.**

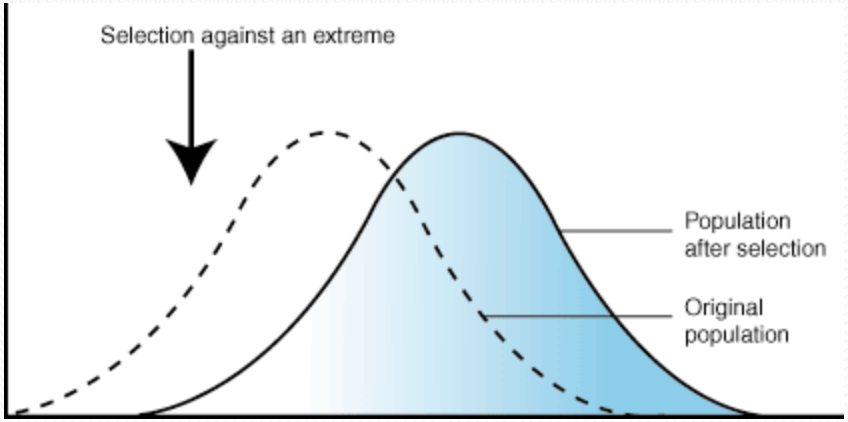
3 ways natural selection shapes a population

- **1. Stabilizing selection**
  - **A. Favors average individuals**
  - **B. Reduces variation**
  - **Example – human birth rate**



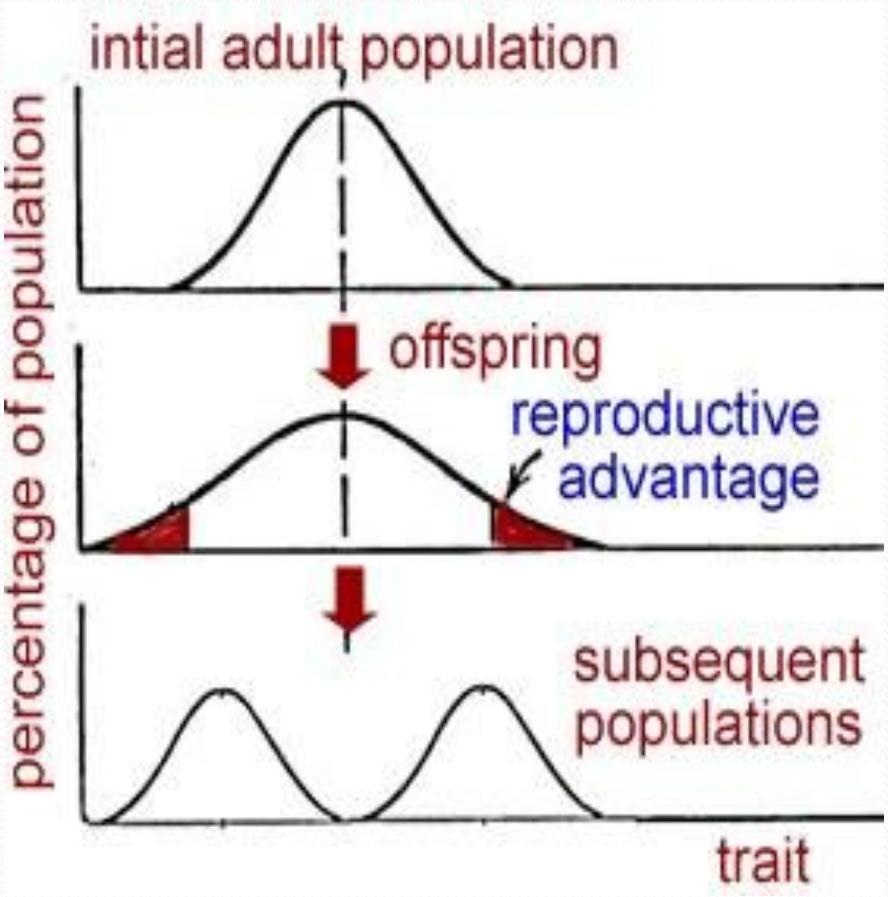
3 ways natural selection shapes a population

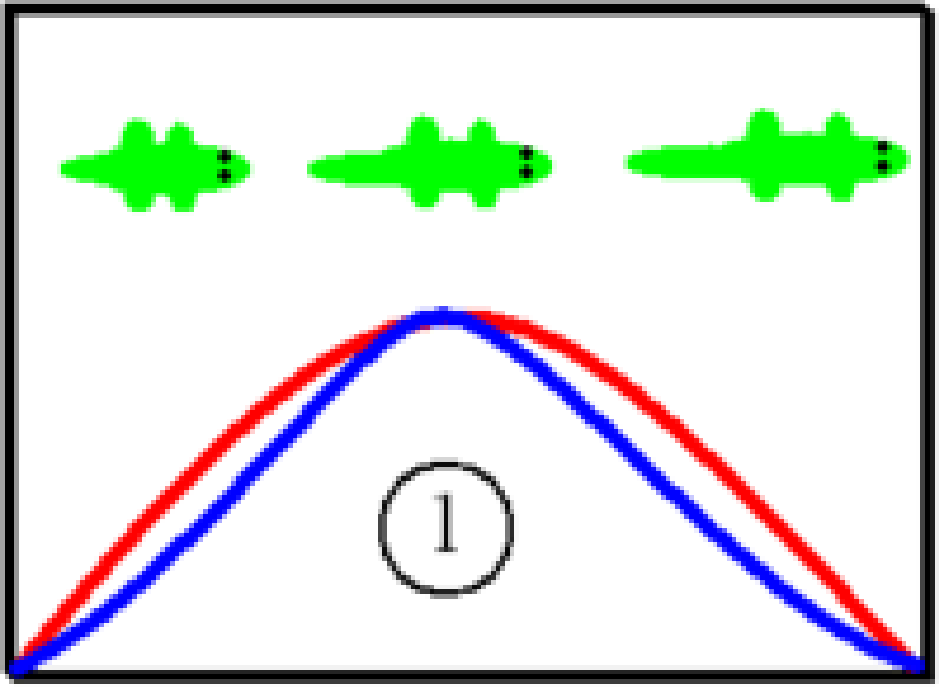
- **2. Directional Selection**
  - **A. Favors one extreme**
  - **B. Rapid Evolution**
  - **Example – Woodpecker beaks, peppered moths**

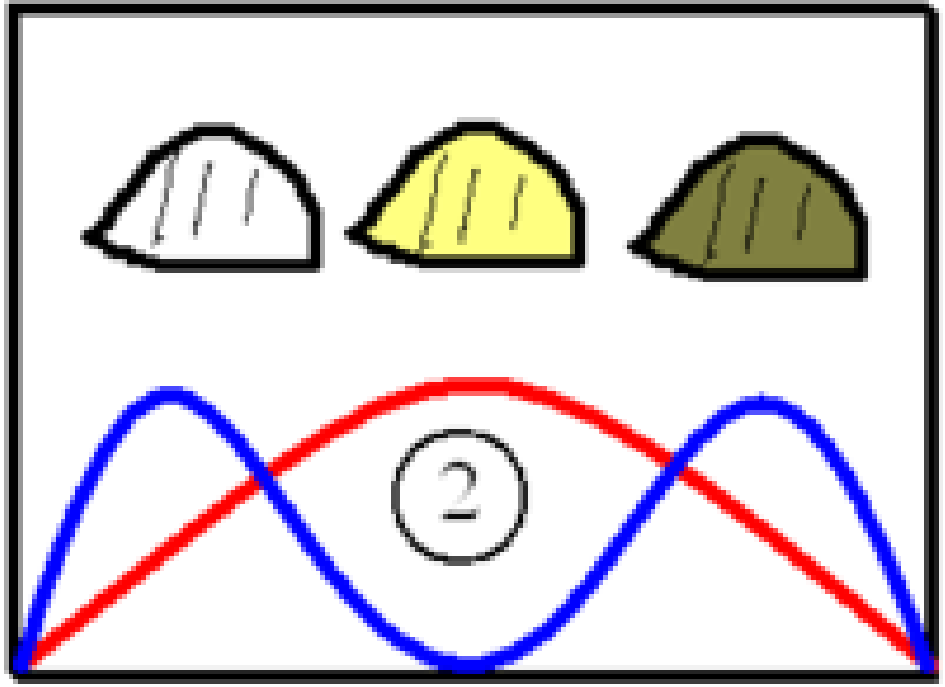


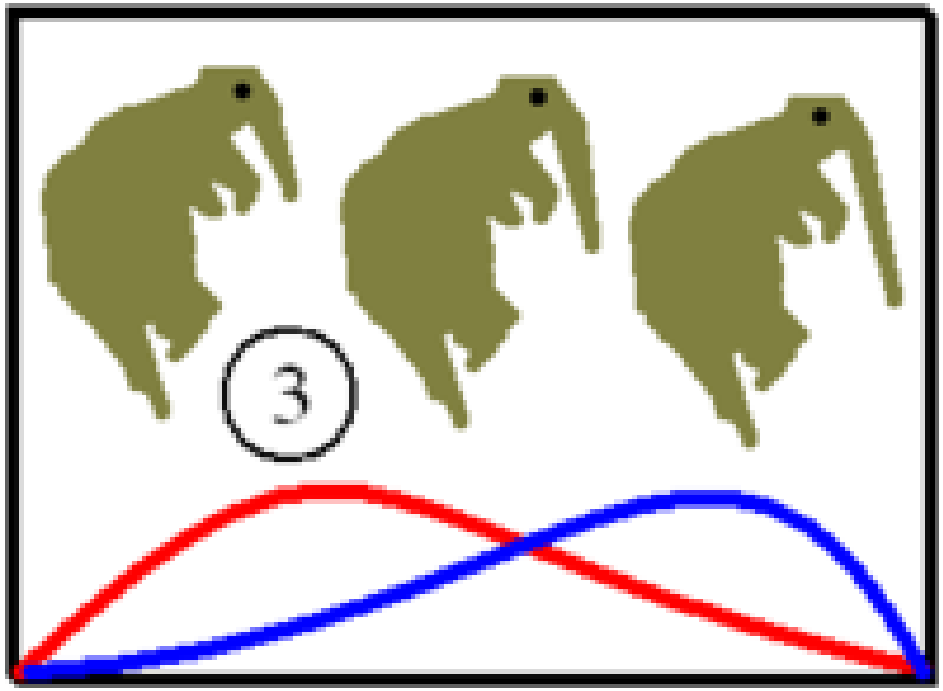
3 ways natural selection shapes a population

- 3. Disruptive selection
- A. Favors both extremes
- B. Leads to evolution of two new species
- Example – Limpets on rocks – Light, Dark, Tan









1 - Stabilizing Selection
2 - Disruptive Selection
3 - Directional Selection

Before

After

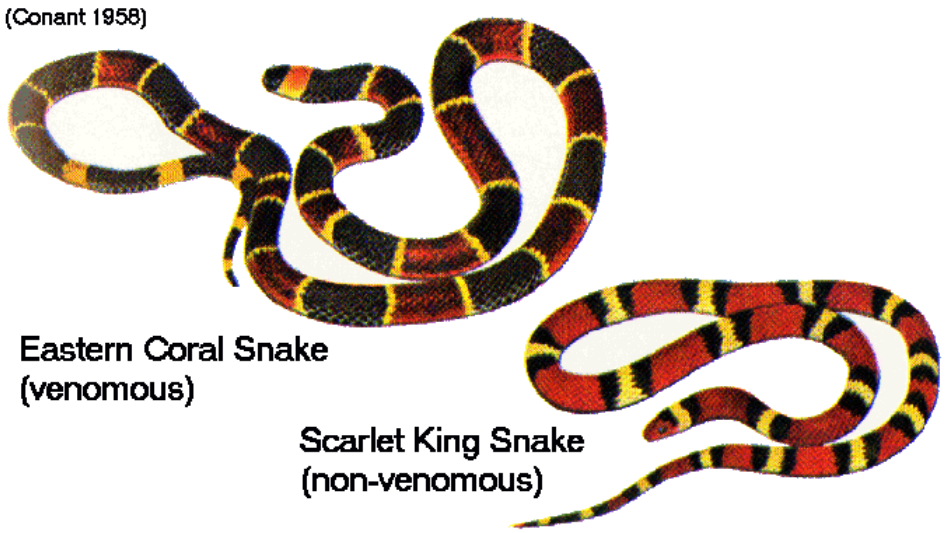
Evidences for Evolution

1. **<u>Structural Adaptations:</u>**

- Part or all of an organism changes/adapts to allow an organism to survive better in their environment.
- This is a very gradual process occurring over generations.

Structural Adaptations:

- **Mimicry** – Where one species resembles or mimics another species.
  - Example – A harmless Syrphid Fly adapts to look like a harmful Yellow Jacket Wasp to avoid predators. Snakes -



Structural Adaptations:

- **Camouflage** – Where an organism blends with their surroundings so they are not easily found by predators.
- Example- Octopus, cuttlefish, many marine organisms

- http://www.youtube.com/watch?v=CtlAL3-9O4c&feature=related
- http://www.youtube.com/watch?v=_JYI7_8L8hY&feature=related

Physiological Adaptations:

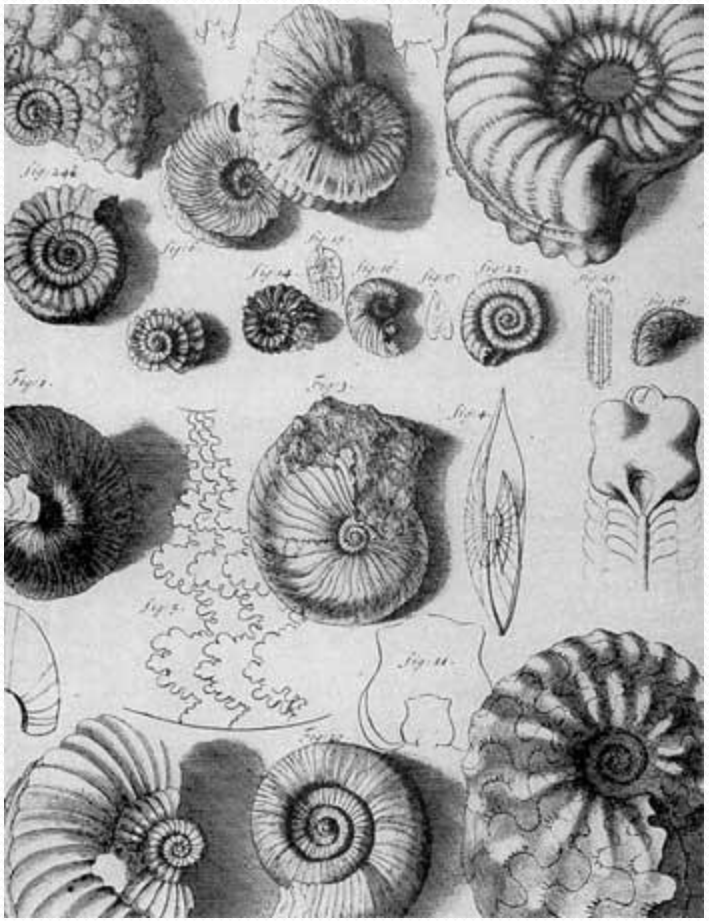
- These are adaptations that occur much faster than structural adaptations

- They are changes to an organism's **metabolic processes.**

- Example – **Antibiotic Resistance** in bacteria. Those bacteria that are not killed by the antibiotic survive to reproduce. They pass their resistance to their offspring and after several generations there is a large population of resistant bacteria.

Fossils

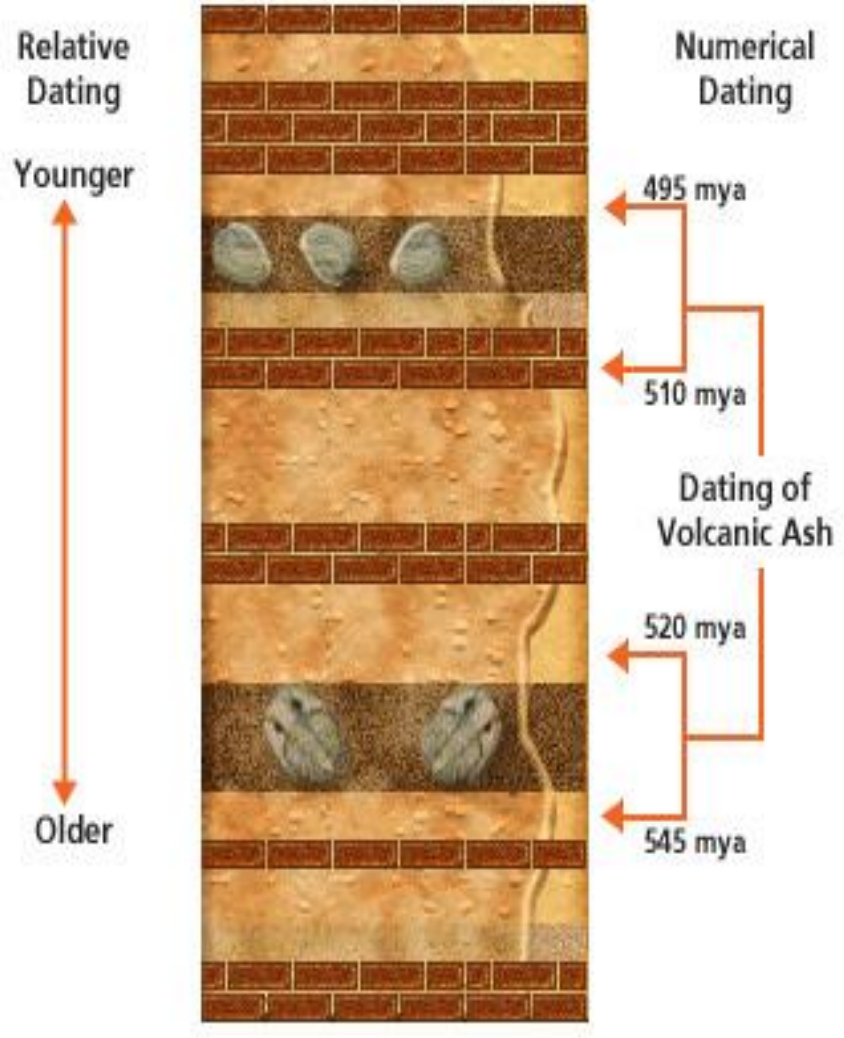
- A fossil is evidence of an organism that lived long ago.
- Fossils can give an overall picture of how species evolved.
- By comparing fossils from different time periods, paleontologists can start to discover which organisms are related and how evolution has occurred.



Two ways fossils to figure out age of fossils

Relative Dating **–**

- Looks at what fossils are found in different layers of the earth.
- Youngest fossils will be found at the top and oldest at the bottom.
- Used for determining appearance and extinction of the species.



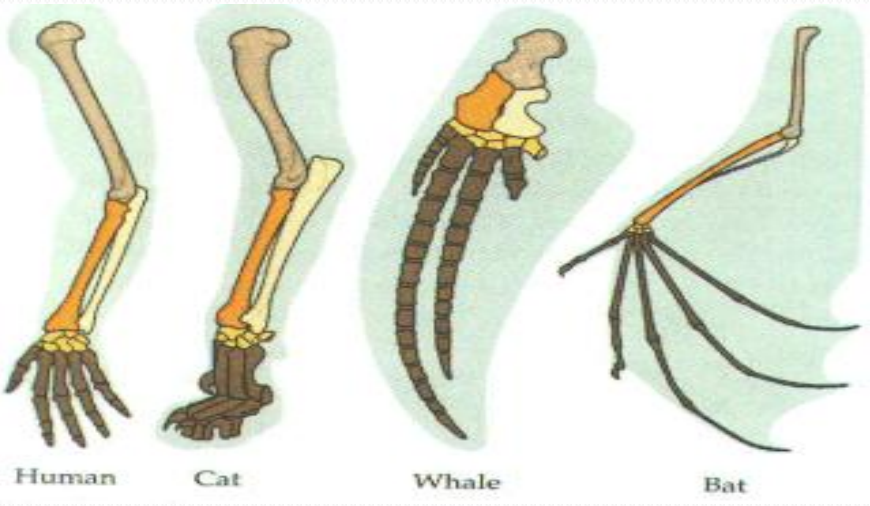
Two ways fossils to figure out age of fossils

Radiometric/Absolute Dating –

- Each fossil contains a radioactive isotope that decays over time.
- Over time, that decay forms a new element.
- Scientists measure how much of the fossil is decayed and how much is normal to find the "half-life".

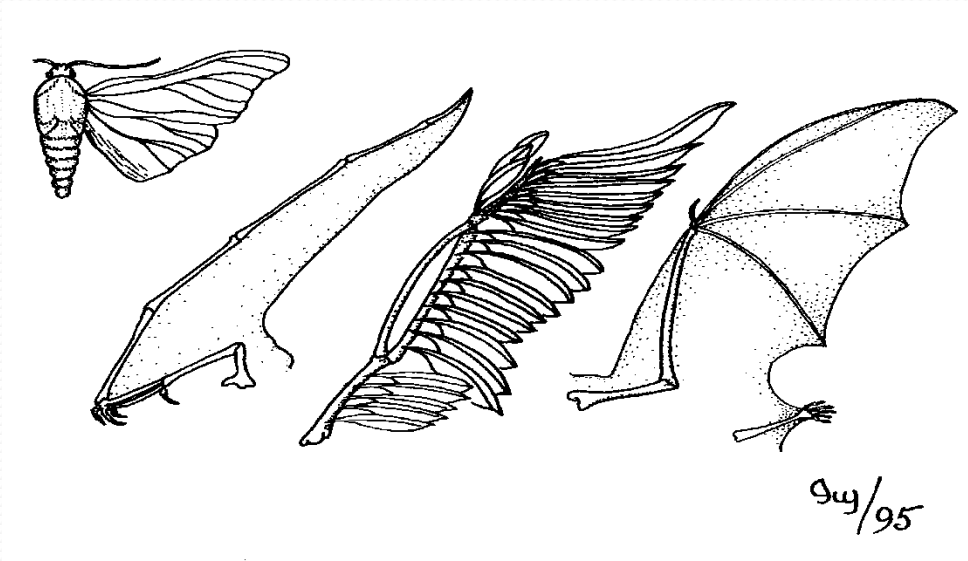
Anatomy

- ***Homologous structures***:
  - Structures in organisms that are similar in arrangement.
  - Show evidence that organisms have a common ancestor. It would be unlikely for so many animals to have similarities if each species arose separately
  - Example: Forelimb bones



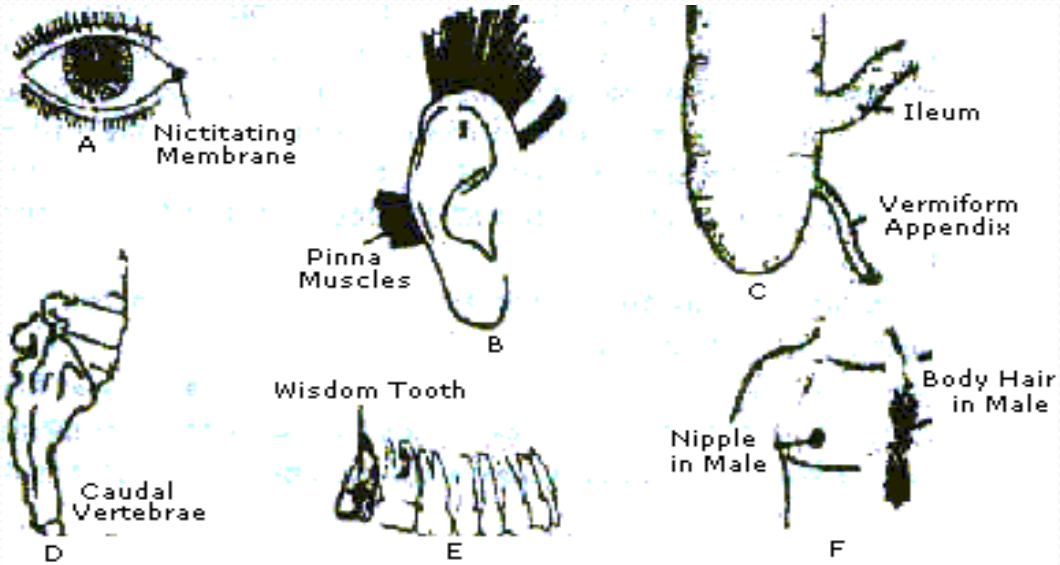
Anatomy

- ***Analogous Structures***:
  - Structures in organisms that are similar in function.
  - These organisms do not have common ancestors, but have adapted to a similar way of life.
  - Examples – Bird wings and insects



Anatomy

- ***Vestigial Structures***:
  - Body Structures that have no function in the present day but were probably useful to an ancestor.
    - Ostriches and penguins have wings but don't fly, humans have a tail bone but no tail, humans have an appendix but it isn't needed.



Vestigial Organs in the Human Body

Embryology

- An embryo is the earliest stage of development and young embryos are relatively indistinguishable. The similarities suggest a distant, common, ancestor.

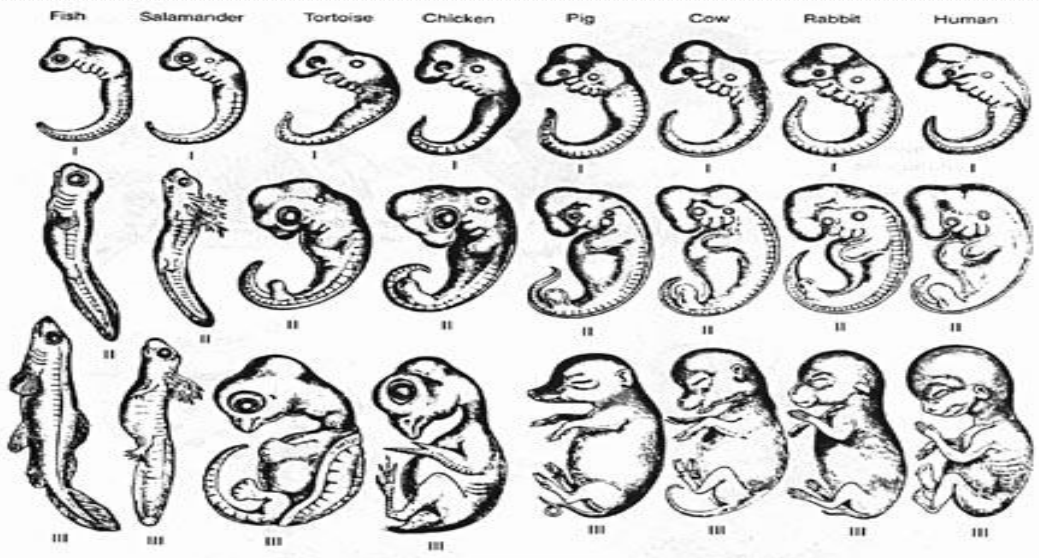
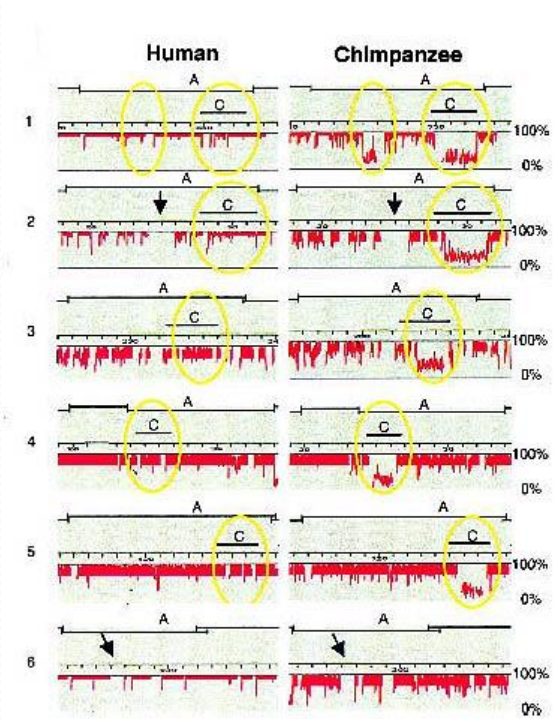


Figure 3–10

A series of embryos of different vertebrates at comparable stages of development. The earlier the stage of development, the more strikingly similar are the different groups. Note that each of the embryos begins with a similar number of gill arches (pouches below the head) and a similar vertebral column. In later stages of development, these and other structures are modified to yield the various different forms. (The embryos in the different groups have been scaled to the same approximate size so that comparisons can be made between them.) (From Romanes, adapted from Haeckel.)

Biochemistry

- Similarities between RNA and DNA sequences show how species are related. The closer the sequence, the more similar the species.



Evolution of a new species

- A species is a group of organisms that **look alike** and **can interbreed** to **produce fertile offspring** in nature.

- Evolution of a new species is called **speciation**. It occurs when members of similar populations no longer interbreed to produce fertile **offspring** in nature.

Ways for a new Species to Evolve

- **Geographic Isolation**
- **Reproductive Isolation**
- **Change in chromosome number**

Geographic Isolation

- When part of a population of the same species becomes geographically isolated from the remainder

- How? Change in ocean level, mountains, canyons, volcanic events

Reproductive Isolation

- This occurs when the genetic material becomes so different that they can no longer mate and produce fertile offspring.

- Behavior differences can keep organisms from interbreeding. An example is mating at a different time of the year.

Change in chromosome number

- Mistakes in mitosis and meiosis can cause too many genes and a mutation occurs, making a mutant.

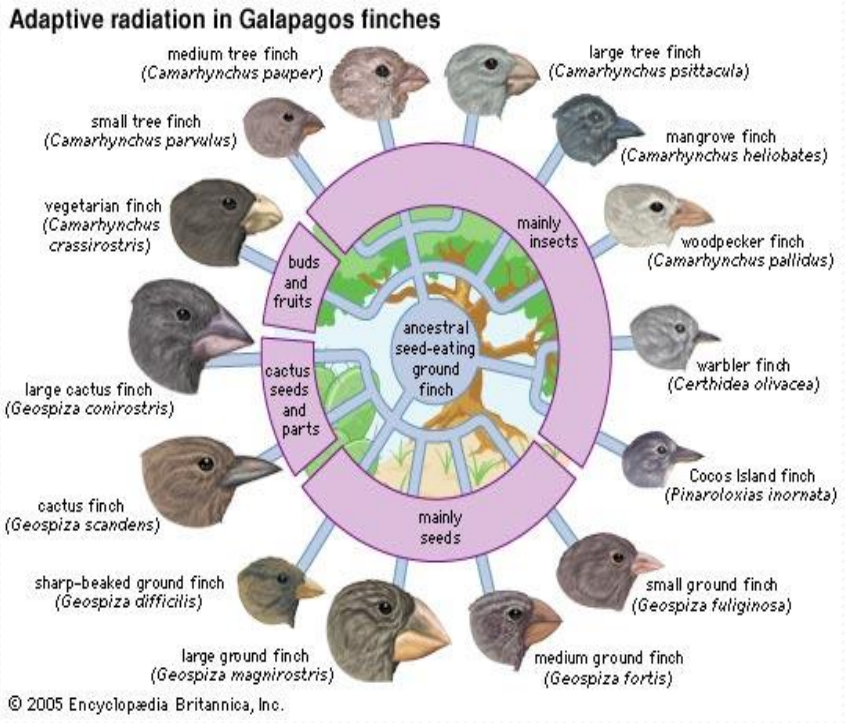
- Many plant species have come about this way. Wheat, cotton, apples, bananas

Patterns of Evolution

- **Divergent Evolution**
- **Convergent Evolution**

Divergent Evolution

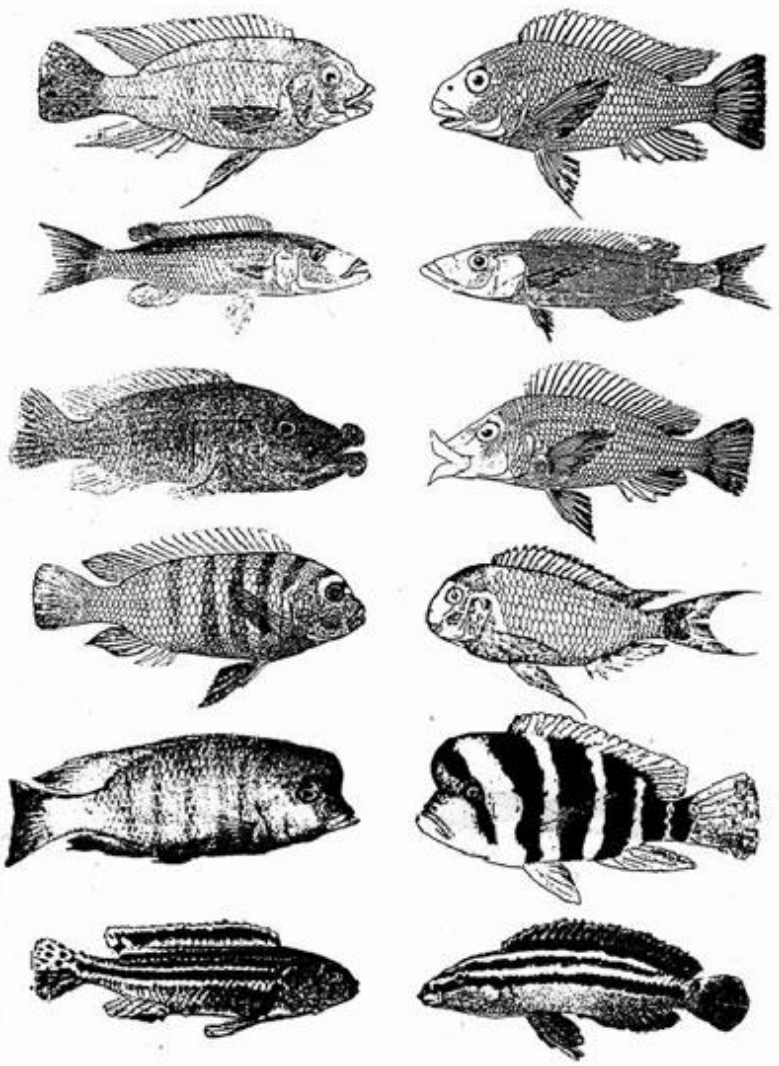
- Divergent Evolution – occurs when a species that was once similar to ancestral species becomes increasingly different.
- This occurs when populations adapting to different environmental condition change and eventually become new species
- This can occur when an ancestral species evolves into many different species to fit diverse habitats. This is called adaptive radiation.



Convergent Evolution

- **<u>Convergent Evolution</u> – occurs when two unrelated species evolve similar traits because they live in similar environments in different parts of the world.**

- **Example – Cacti, fish**



Description of Population

- **1. A population is defined as members of a species that live in one area.**
- **2. Populations evolve, not individuals.**
- **3. Populations are always either evolving or are in genetic equilibrium.**

Changes in Genetic Equilibrium

- There are 3 ways to have a change in Genetic Equilibrium
  - Gene Flow
  - Genetic Drift
  - Mutations

Changes in Genetic Equilibrium

- **Gene Flow - is the movement of individuals in and out of a population. This can introduce or remove alleles in the gene pool.**

Changes in Genetic Equilibrium

- **Genetic Drift – is the alteration of allele frequencies by chance events. This occurs when populations become isolated.**

Example – Amish populations – recessive alleles are more common.

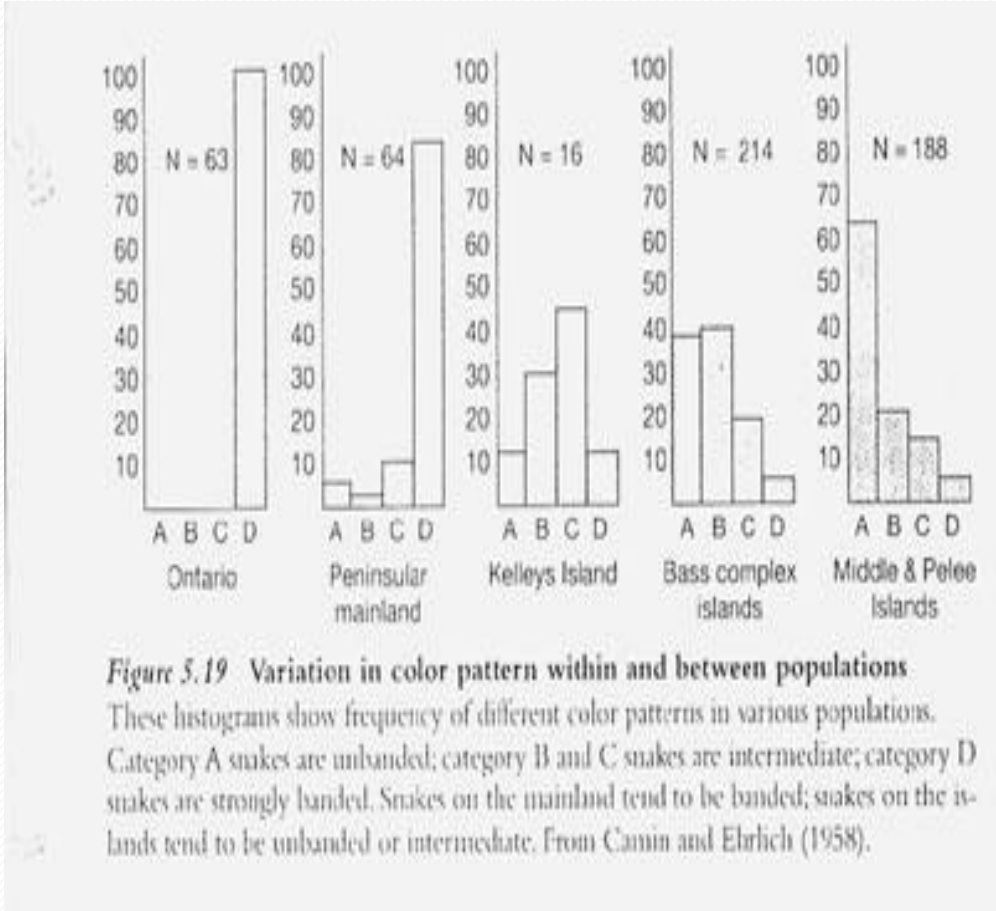


Figure 5.19 **Variation in color pattern within and between populations** These histograms show frequency of different color patterns in various populations. Category A snakes are unbanded; category B and C snakes are intermediate; category D snakes are strongly banded. Snakes on the mainland tend to be banded; snakes on the islands tend to be unbanded or intermediate. From Camin and Ehrlich (1958).

Changes in Genetic Equilibrium

- Mutations caused by **chance** or **environmental factors** can introduce new alleles to the gene pool. These mutations can be **good or bad.**