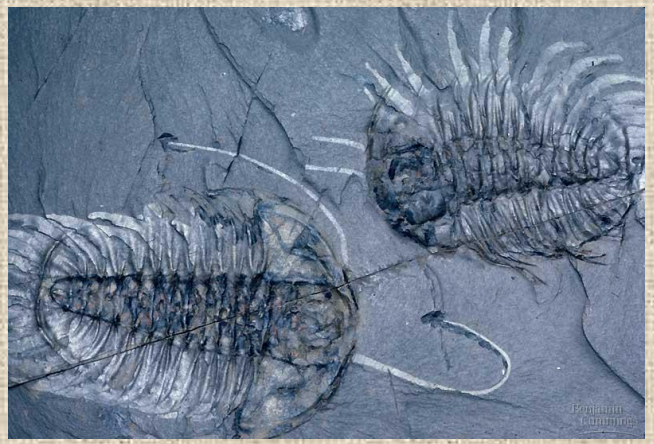
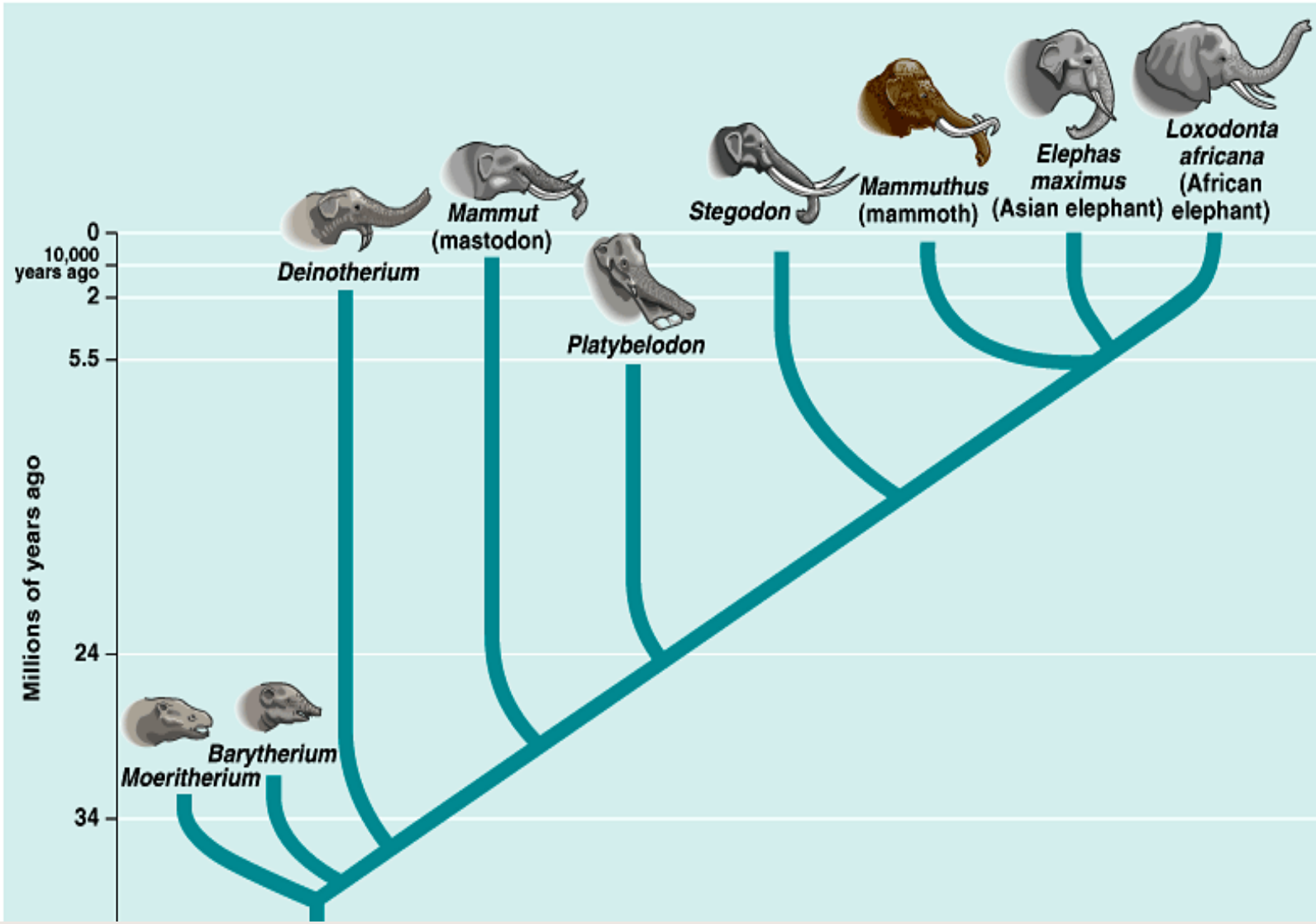
Aim: Defining Organic Evolution



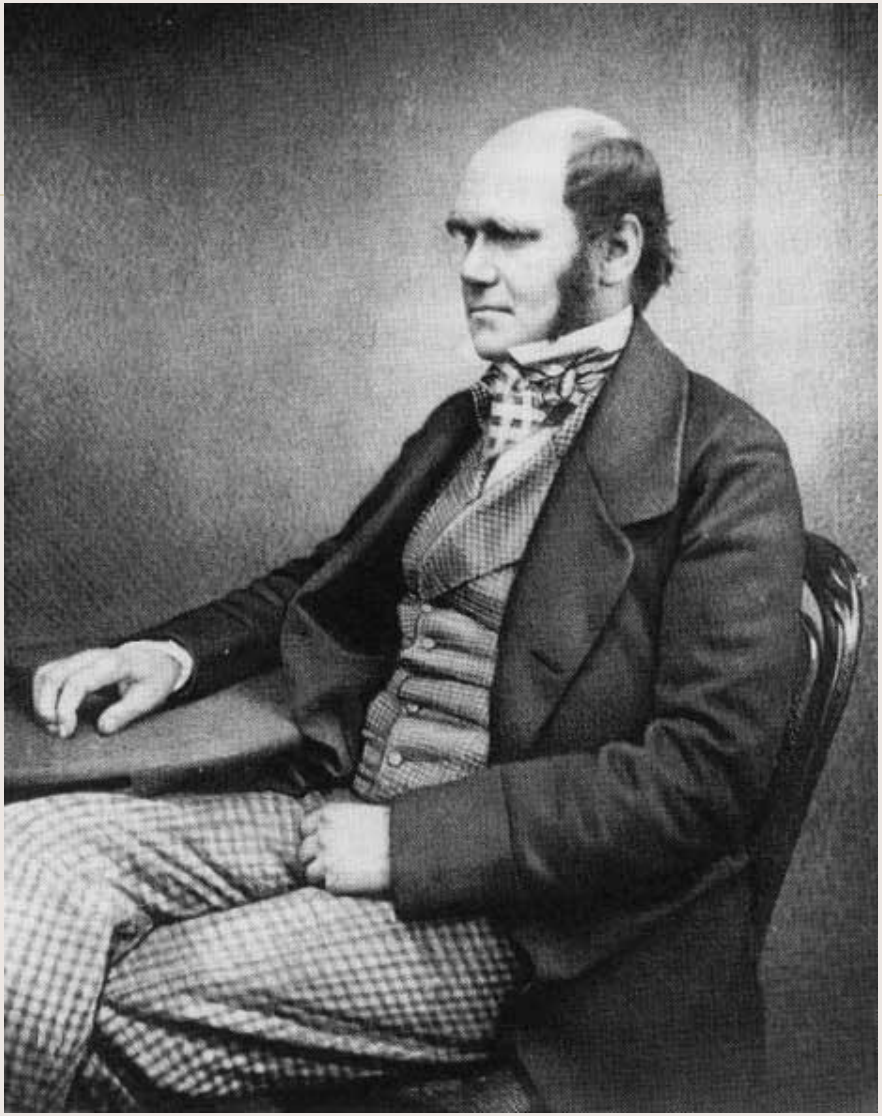
Evolution

- Evolution – involves the changes in populations, species or groups of species.
- Involves the changes in the frequency of inheritable traits from one generation to the next in a population
- Areas of evolutionary study:
  - Microevolution – how populations change; how new species form
  - Macroevolution - patterns of changes in groups of similar species over broad periods of geologic time.
  - Phylogeny – evolutionary relationships among species or groups of species.


Millions of years ago
0
10,000 years ago
2
5.5
24
34
Moeritherium
Barytherium
Deinotherium
Mammut (mastodon)
Platybelodon
Stegodon
Mammuthus (mammoth)
Elephas maximus (Asian elephant)
Loxodonta africana (African elephant)

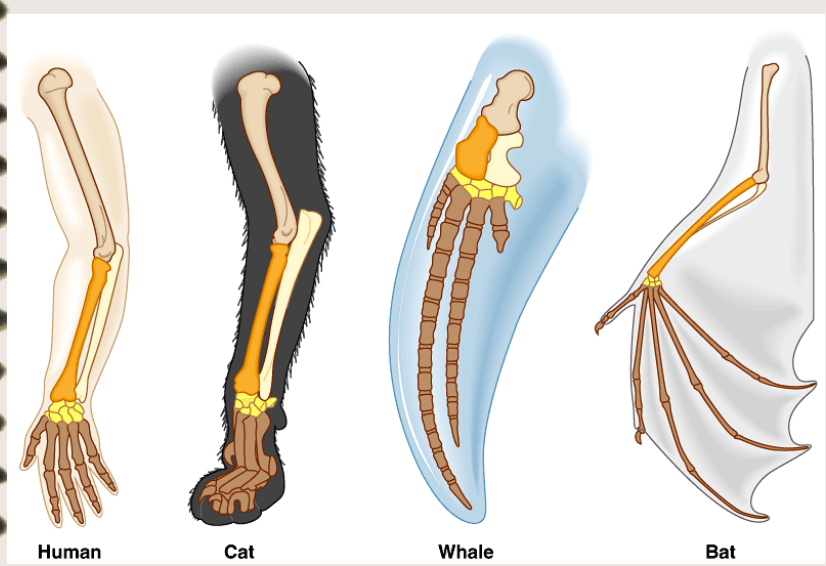
Lamarck's Theory of Evolution

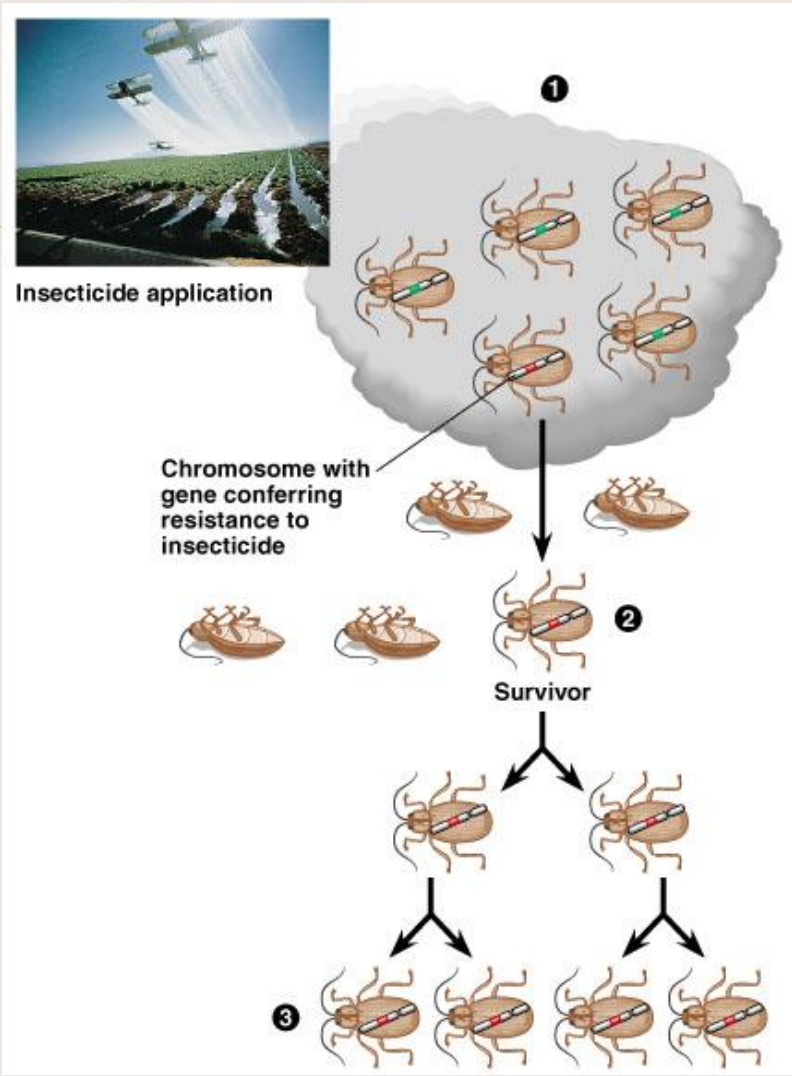
- 1809 – France
- 1) use and disuse – as an organism uses an organ, it grows stronger.
- 2) inheritance of acquired characteristics – incorrect idea that offspring inherit characteristics that their parents acquire during their lifetime, such as cancer, intelligence,etc.
- 3) natural transformation of species – incorrect idea that evolution occurs as slow gradual changes in the species accumulate over time.



Darwin's Theory of Evolution

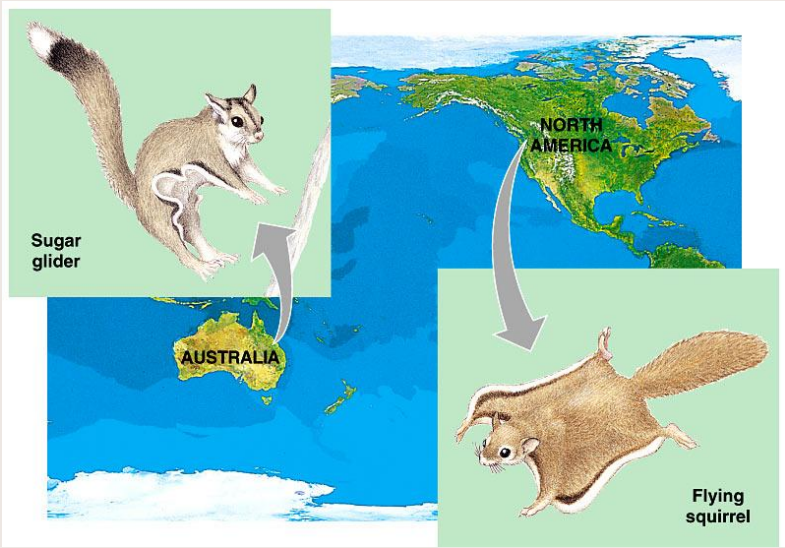
- 1) populations possess an enormous reproductive potential. (overproduction)
- 2) population size remains stable.
- 3) resources are limited.
- 4) individuals compete for survival.
- 5) there is variation amongst individuals in a population
- 6) much variation is inheritable (through fertilization of sex cells.)
- 7) only the most fit individuals survive
- 8) evolution occurs as advantageous traits accumulate and are acted upon by nature.


Human
Cat
Whale
Bat


Insecticide application
1
Chromosome with gene conferring resistance to insecticide
2
Survivor
3

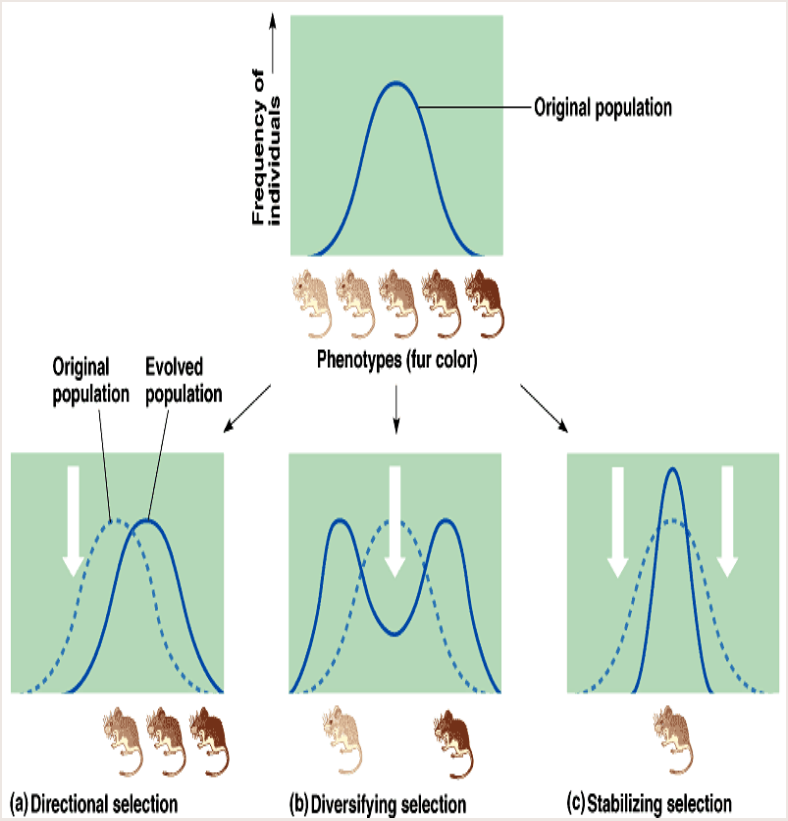
Evidence for evolution

- 1) paleontology (fossil evidence/ index fossils)
- 2) biogeography (Australia vs South America)
- 3) embryology
- 4) comparative anatomy
  - Homologous structures (indicates common ancestor)
  - Analogous structures (convergent evolution due to similarity of the environment – no common ancestor)
- Molecular biology (DNA/ protein)



Types of Natural Selection

- Stabilizing selection – eliminates individuals with extreme traits.
- Directional selection – favors traits that are one extreme of a range of traits.
  - Insect resistance
  - Industrial melanism



Types of Natural Selection

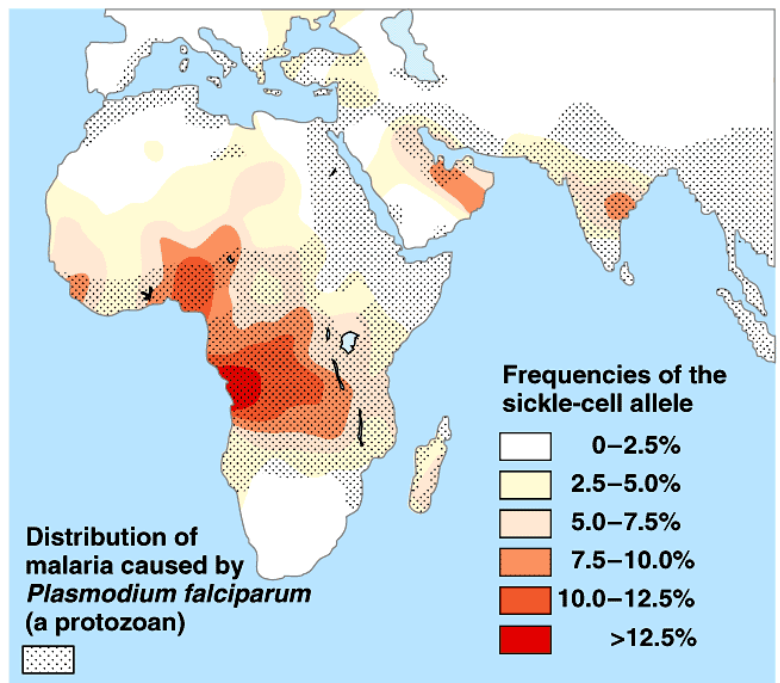
- Disruptive (diversifying) selection – favors the extreme
  - Tall (wild) vs short (garden) weeds
- Sexual selection (sexual dimorphism)
  - Male competition
  - Female choice
- Artificial selection (breeding of domesticated crops and animals)

Sources of Variation

- 1) mutations
- 2) sexual reproduction (genetic recombination)
  - Crossing over during meiosis
  - Independent assortment of homologous chromosomes
  - Random joining of gametes
- 3) diploidy
- 4) outbreeding – mating with unrelated partners
- 5) balanced polymorphism – maintenance of different phenotypes in a population

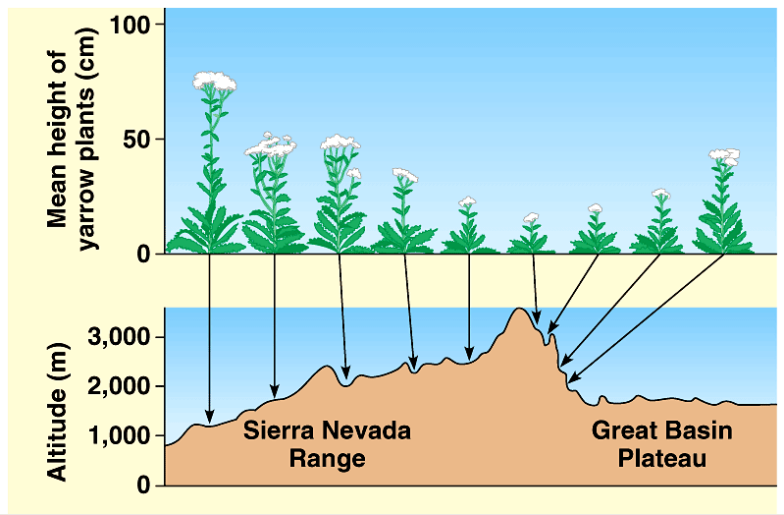
Balanced Polymorphism

- Heterozygote advantage – heterozygote has a distinct advantage and both alleles remain in the population – sickle-cell anemia
- Hybrid vigor – superior quality of offspring resulting from crosses between two different plant strains (hybrid corn)
- Frequency-dependent selection (minority advantage)



Causes of changes in allelic frequencies in a population

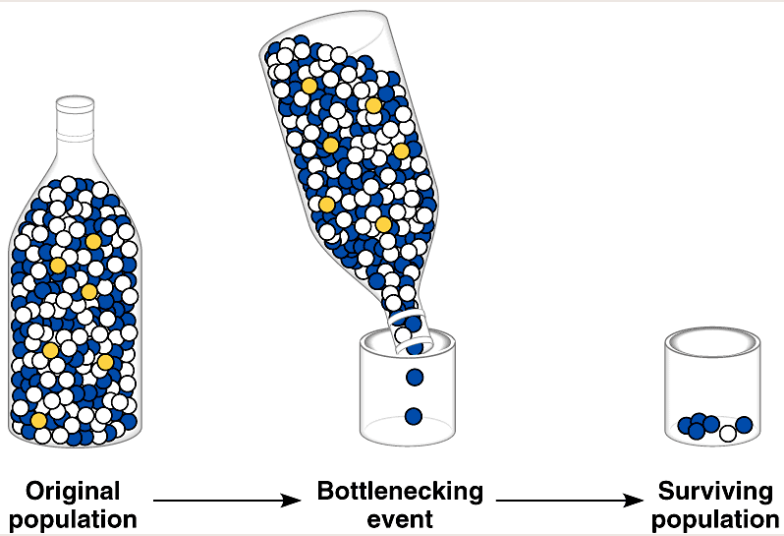
- 1) natural selection
- 2) mutation
- 3) gene flow (immigration & emigration)
- Nonrandom mating
  - Inbreeding
  - Sexual selection – females mate with specific males



Examples of a cline

Geographic variation in the form of graded change in a trait along a geographic axis is called a **cline**.

Causes of changes in allelic frequencies in a population



- 5) genetic drift – random increase or decrease in allelic frequency due merely to chance occurrence
- A) founder effect – migrating group has allelic frequency different from main population
- B) bottleneck occurs when a population undergoes a dramatic decrease in size