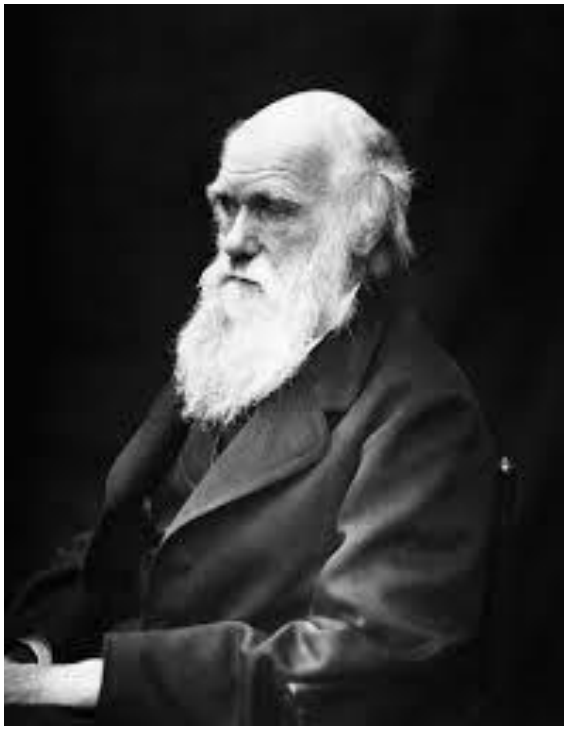
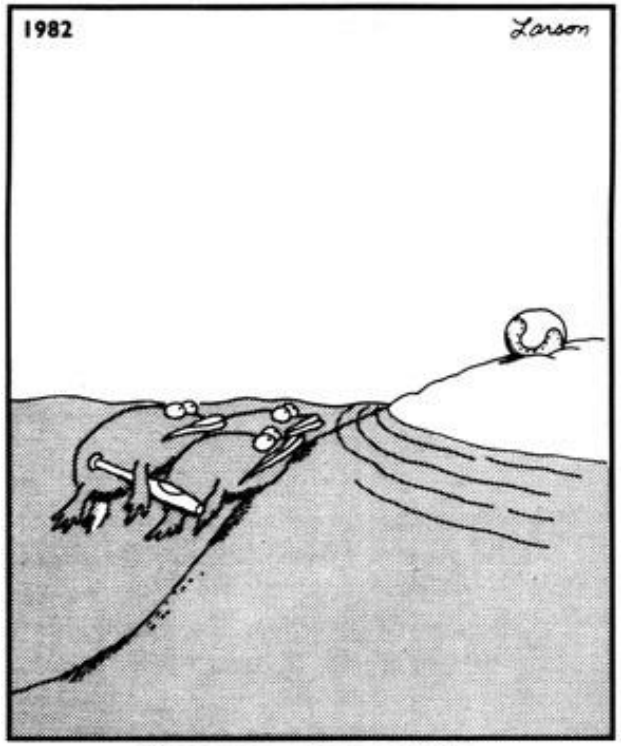
#Evolution

"Nothing in Biology makes sense except in the light of evolution."





Great moments in evolution

The Theory of Evolution

- Change over time.
  - People used to think that species did not change.

DARWIN WAS NOT THE PERSON TO COME UP WITH EVOLUTION

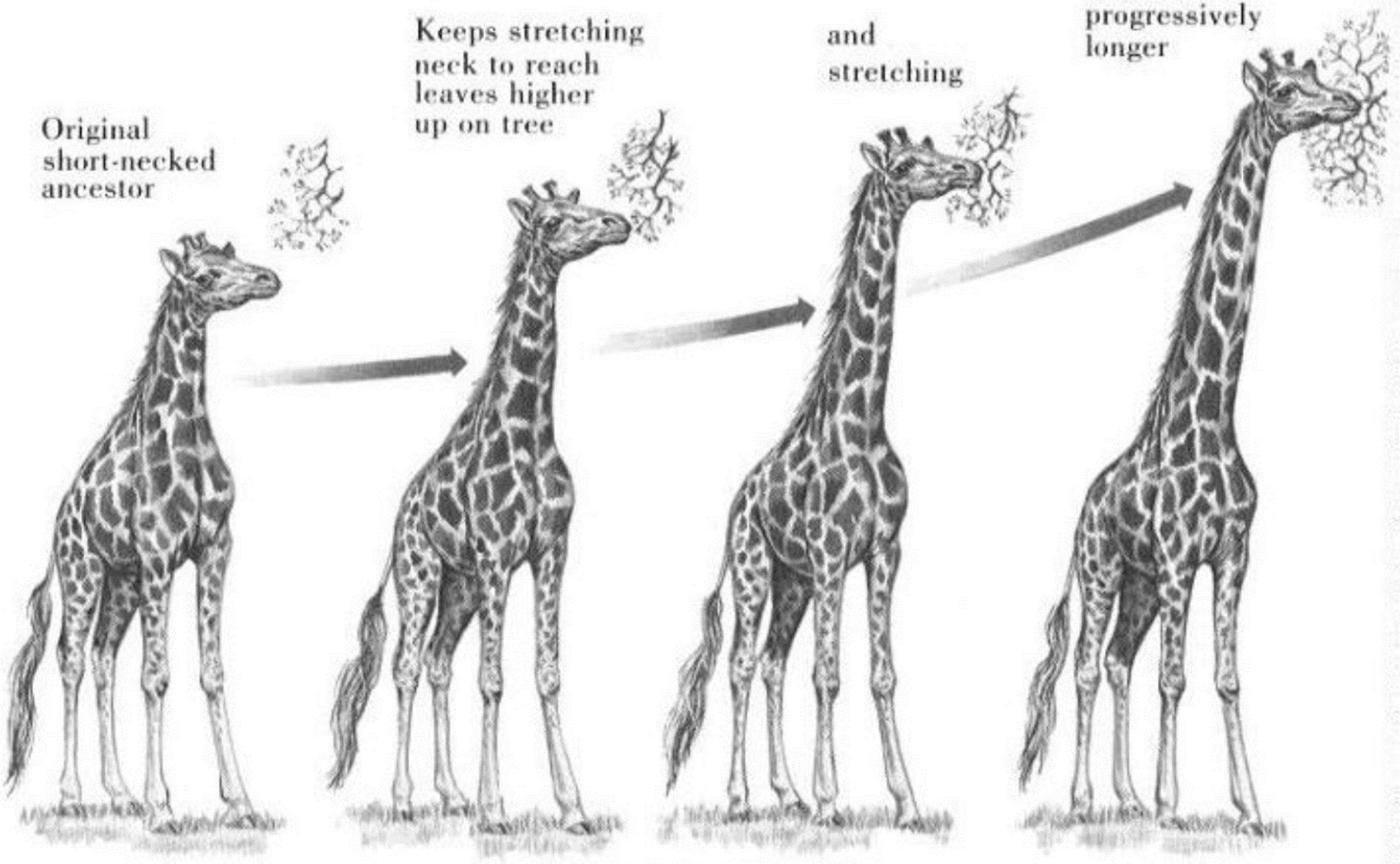
MANY scientists came up with the idea that species change They just didn't know **how**

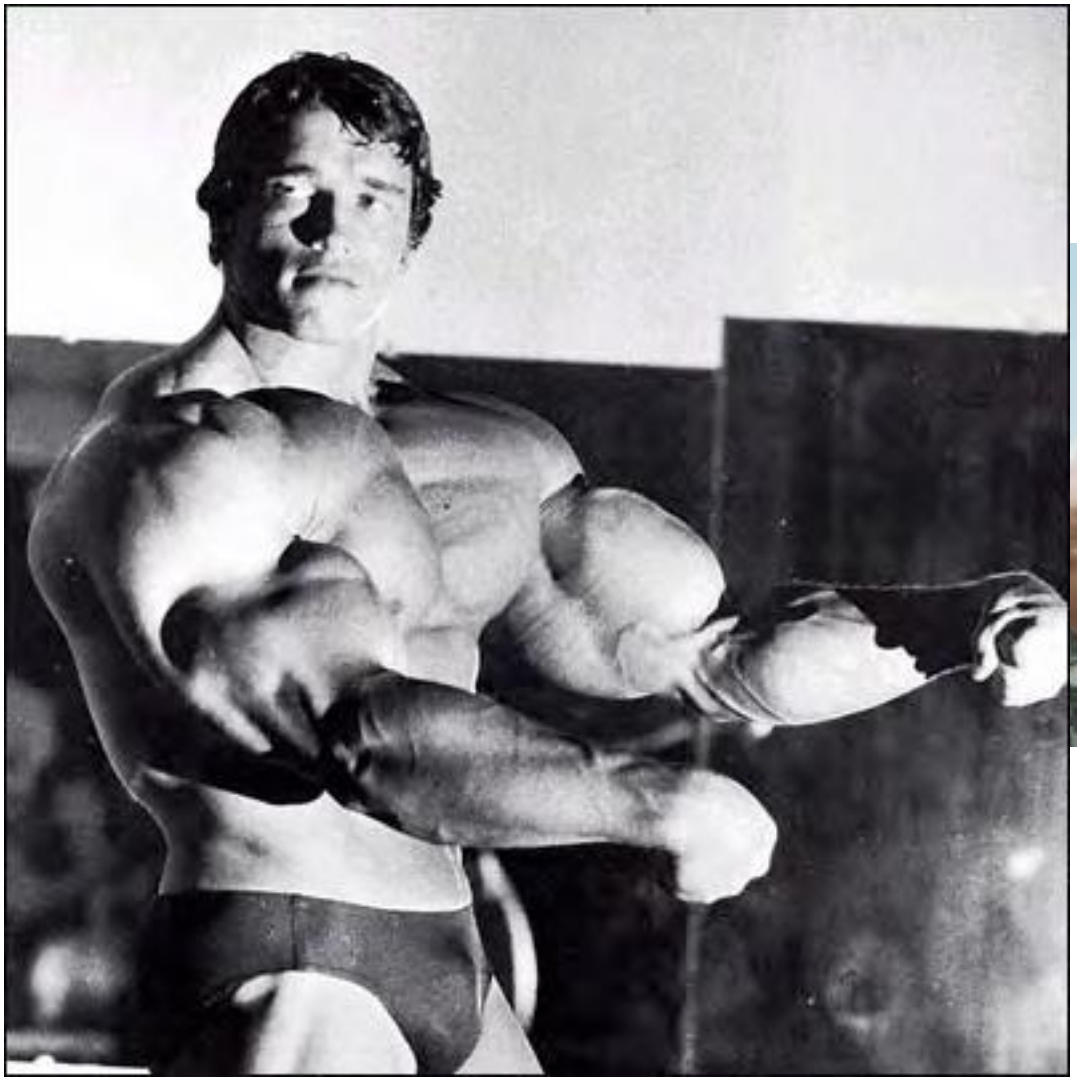
John Baptiste Lamarck

- French Biologist (1744-1829)
- Knew species changed, just had the wrong mechanism

- Lamarckian Inheritance
  - Use and disuse of acquired characters

LAMARCK'S GIRAFFE





Lamarck's mechanism was wrong

Darwin's Natural Selection is the correct mechanism

ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

1859

Natural Selection: Darwin's mechanism

- We can break it down into **5** facts & **3** conclusions.

Fact 1: **High reproductive potential**

The Duggar Family- 19
Kids and counting

Sultan Ishmael the Blood thirsty of Morocco fathered 800 children

Fact 2: **Constant Population Size**

Populations maintain and stay the same size

Fact 3: **Natural Resources are Limited**

- There's only so much food, shelter, habitat available to living organisms

Conclusion 1: **Struggle for Existence**

- Not all acorns or rabbits produced will survive!

Fact 4: **Variation- all species are variable**

Fact 5: **Variation is inherited**

- **Variation is passed on from parent to offspring.** Darwin knew this and he didn't know anything about Genetics.

- Conclusion 3: **Natural Selection= Survival of the Fittest** (the organism that can best reproduce)
  - Those individuals that survive better than the others, will pass on their genes to the offspring.

- Conclusion 4: **EVOLUTION- species change over time**

RECAP

Populations are variable

Natural Selection

Some individuals survive better & reproduce more than others

The next generation is more like the survivors

Result: the population changes = **evolution**

Heritable Characteristics

- These improve survivability and reproductive potential.
- Example:
  - Lizards changing color to camouflage
  - Octopus changing color and shape

Differential Reproductive Success

- The ability of an organism to compete successfully for resources, survive predation, resist disease and live to adulthood allows that organism to reproduce.

Adaptations

- A genetic change that allows organisms to survive natural selection in their habitat.
- Adaptations lead to change in species.
- Examples:
  - Beak shapes on birds
  - Thorns on stems of flowers
  - Mimicking a poisonous animal or plant (fly mimics wasp)

Note on Natural Selection

- Evolution does not occur in individuals.
- Natural selection acts on the phenotypes of individuals which survive and reproduce
- So, evolution acts directly on the population as a whole.

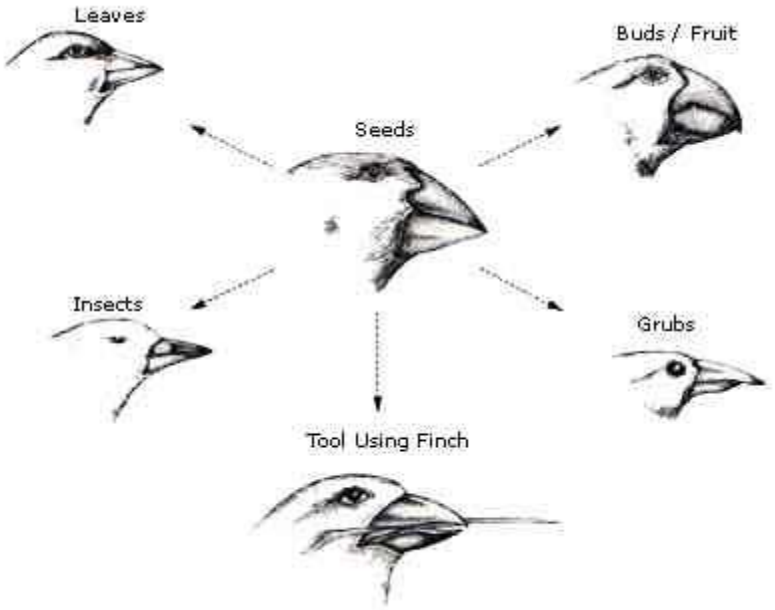
- Variation is the Raw material for evolution

Evidence of Evolution

Darwin's 2nd Contribution

Morphologies

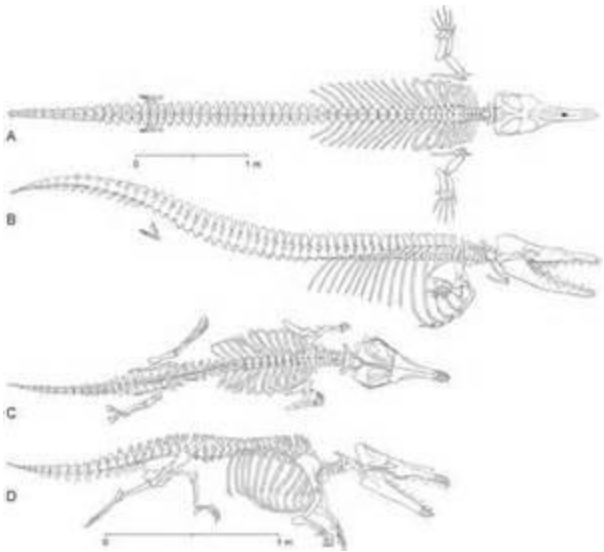
- The form and structure of organisms' traits depending on their environment.
- Example:
  - Finches have different beak shapes for the function of eating different food items

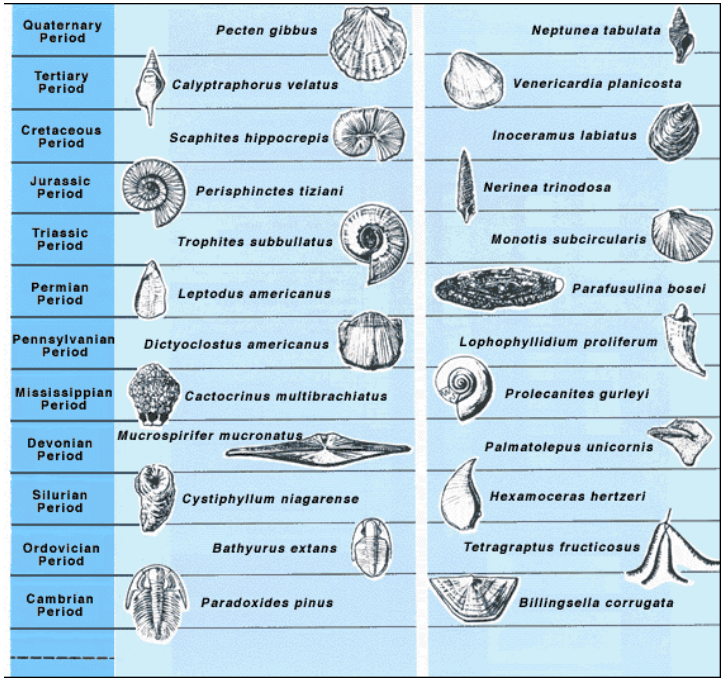


Fossils:

- Study of preserved remnants or imprints of organisms
- Transitional fossils explain “links” between different groups

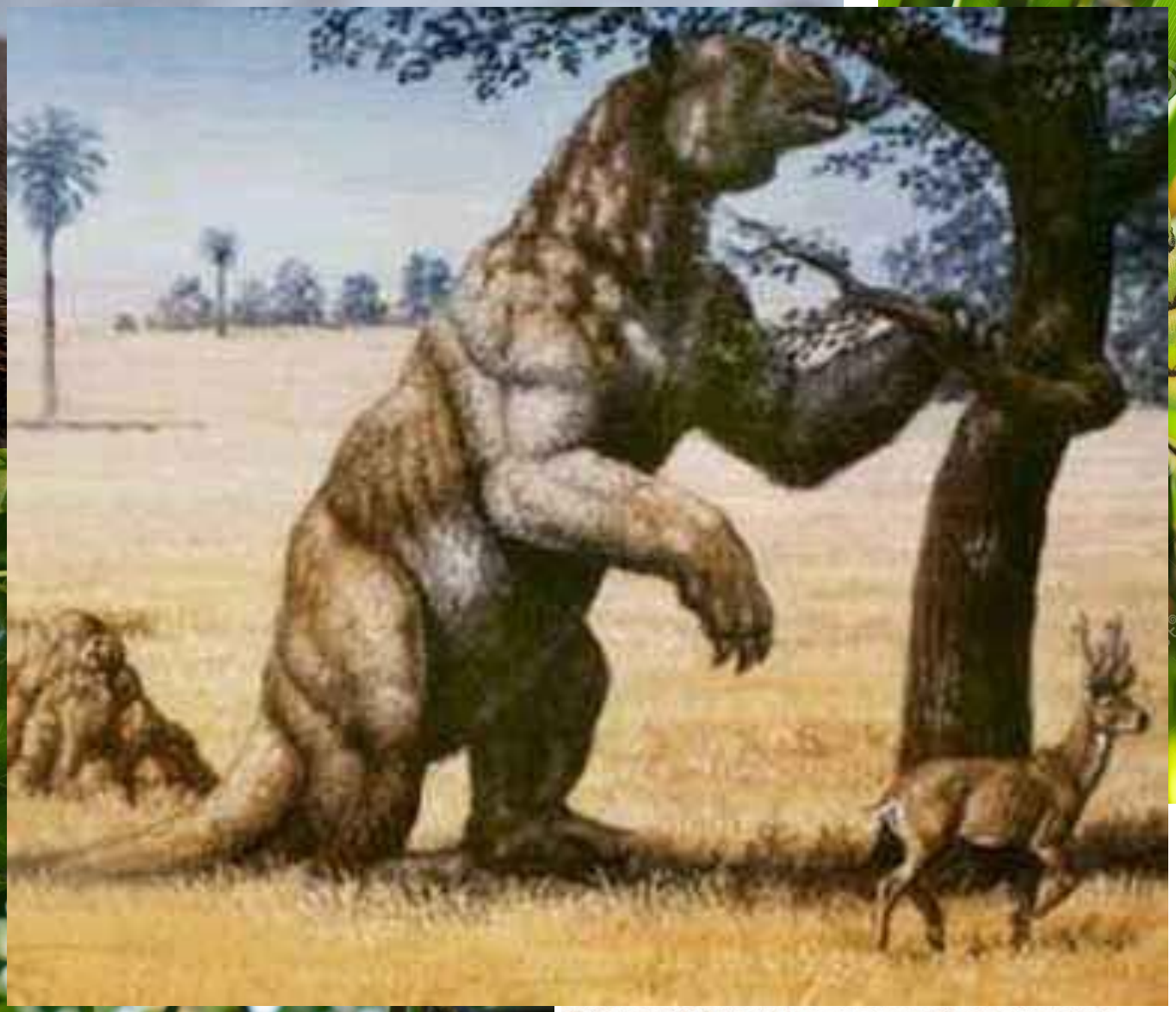
* Does not show cellular or molecular data





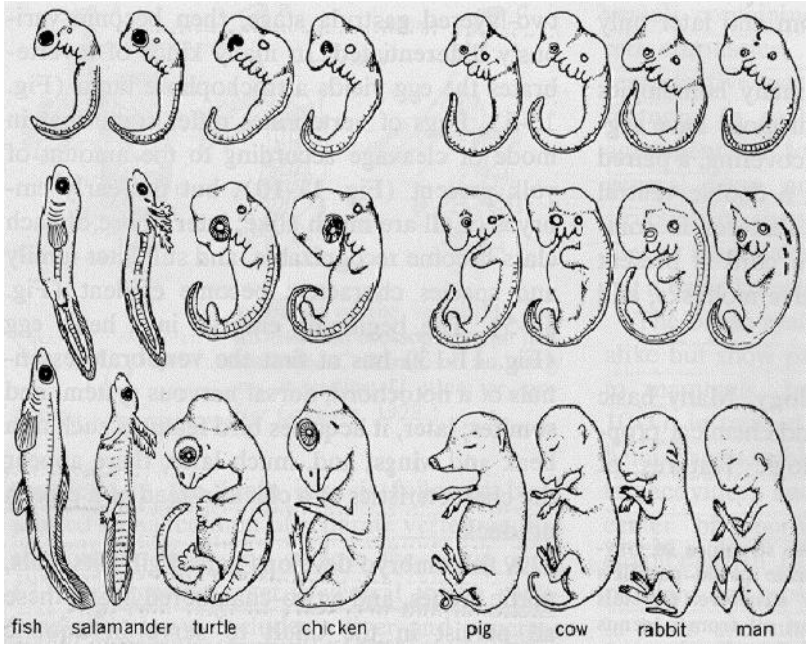
Living Fossils

(ghosts of evolution, **anachronisms**)



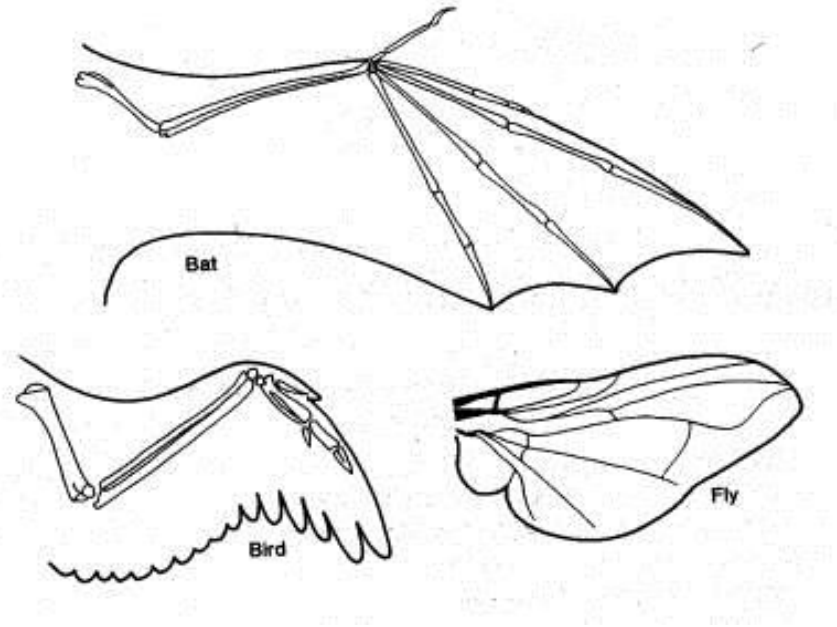
Embryology

- Comparing embryos of different organisms for similarities showing the developmental process is the same in different species.
- Example:
  - All vertebrates have gill slits and a tail bone in the embryonic stage. In some animals these turn into actual gills in others they turn into ear bones.



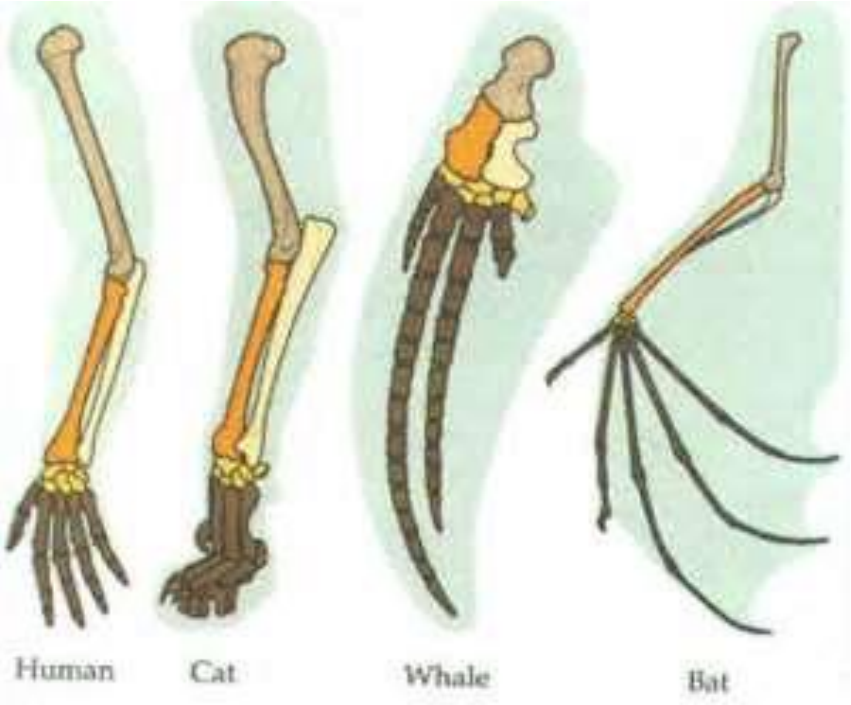
Analogous Structures

- Same function, different structure
- Example:
  - Due to convergent evolution, different organisms need to function the same



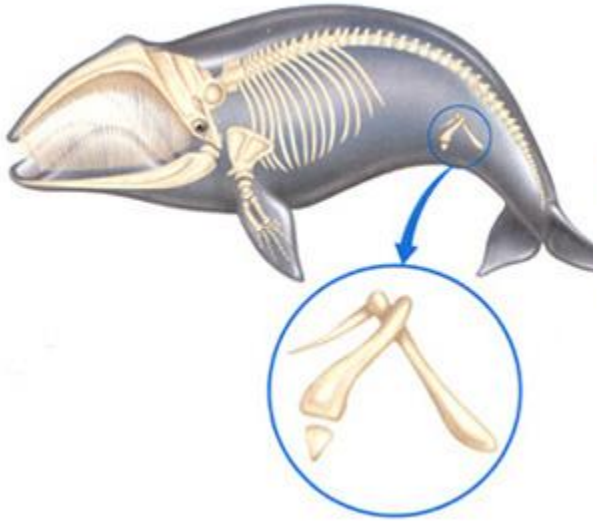
Homologous Structures

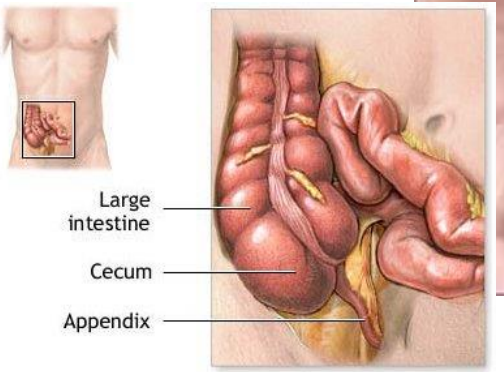
- **Structure and placement are the same.**
  - Why? Due to a common ancestor
- Example:
  - Due to divergent evolution, like organisms develop different structures for different functions



Vestigial Structures

Structures present in modern organisms that no longer function, but functioned in ancestral organisms





YOU HAD A TAIL!

Other Types of Evidence

- Domesticated Animals/Cultivated Plants
- Geographic Distribution/Biogeography
- Darwin didn’t know about:
  - Bacterial Resistance
  - Molecular Data
  - Endosymbiosis

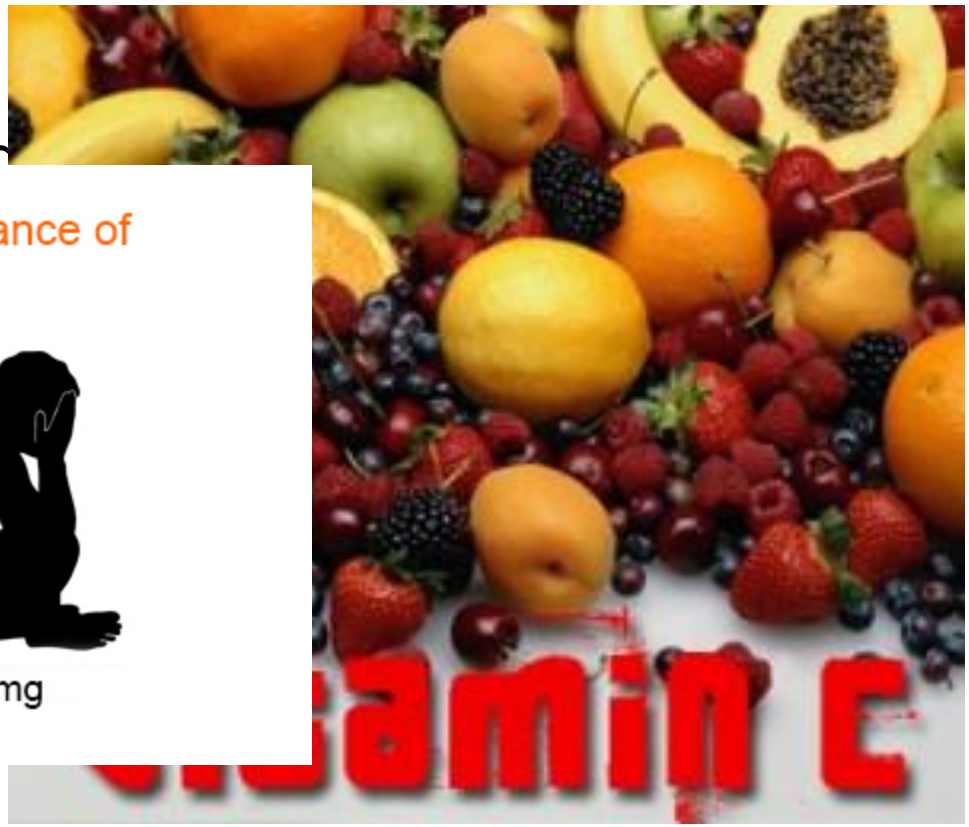
Biogeography- Geographic Distribution

- When a population is split into two separate populations in two different habitats and each group evolves differently to survive.

Alligators lack salt glands of crocodiles; the Chinese (Asian) and Amerian species had separated no later than 14 mya

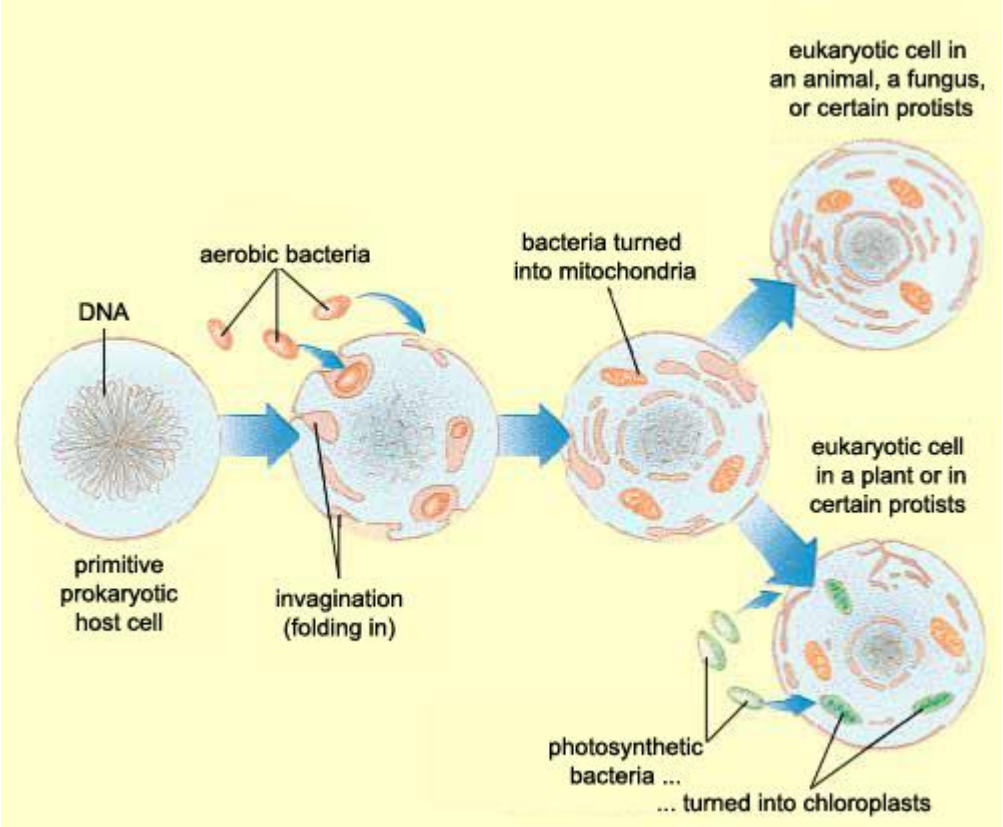
Molecular Data

- Finding the relationships in the amino acids and DNA of different species to see how similar or different they are from each other.
- Example:
  - In the hemoglobin and



Endosymbiosis

- Small bacteria cells entered larger bacterial cells. These smaller cells began to live inside and benefit their host cell, eventually becoming cellular organelles like mitochondria, and chloroplast.
- Example



Ancestral animal cell (mitochondria only)

Ancestral plant cell (mitochondria and chloroplasts)

Mechanisms of Evolution

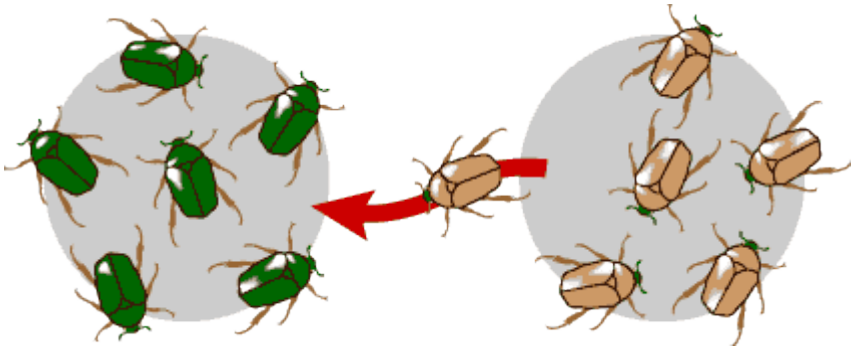
- Natural Selection
- Mutations
- Gene Flow
- Genetic Drift
- Isolating Mechanisms
  - Behavioral
  - Geographical

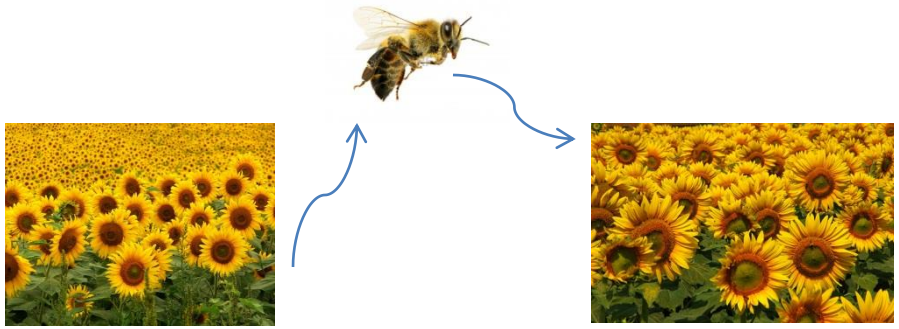
Mutations

- If a mutation benefits the survival of a population it will become a common trait
- If a mutation is detrimental to the population, it will not become a common trait.
- Alleles only increase if the mutation is beneficial.
- **VERY RARE**

Gene Flow

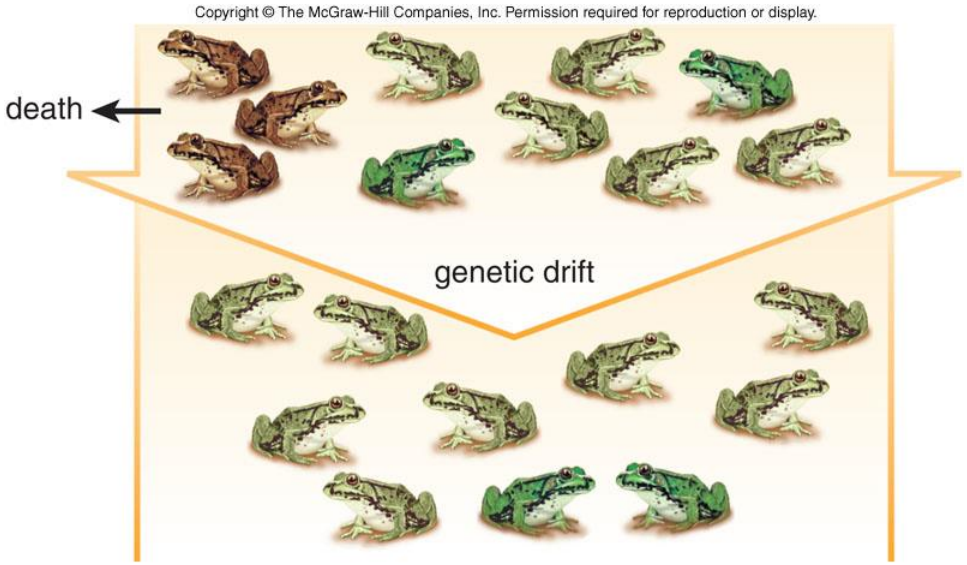
- The transfer of alleles from one population to another.
- Example:
  - An individual leaves one population and travels to another and reproduces with the new population.
  - An animal carries pollen from one population of flowers to a different population of flowers





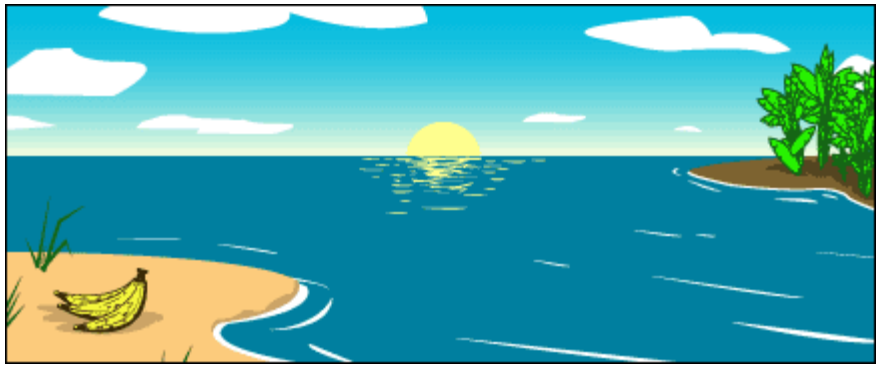
Genetic Drift

- The change of frequency of alleles in one population in a certain area.
- Example:
  - In a population of frogs living in a swamp, those with lighter skin survive longer – the light skin allele will increase throughout the population of these frogs.



Geographical Isolation

- Populations are separated by water or land and evolve differently increasing biodiversity.
- Examples:
  - Darwin's finches on islands separated by water
  - Population of squirrels separated by a canyon
  - Population of rabbits separated by a river



Behavioral Isolation

- Reproduction does not occur due to some type of behavior
- Example – the male peacock spider displays his colors and dances to attract a female, if a female peacock spider does not respond or recognize this dance ritual, she will not mate with him.

Temporal Isolation

- Reproduction doesn't occur because they mate at different times.
- Example; Spring Field Cricket and the Fall Field Cricket

(a) Spring field cricket (*Gryllus veletis*)

(b) Fall field cricket (*Gryllus pennsylvanicus*)