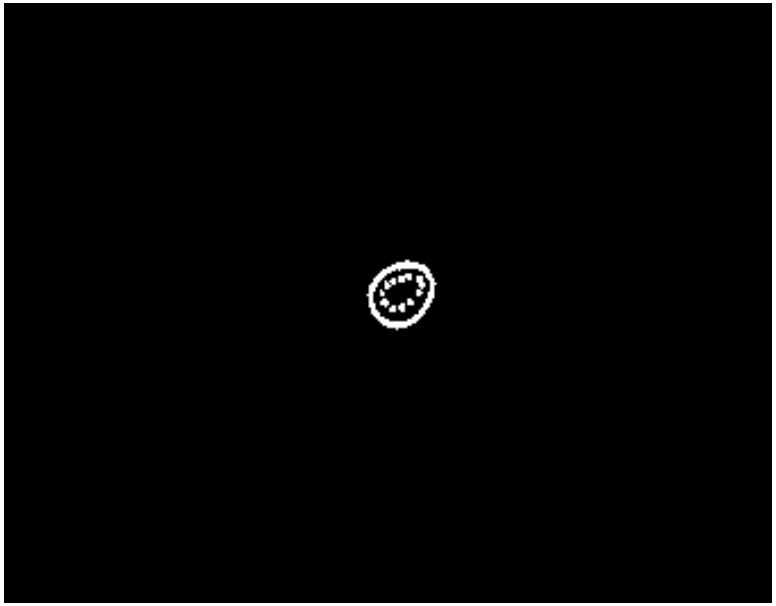
Evolution & Change Over Time

Mechanisms of Evolution

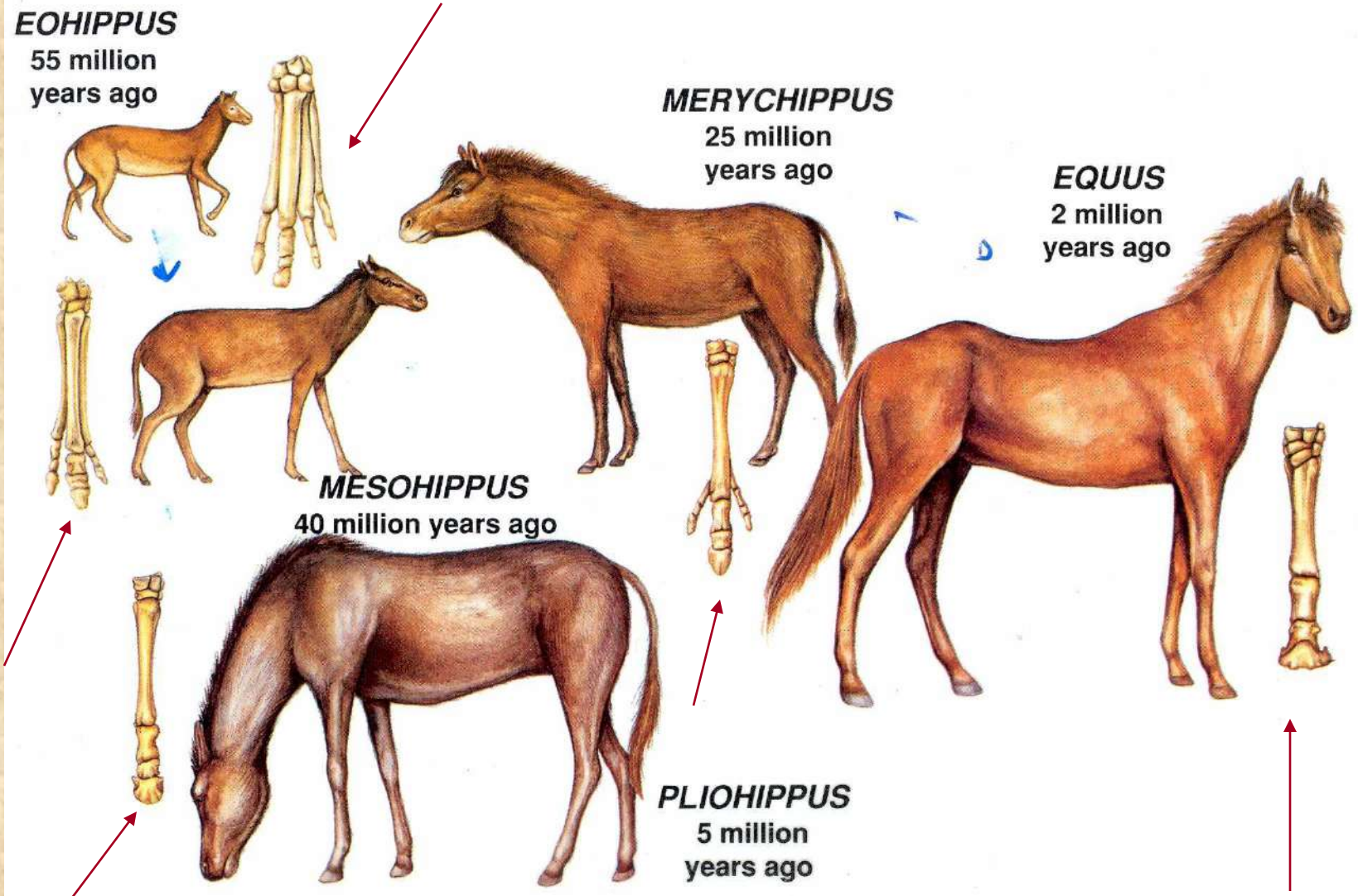
- *Evolution*: **change** in the hereditary features of species **over time**.
  - *Species*: a group of **organisms** that successfully **reproduce** among themselves.
- *There are two kinds of evolution:*

1. *Gradualism*: slow change of one species to another **new species**. In this theory, there are **intermediate** forms of the species

- Example: **horses**

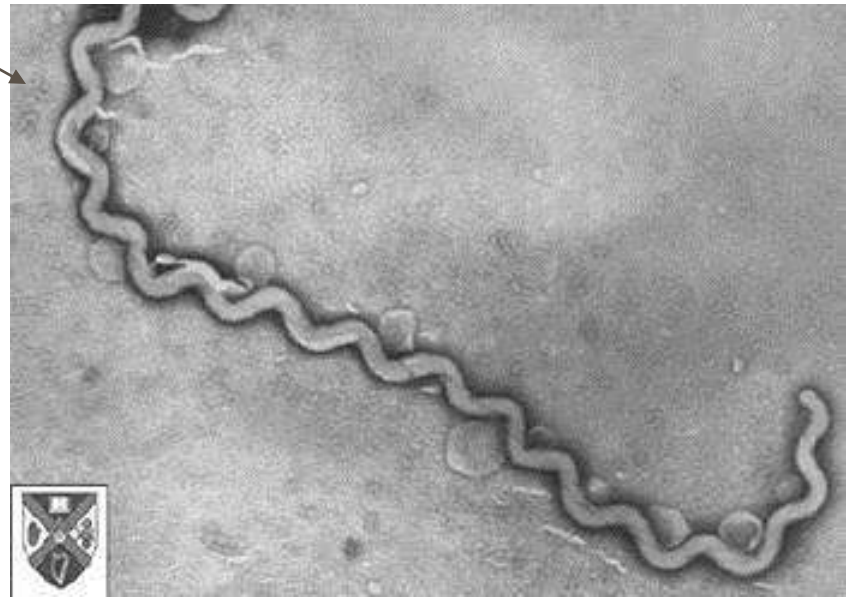


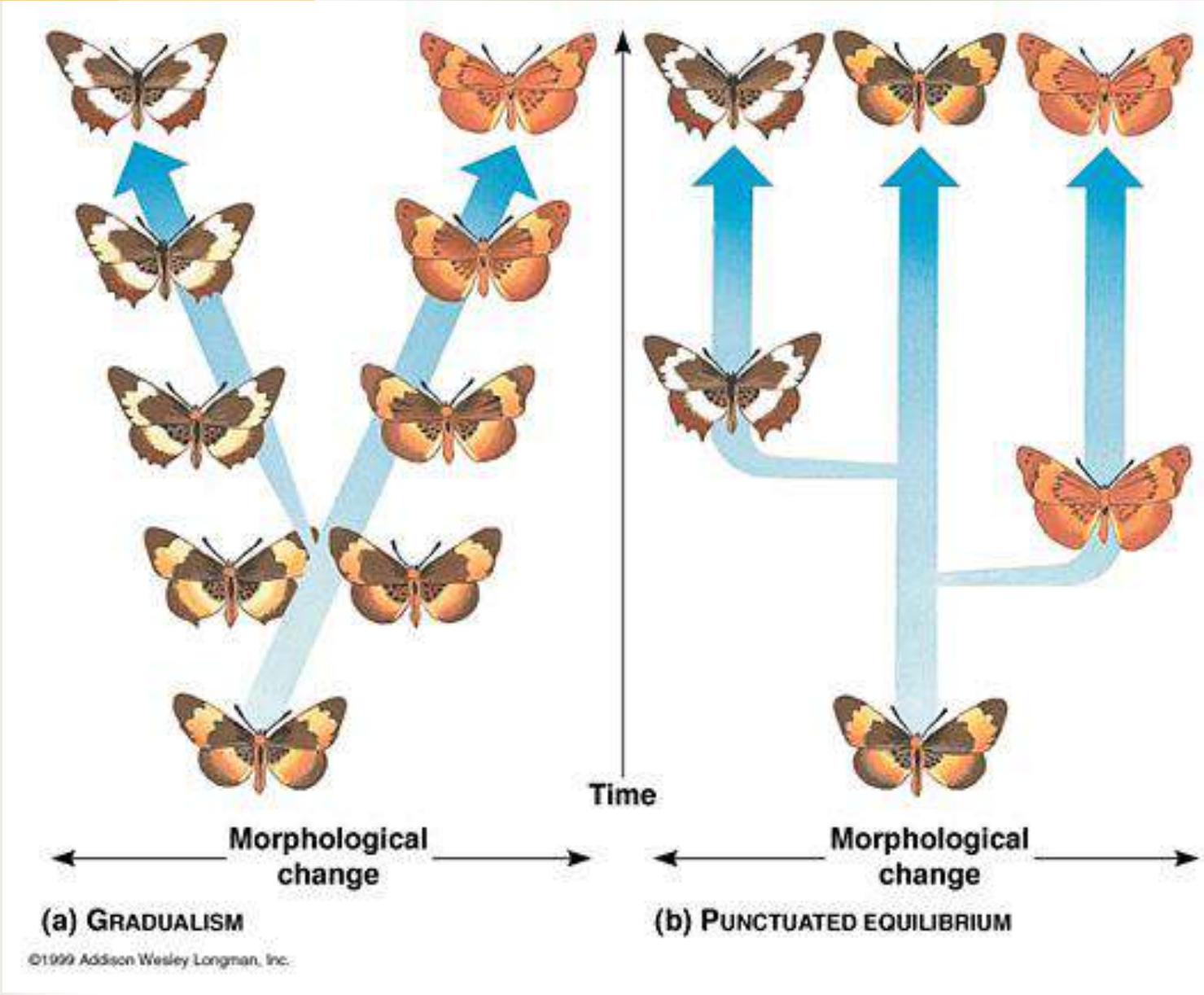
9. HORSE EVOLUTION

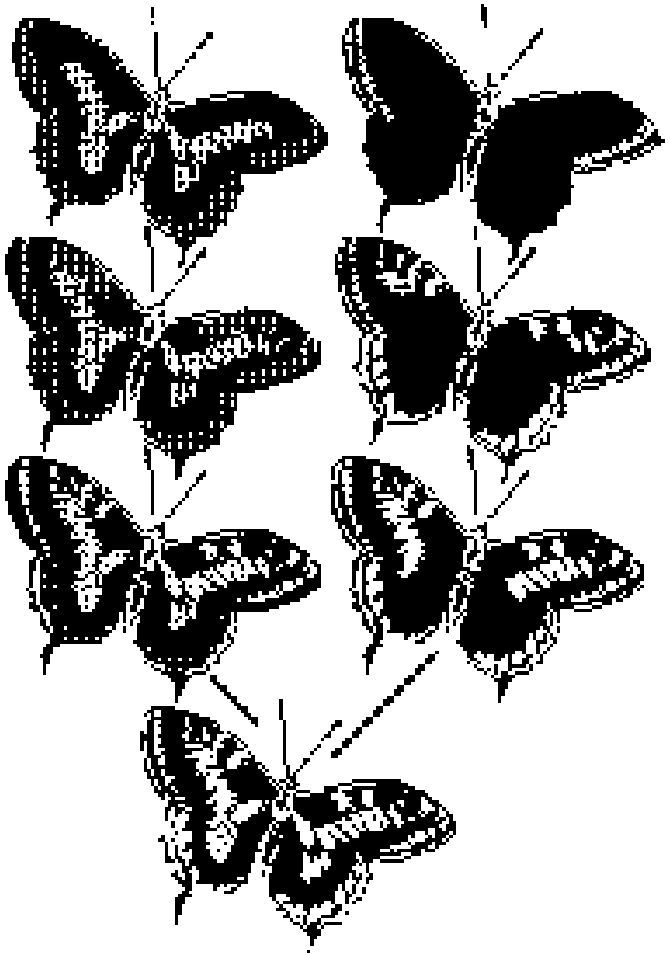


2. *Punctuated equilibrium*: rapid changes in species by the mutation of just a few **genes** in a short period of time

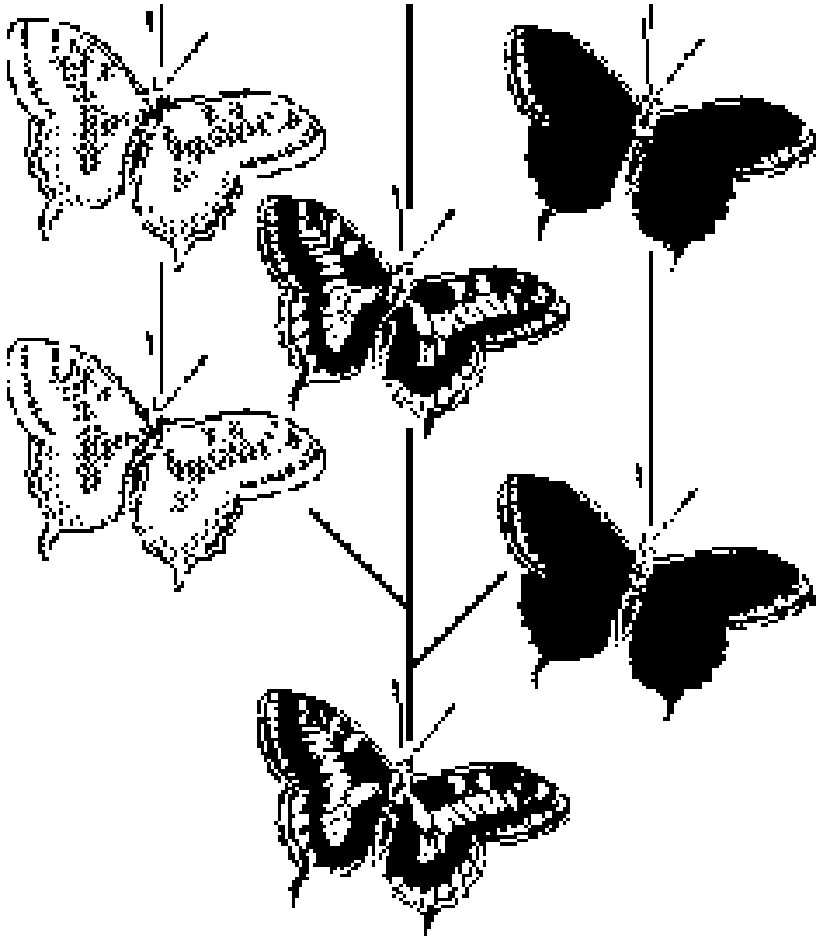
- (Examples: anti-biotic resistant **bacteria**, Viruses/COLDS, FLUS)







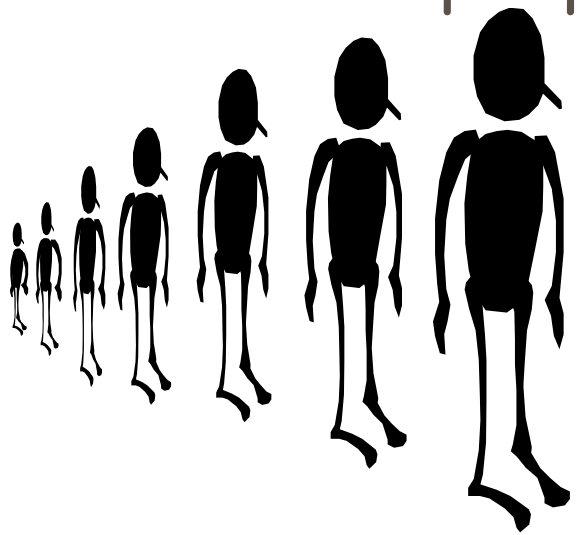
gradualism



punctuated equilibrium

When studying evolution, we look at POPULATIONS of ORGANISMS

- *Population*: a group of **organisms** in a certain area
  - (ie: Paulding makes up a population, City of Dallasbbb makes up a population)



Populations can have *Variations*

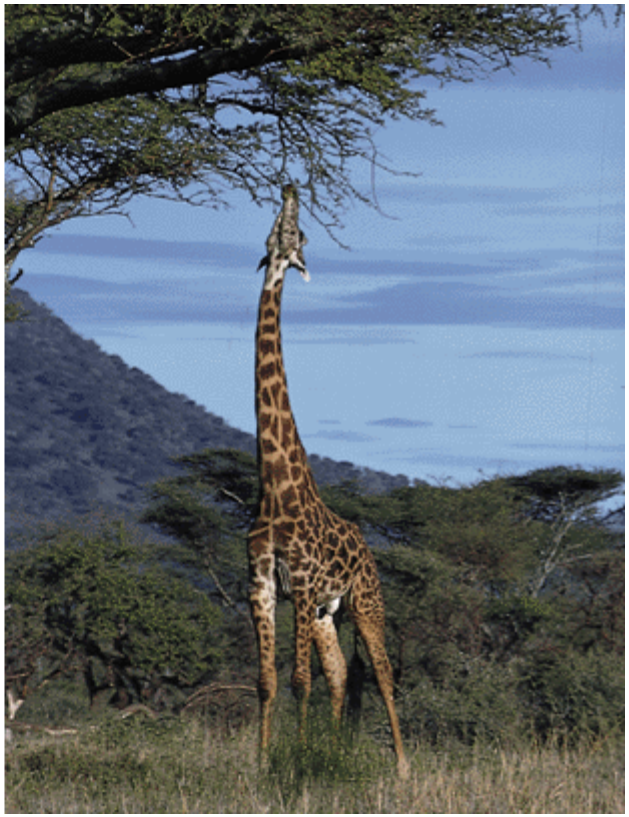
- *Variation*: the appearance of an **inherited** trait that makes an individual different from other members of the same species (usually from a mutation)

Sometimes, Variations are considered Adaptations

- *Adaptation*: any variation that makes an organism **better suited** to it's environment. (examples could be in the organism's **color**, shape, **behavior**, or chemical makeup.)

- If the organism is not well adapted to its environment, it may **die**. If it is well adapted to its environment, its chances of survival and reproduction are **increased**.

What might be these animals' adaptations?



Bat Adaptations

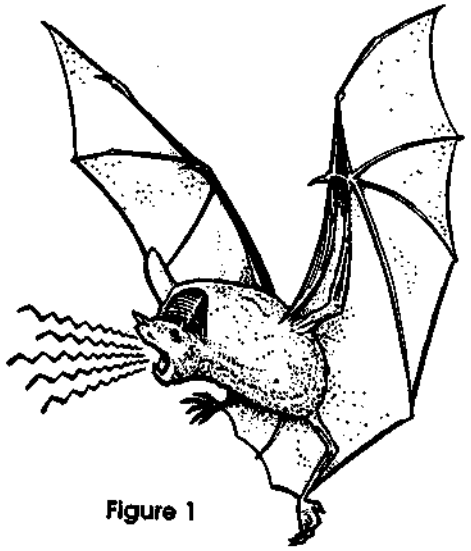


Figure 1

Bats usually feed by catching insects at night. Bats locate insects by giving off high-frequency sounds as they fly. These sounds bounce off insects and return to the bat. List 3 adaptations shown in Figure 1 that aid the bat in **catching food**.

Fish Adaptations

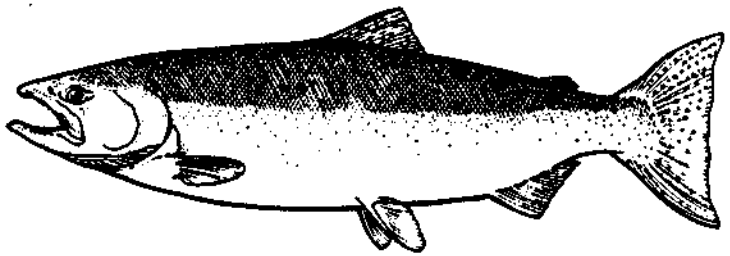


Figure 2

Fish have a number of predators. Birds such as pelicans or gulls feed on fish. Large fish often feed on other smaller fish. List 2 adaptations show in Figure 2 that aid the fish in **avoiding predators** (note coloration).

Camouflage & Mimicry

- Allows organisms to blend into their environment in order to avoid predators or catch prey







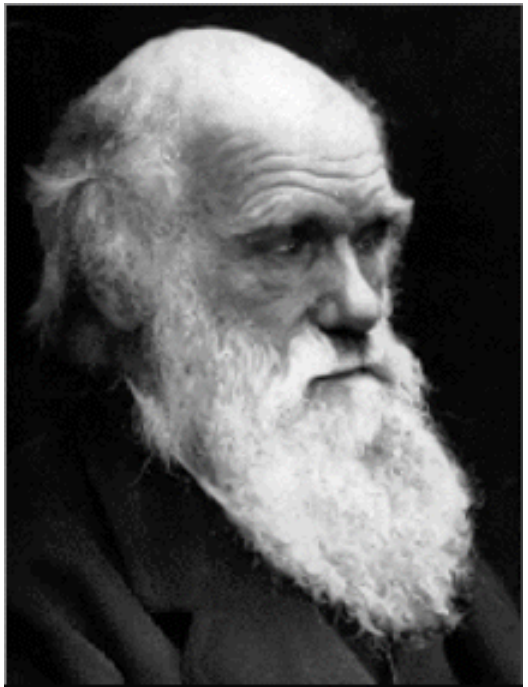
Scientific Explanations

John Baptiste de Lamarck—

- Hypothesized that species evolved by **keeping inherited traits** and that characteristics not used were **lost** from the species.
- The study of **genetics** proved Lamarck's hypothesis incorrect.

Charles Darwin

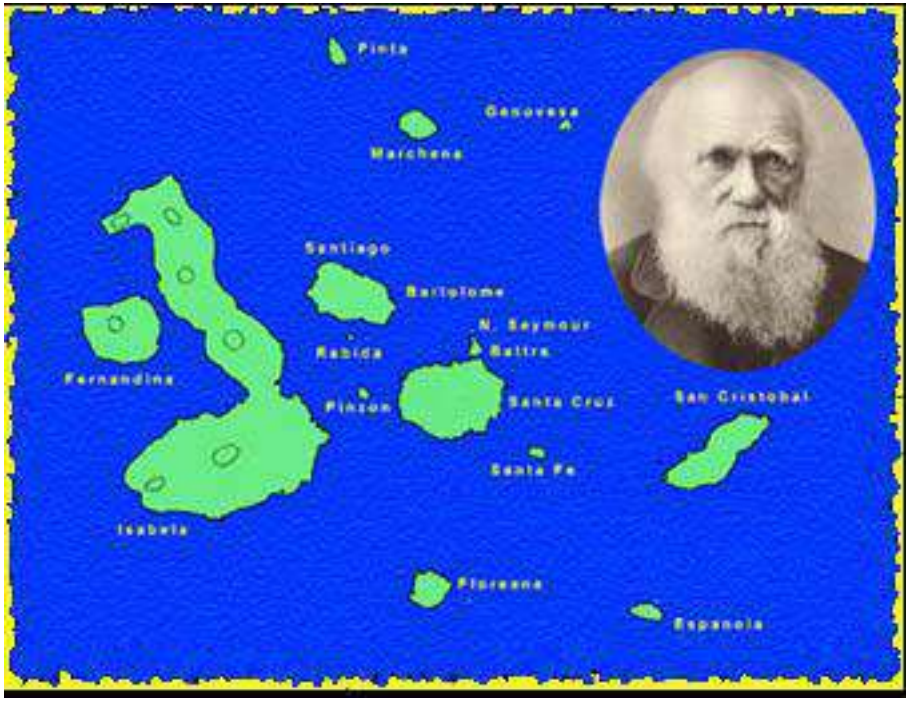
- Hypothesized that individuals with traits **advantageous** for a specific environment survived and passed on these traits to their offspring.



- Also known as the theory of evolution by "**natural selection**". (means that only organisms with the traits best suited for their environments are more likely to **survive**.)

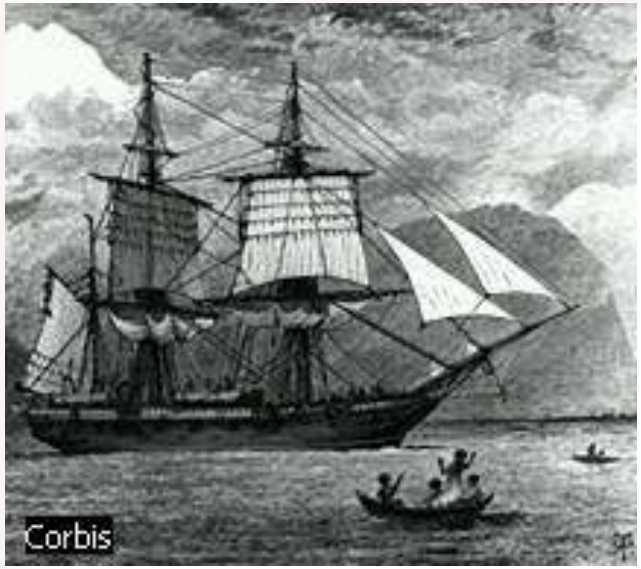
…(and therefore pass on those traits)

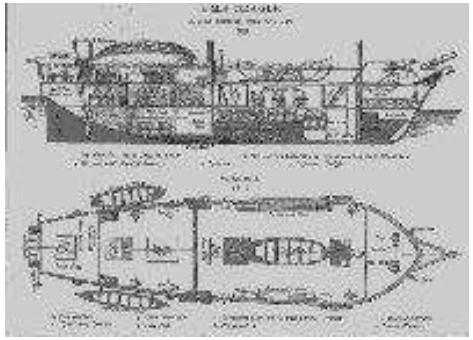
- Darwin came up with this theory while in the **Galapagos Islands** where he observed many different organisms.

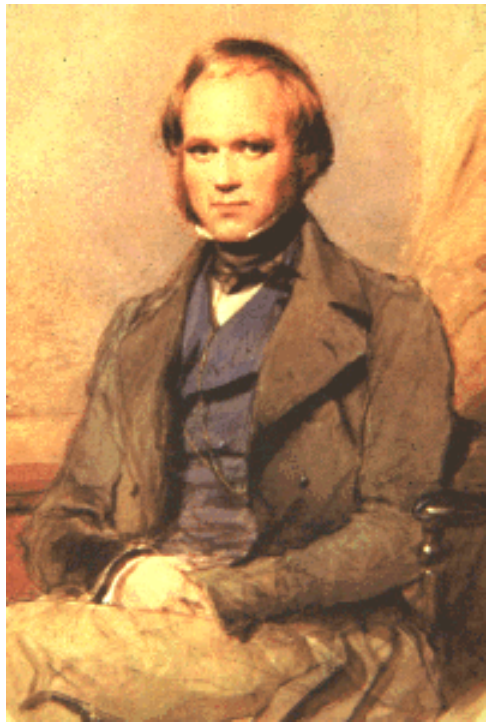


Galapagos island clip

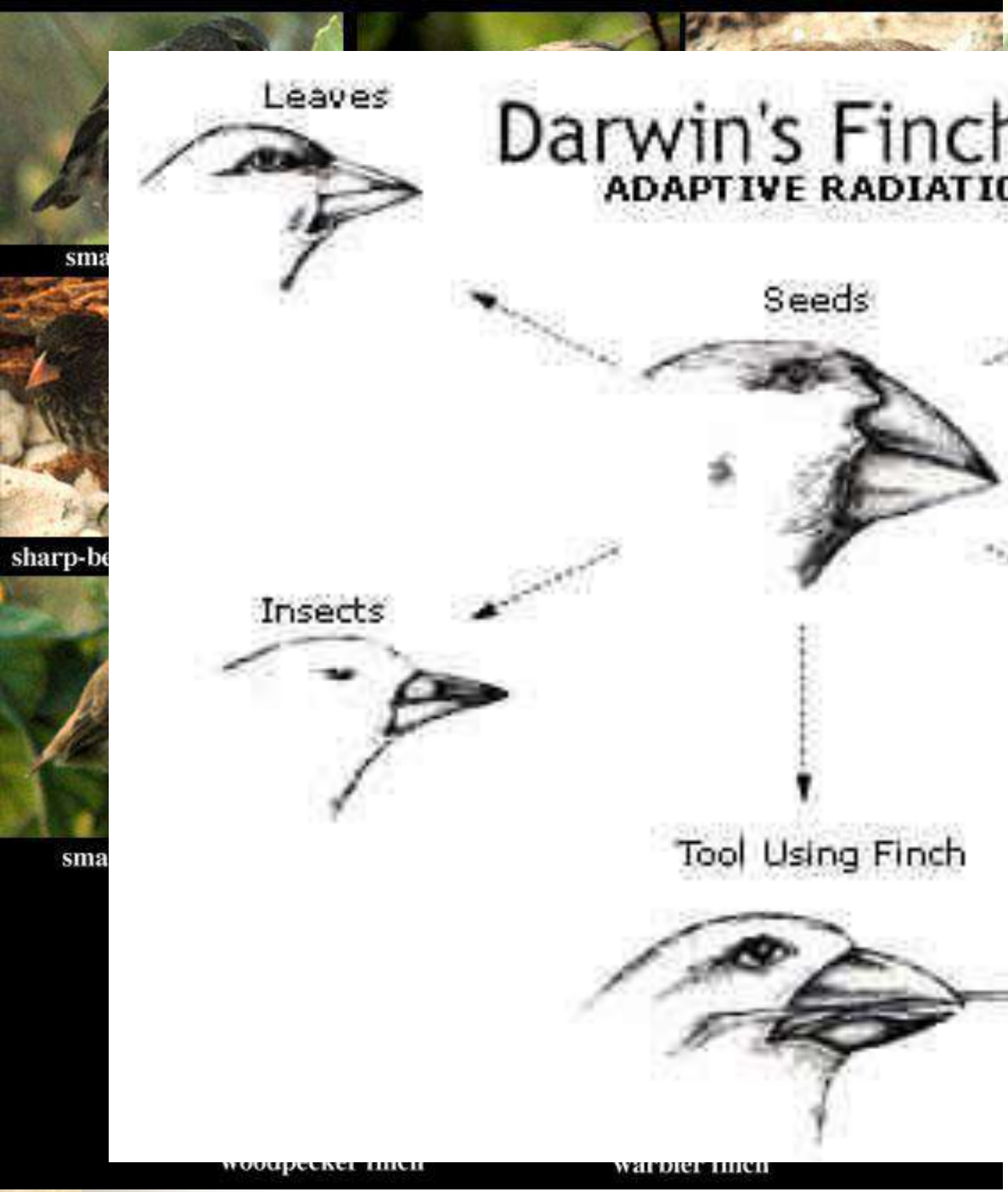
1st 3 minutes only...

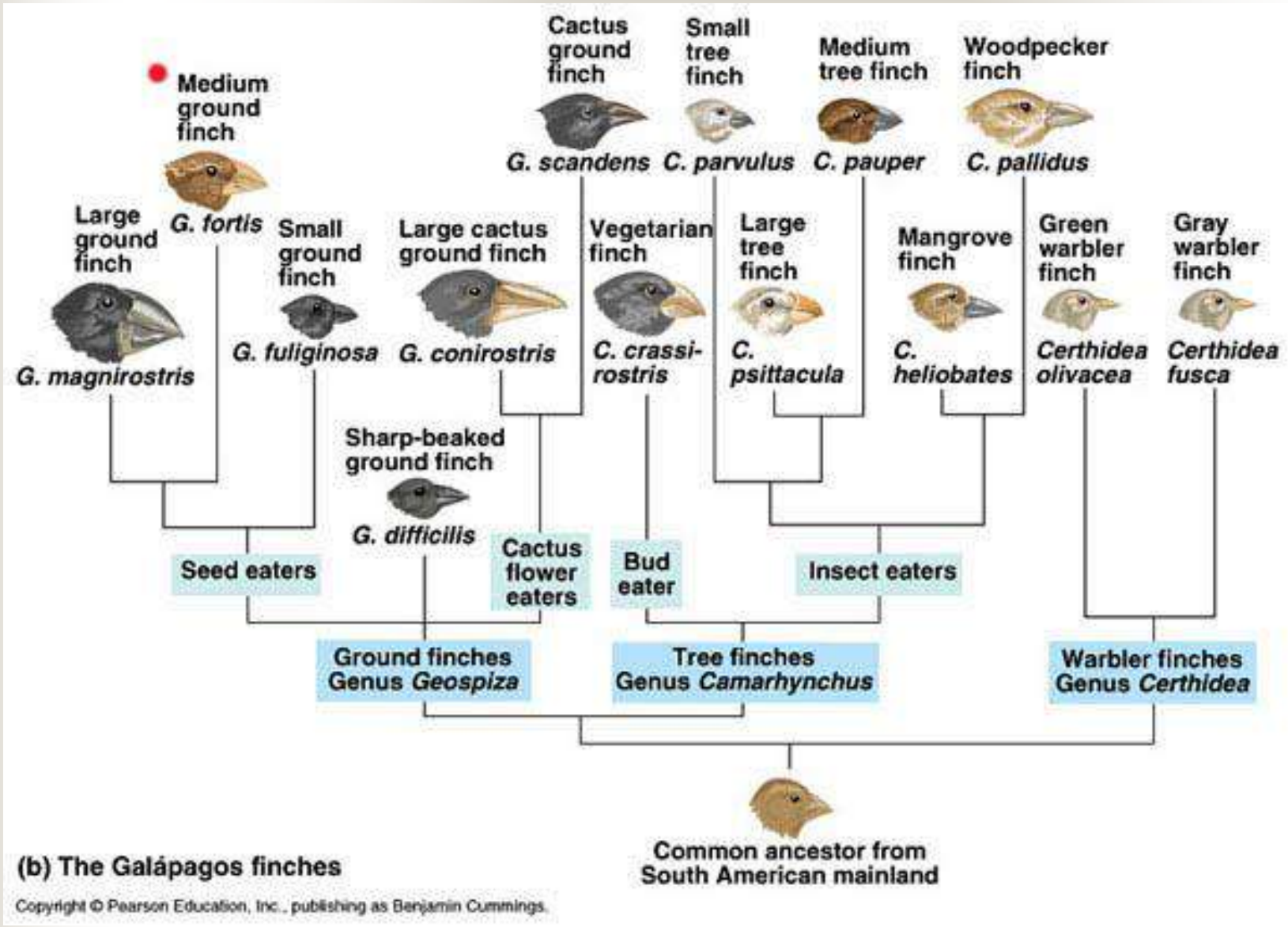






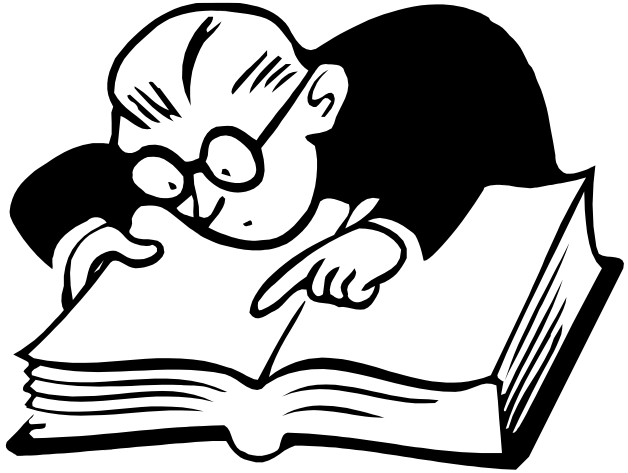
The **HMS Beagle**, the ship on which Darwin sailed to the Galapagos


Darwin's Finches
ADAPTIVE RADIATION
Leaves
Buds / Fruit
Seeds
Insects
Grubs
Tool Using Finch



(b) The Galápagos finches

- He later wrote a book called **On the Origin of Species by Means of Natural Selection**, in which he outlines four factors that control natural selection:

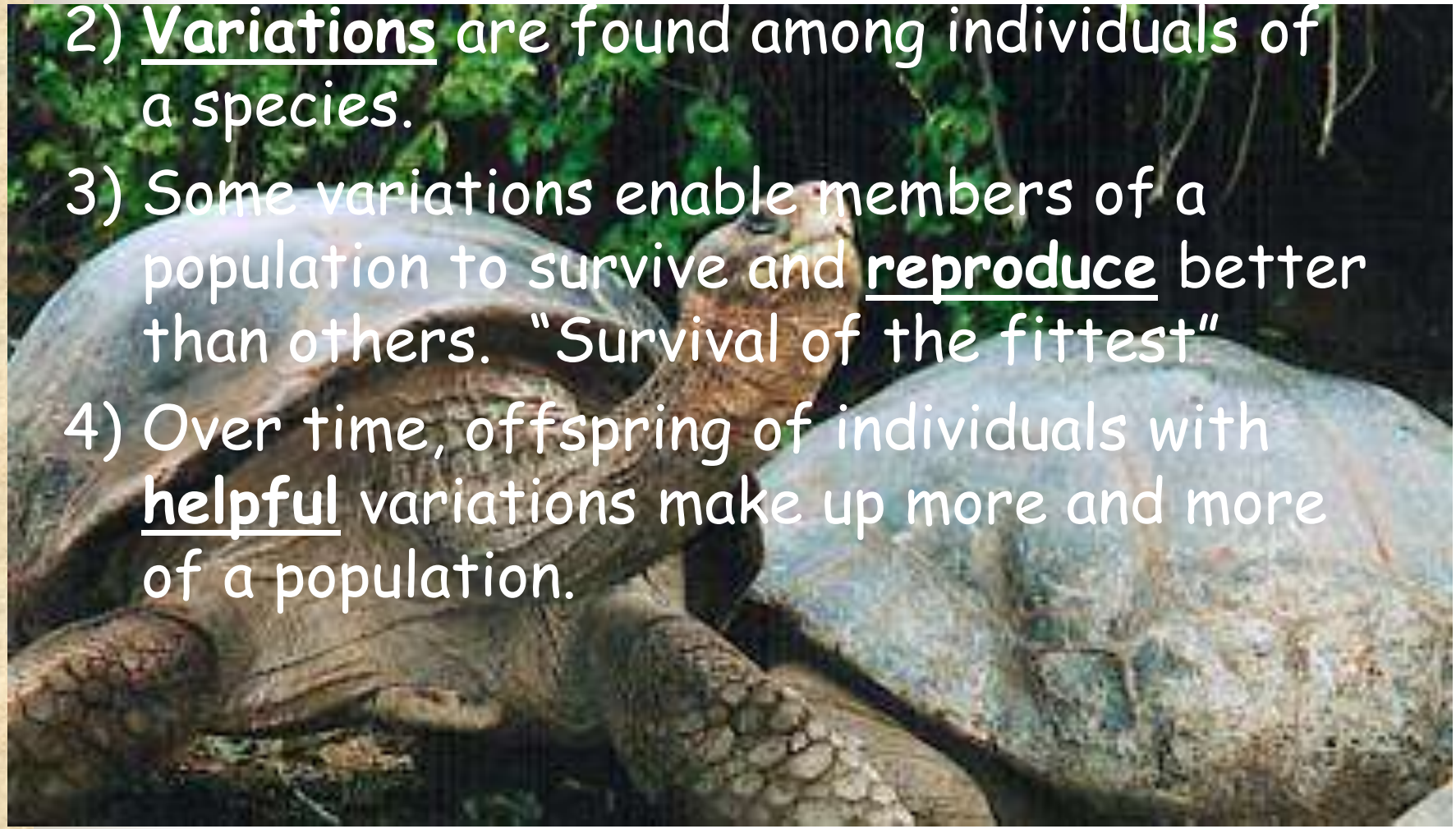


1) Organisms **produce** more offspring than can survive.

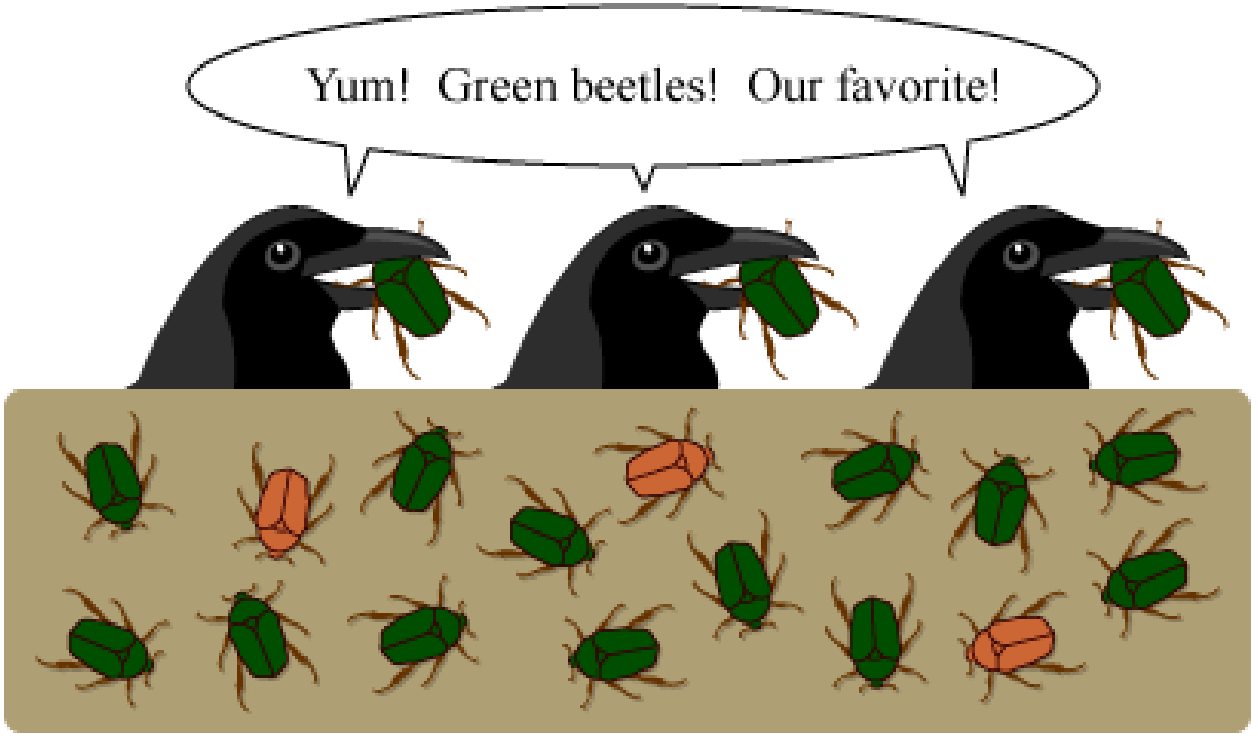
2) **Variations** are found among individuals of a species.

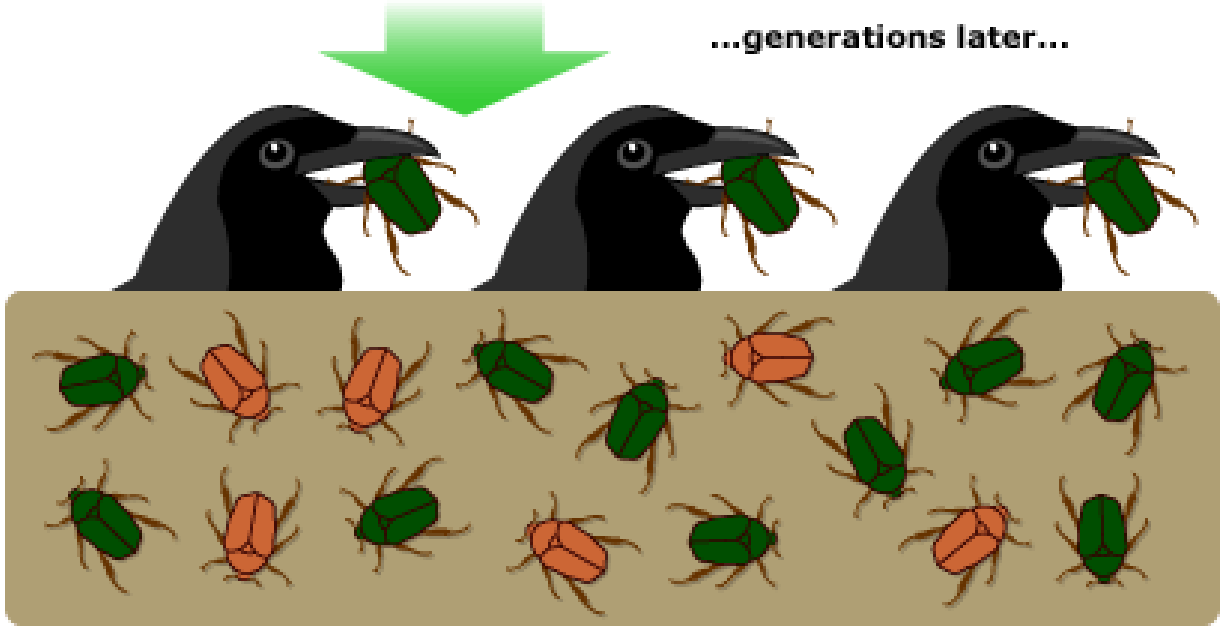
3) Some variations enable members of a population to survive and **reproduce** better than others. "Survival of the fittest"

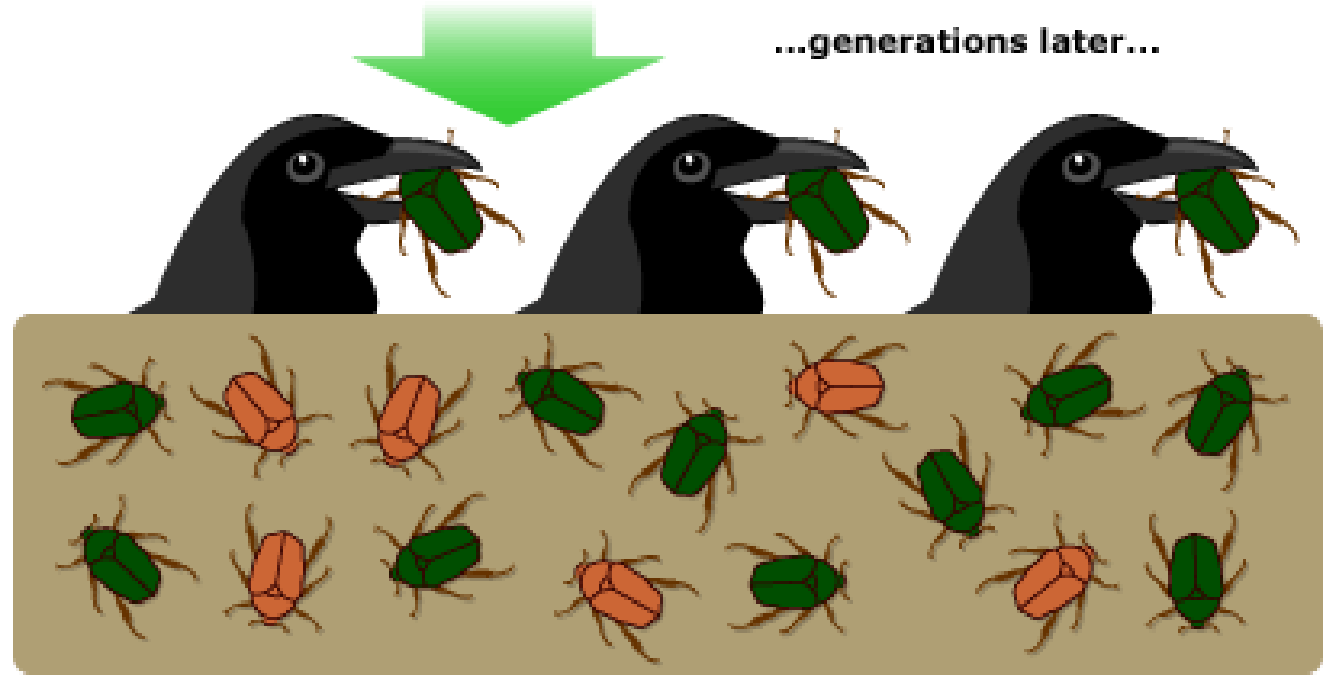
4) Over time, offspring of individuals with **helpful** variations make up more and more of a population.

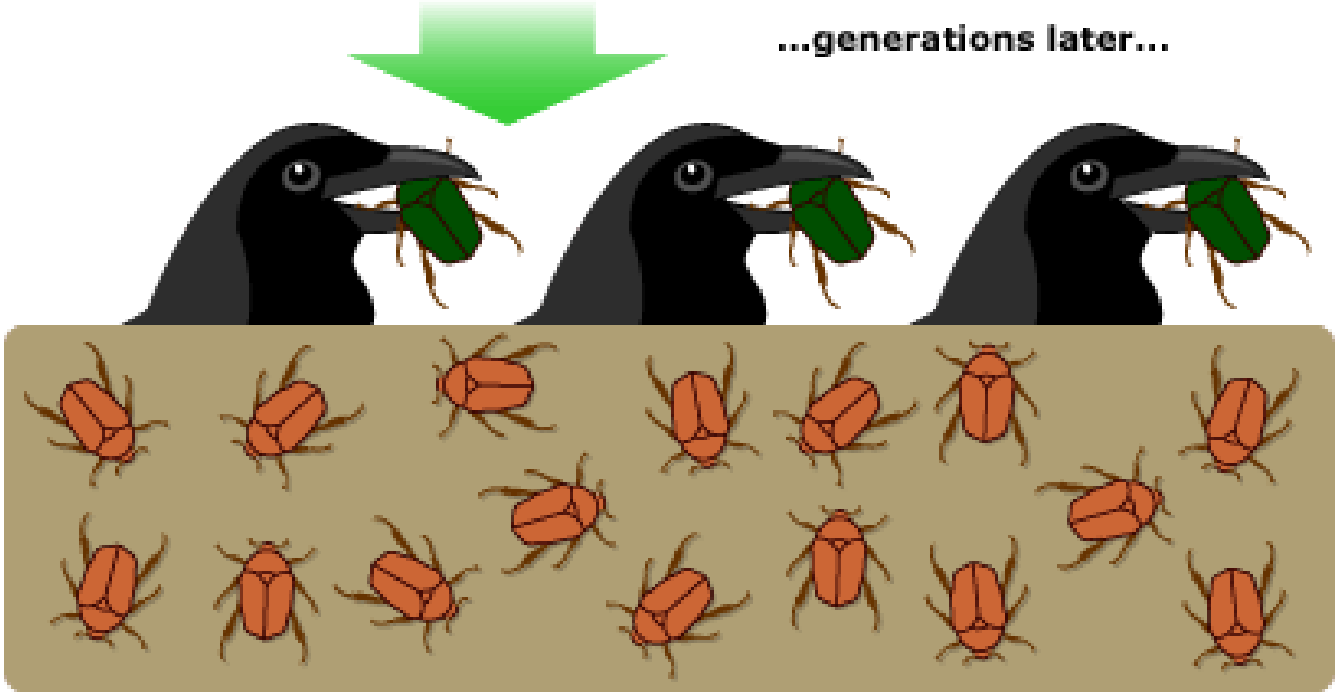


Natural selection, in a nutshell:




...generations later...


...generations later...

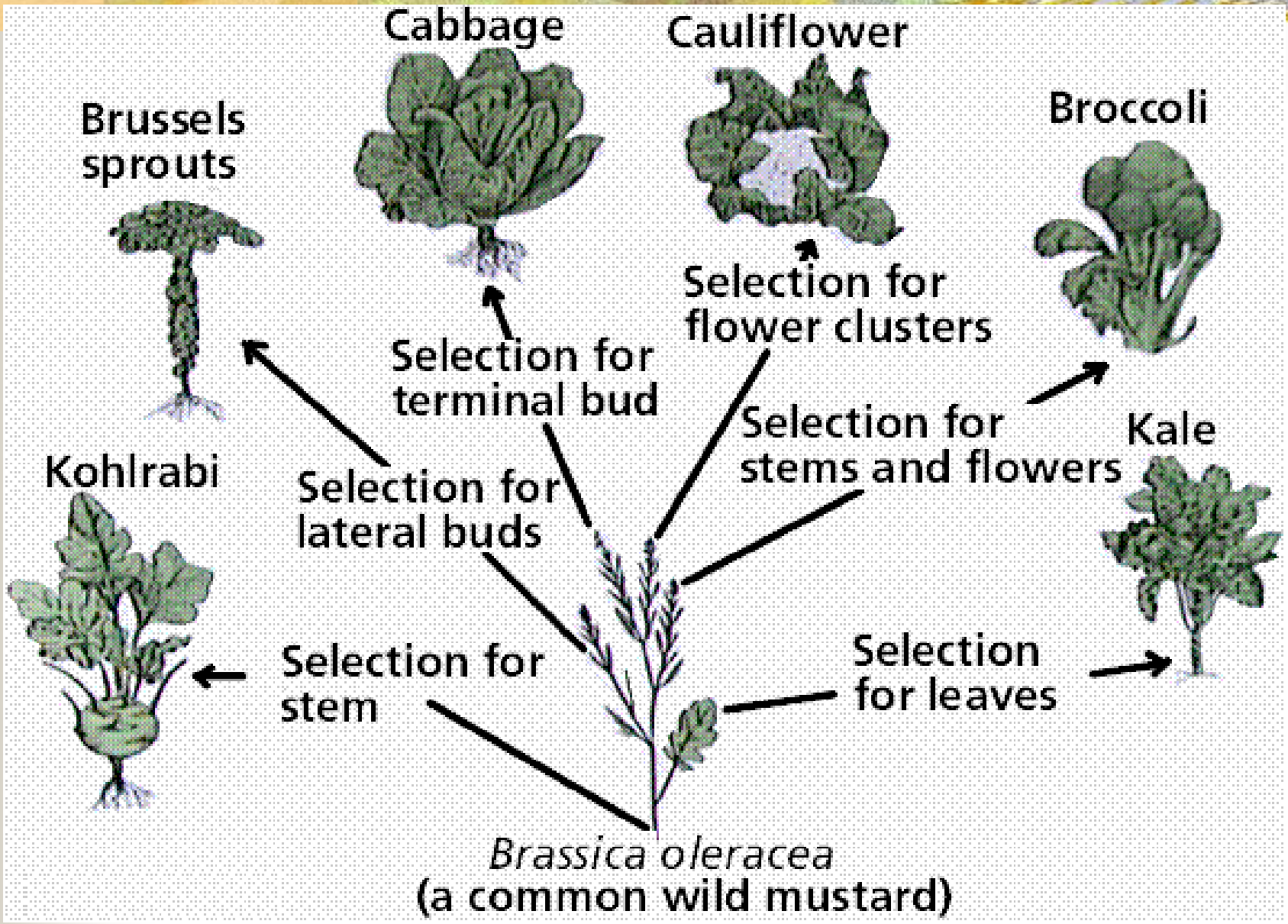


Green beetles have been selected against, and brown beetles have flourished.

NATURAL SELECTION

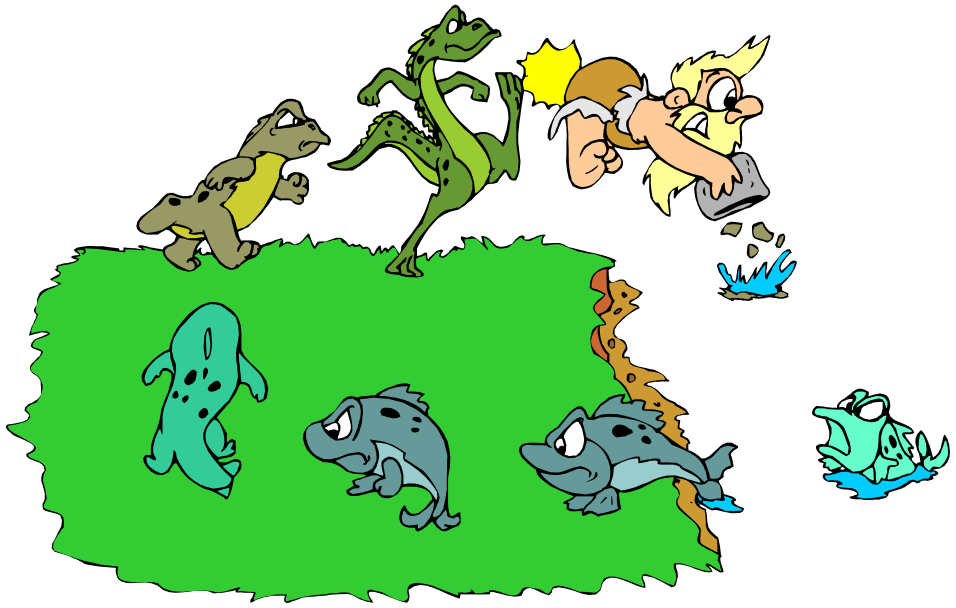
A Common Misconception…

Natural selection does not grant organisms what they "need".


Cabbage
Cauliflower
Brussels sprouts
Broccoli
Selection for flower clusters
Selection for terminal bud
Selection for stems and flowers
Kale
Kohlrabi
Selection for lateral buds
Selection for stem
Selection for leaves
Brassica oleracea
(a common wild mustard)

- Darwin's theories are still widely accepted today and are one of the most important concepts in life science.

Charles Darwin Clip



Artificial Selection

- The process of intentional or unintentional modification of a species through **human actions** which encourage the breeding of certain traits over others
- Also known as "**selective breeding**"

Artificial Selection

- Examples:

Dogs

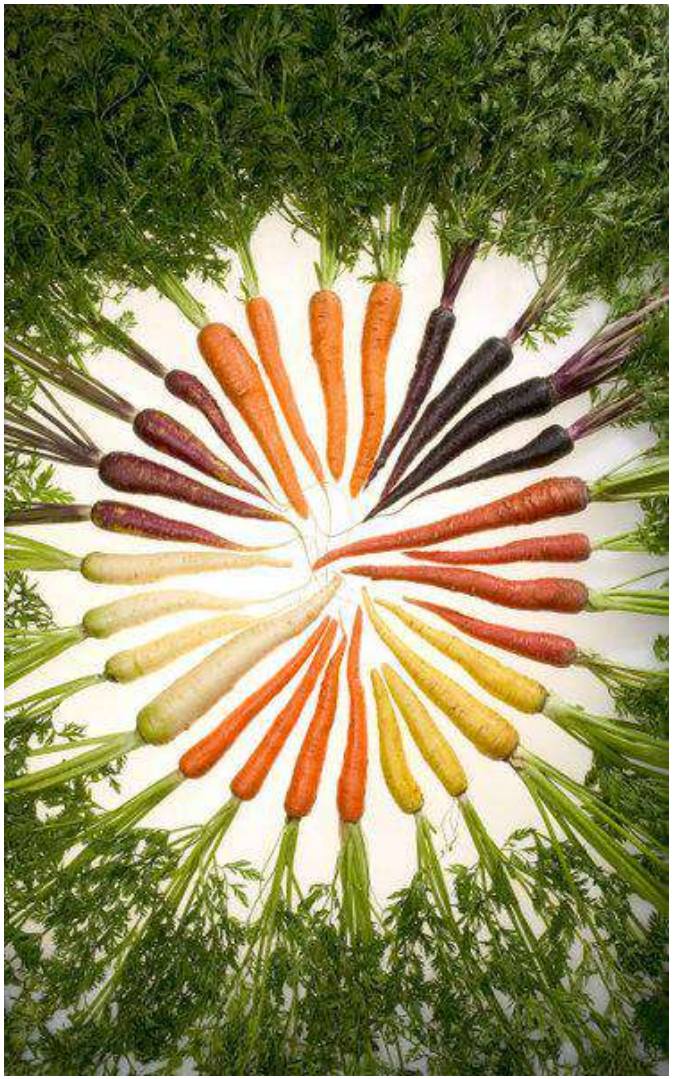
Artificial Selectio

- Examples:

Dogs

Artificial Selection

- Examples: **Crops, Decorative Plants**

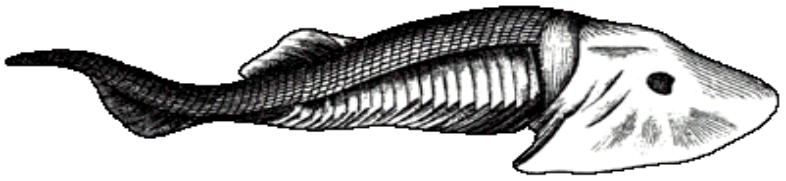


Artificial Selection

- http://www.nhm.org/exhibitions/dogs/evolution/selection/index.html

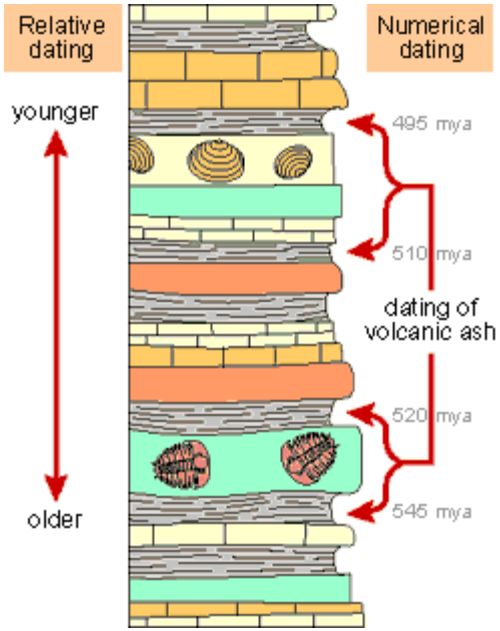
What is the science behind this theory?

- Fossils—any remains of **life** from an earlier time and the most abundant evidence for evolution
- Sedimentary rock contains the most fossils and is formed from mud, sand, and other fine particles



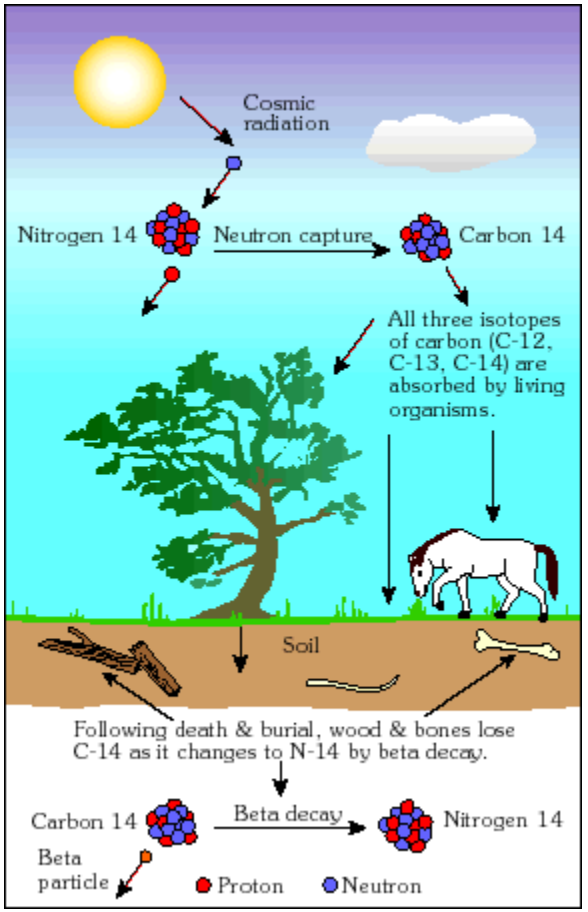
How do scientists figure out how old something is?

- **Relative dating** —looking at where the rock is **located**. Older layers are deeper than the layers above. This method only provides an *estimated* age of a fossil.



How do scientists figure out how old something is?

- **Radioactive dating** — measuring how a radioactive element in the fossil (like Carbon or Uranium) has **decayed**. They compare the amount of stable rock to amount of radioactive element still present.



- Fossils document how organisms changed over time, but much of the fossil record is missing or incomplete (like a book with pages ripped out)!

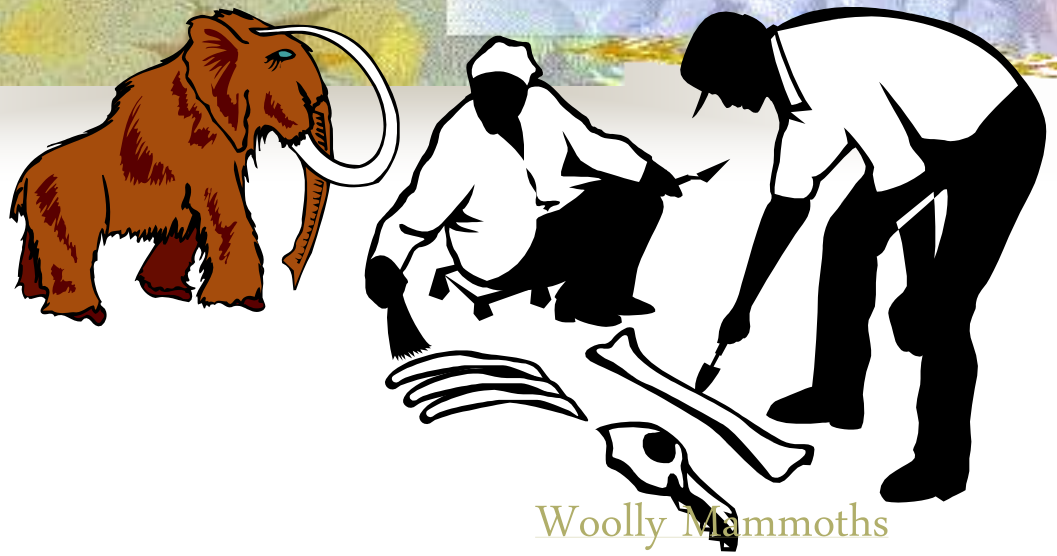
Fossil Hunting on the Galapagos

Amber Fossils

Prehistoric termites trapped in amber

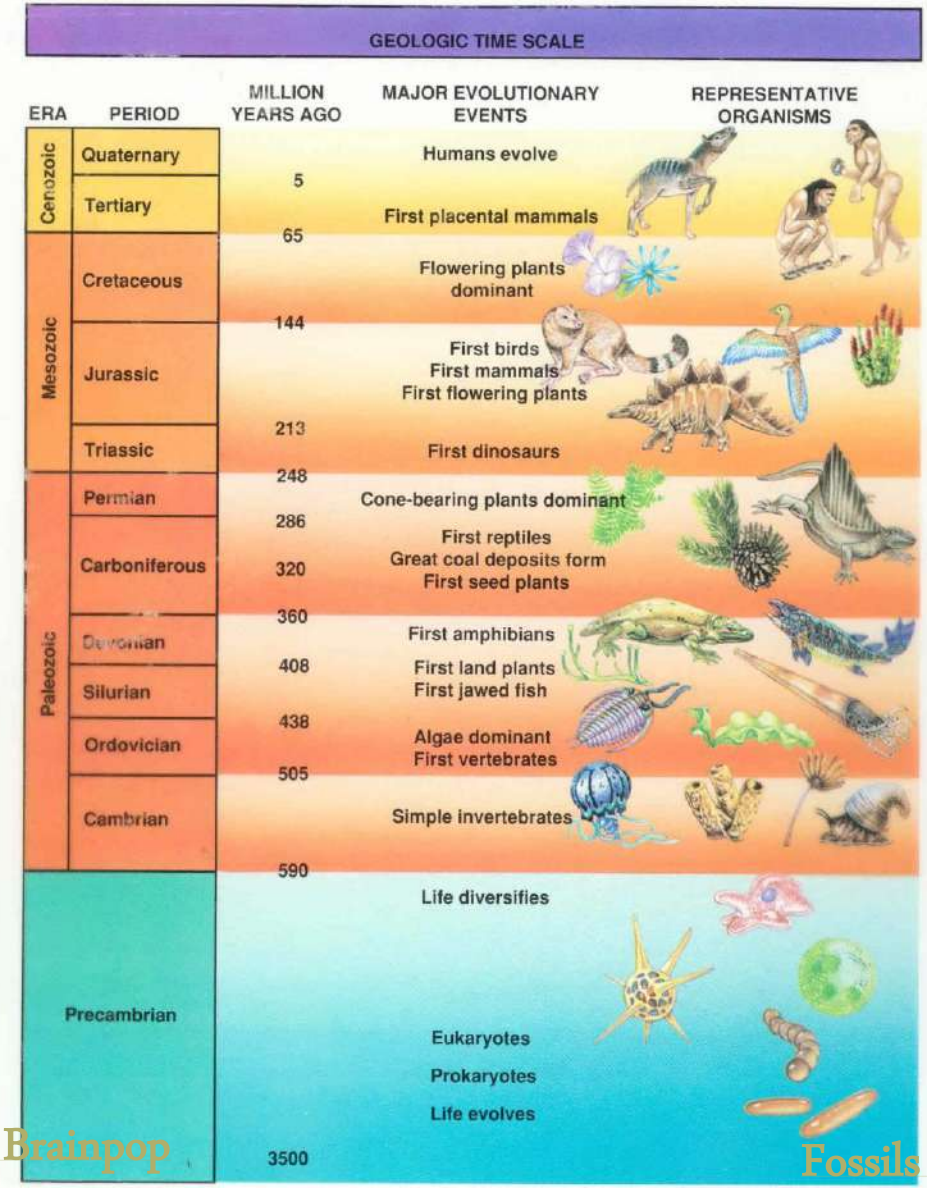
Lizard in Amber

Frog in Amber



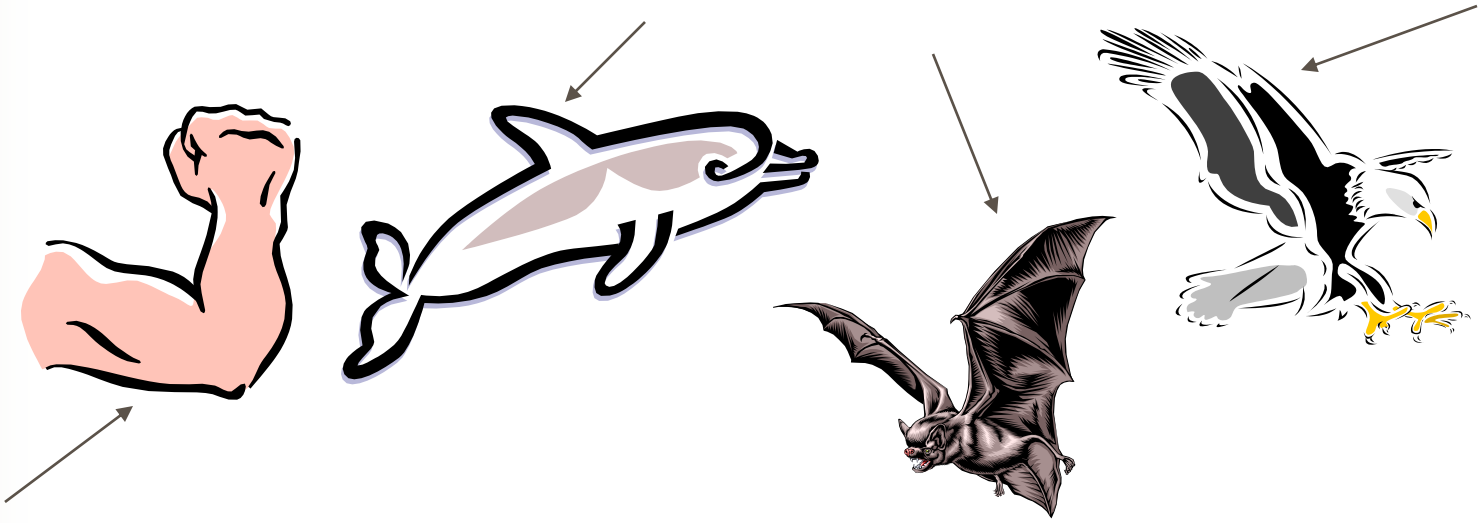
Woolly Mammoths

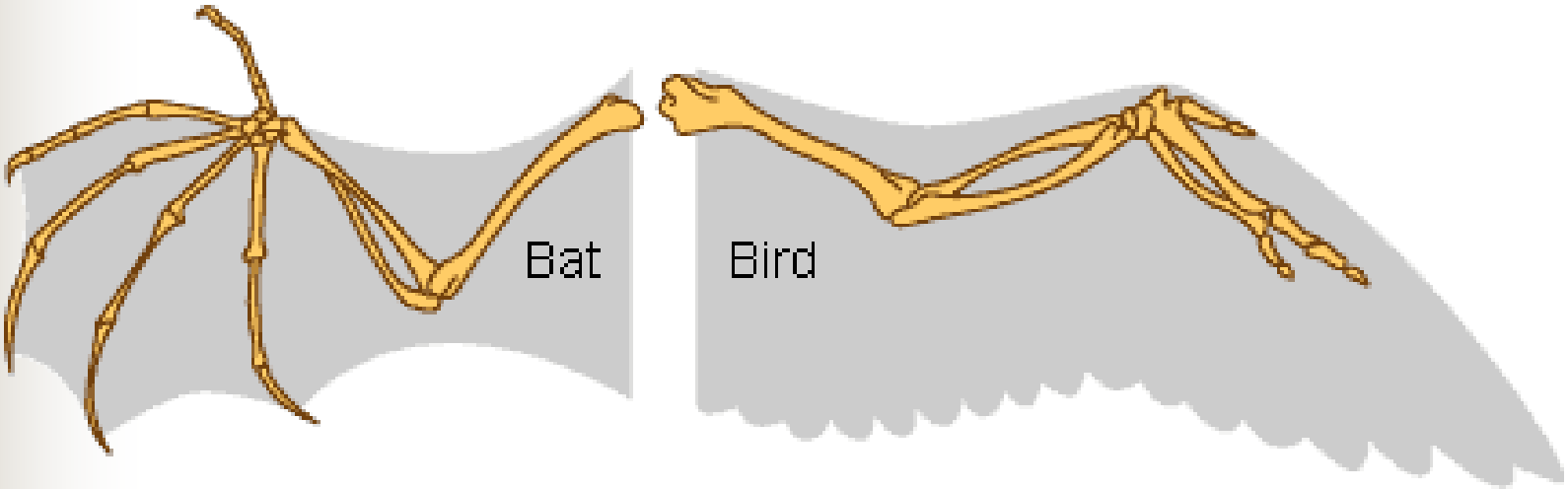
10. GEOLOGIC TIME SCALE



- Homologous Structures —body parts that are similar in **origin** and **structure**.

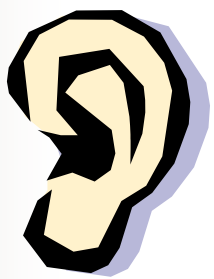
Example: arms, dolphin fin, bat wing, bird wing

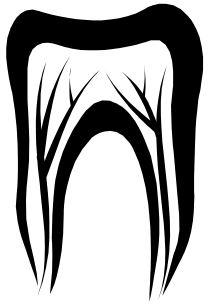


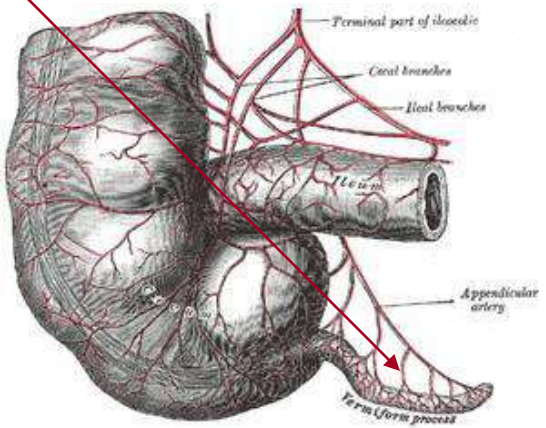

Bat
Bird

- Vestigial Structures —a body part that is reduced in **size** and does not seem to have a **function**.

Examples: human **appendix, wisdom teeth** and muscles that are for moving the **ears**.

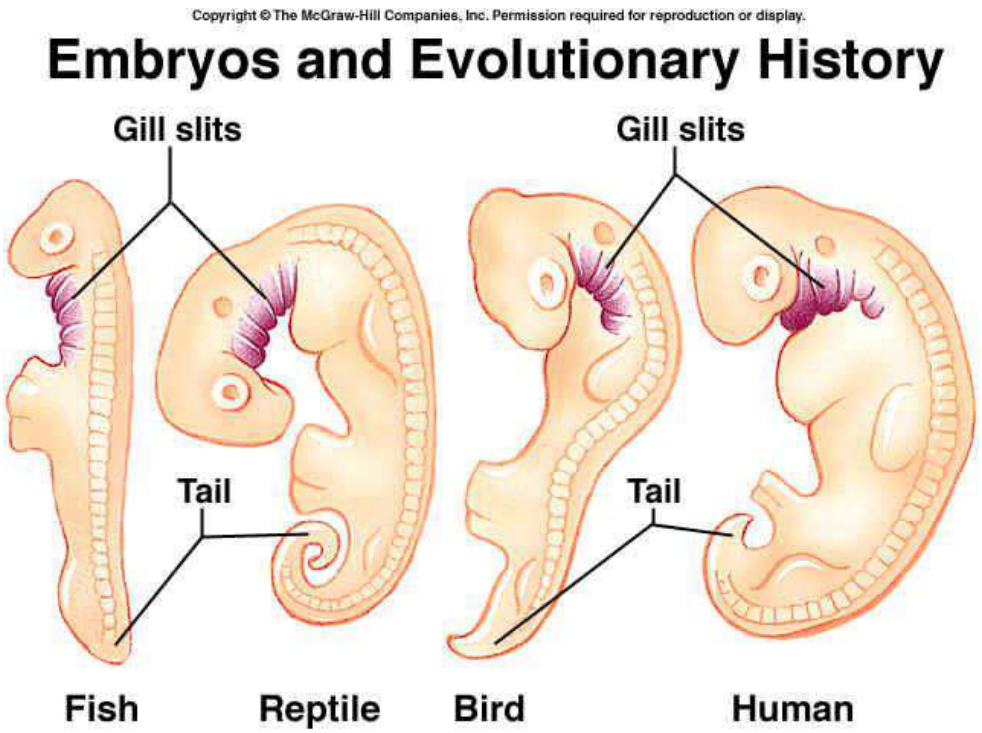




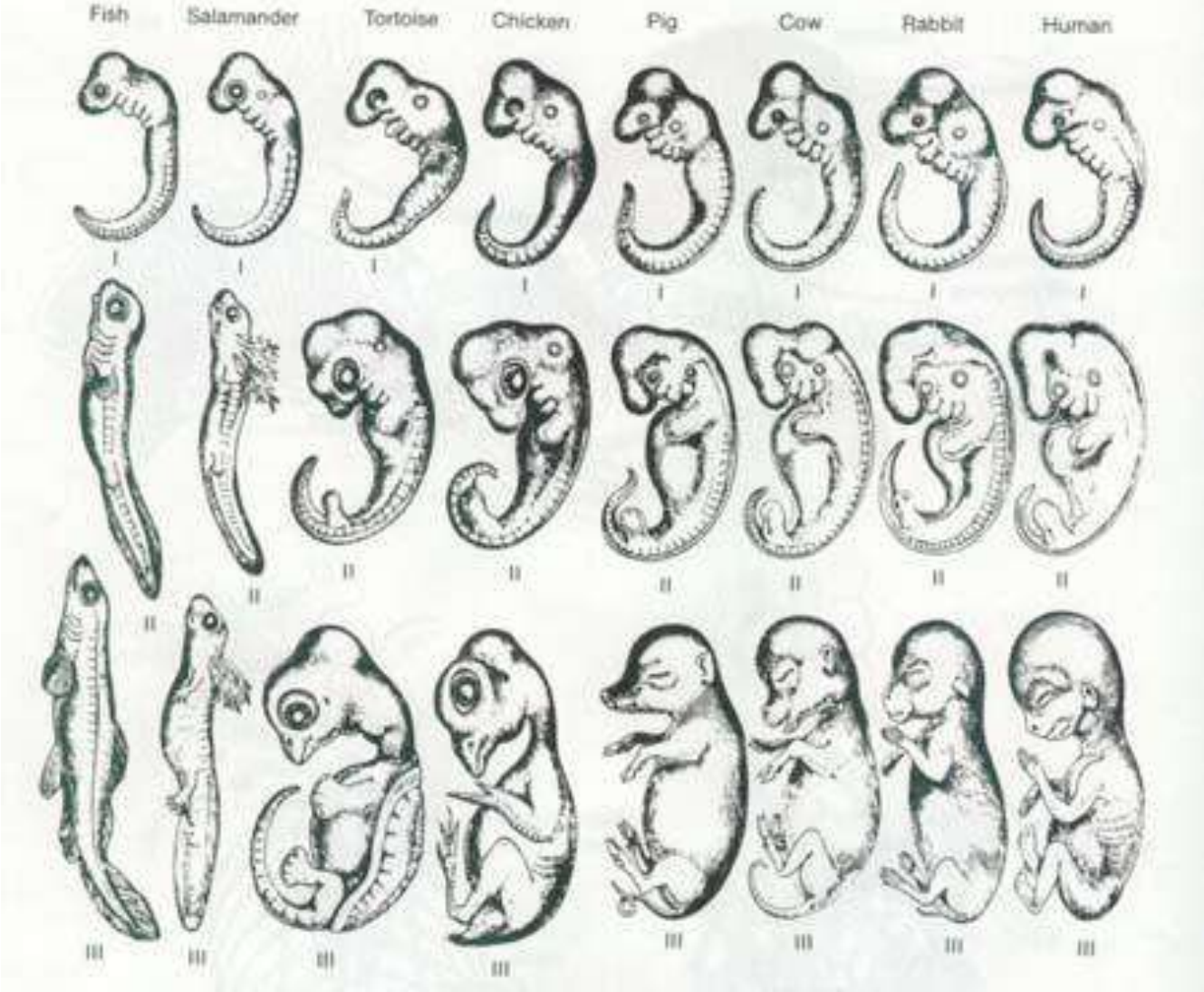


- Embryology —study of the development of **embryos** (an organism in its earliest stages of development).

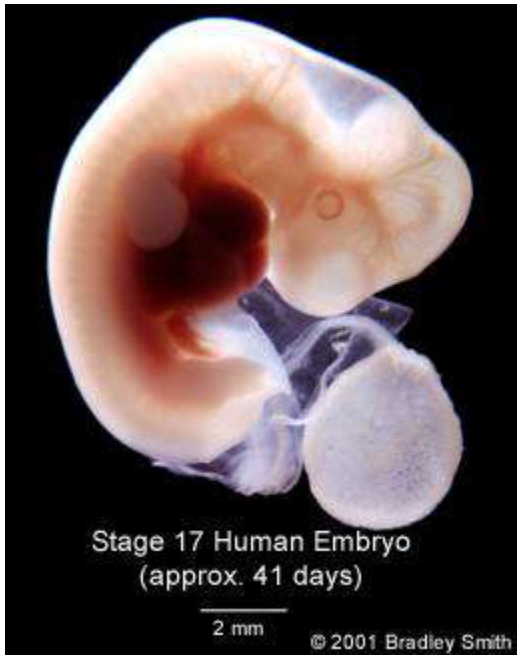
Examples: **gills** and tailbones in humans

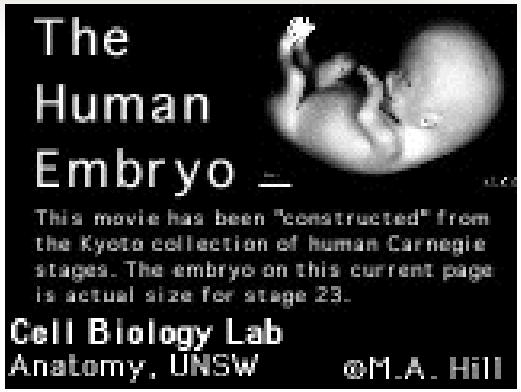


What similarities do you see between these embryos?



Embryology



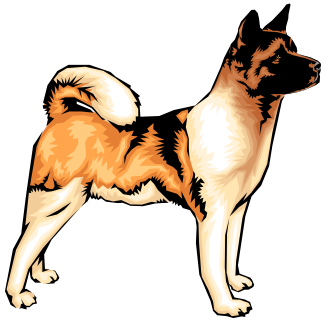


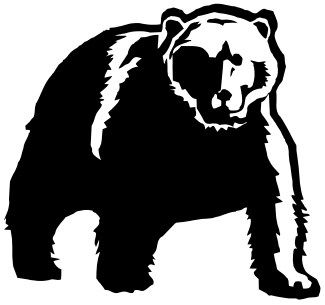
http://embryo.soad.umich.edu/carnStages/stage16/stage16.html

- Comparing DNA —the closer the DNA sequences are in organisms, the more closely **related** they are.

Example: DNA has shown that dogs are the closest relatives of **bears**. Human's closest relatives are from the ape family.

Cousins?

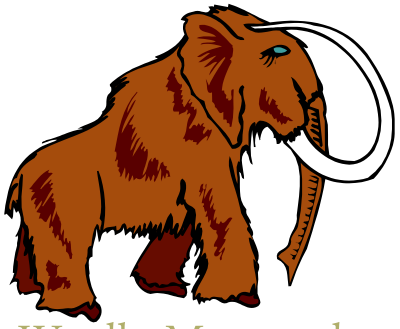




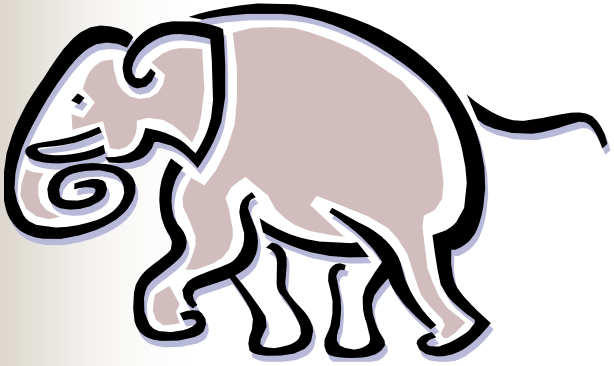
- ***Example***: Humans are most closely related (_____%) to **chimpanzees**.

- Evolution in Action Video Clip—United Streaming

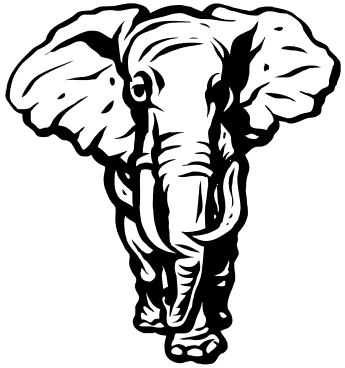
Evolution of a Species



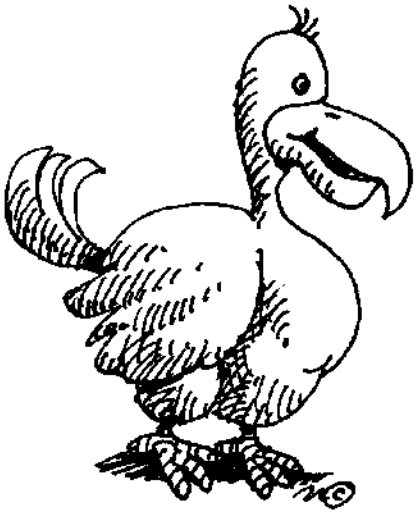
Woolly Mammoths



Elephant Evolution

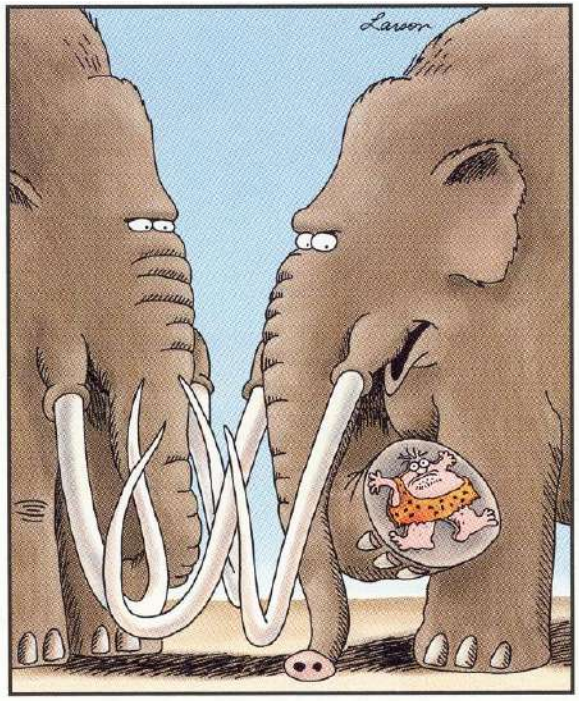


Extinction



Unbeknownst to most ornithologists, the dodo was actually a very advanced species, living alone quite peacefully until, in the 17th century, it was annihilated by men, rats, and dogs. As usual.

Human Evolution

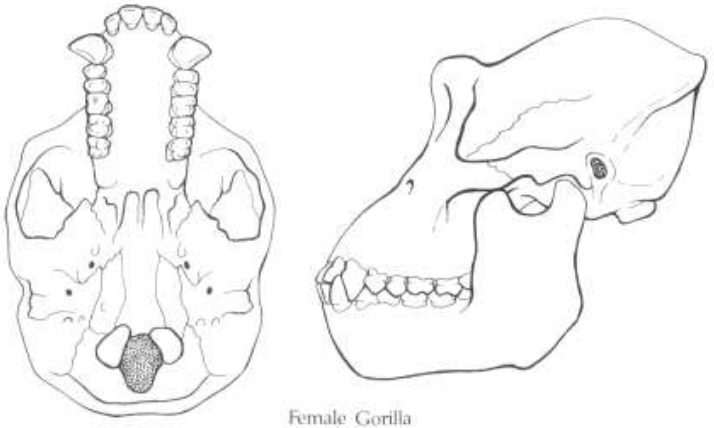


"Well, what the? … I *thought* I smelled something."

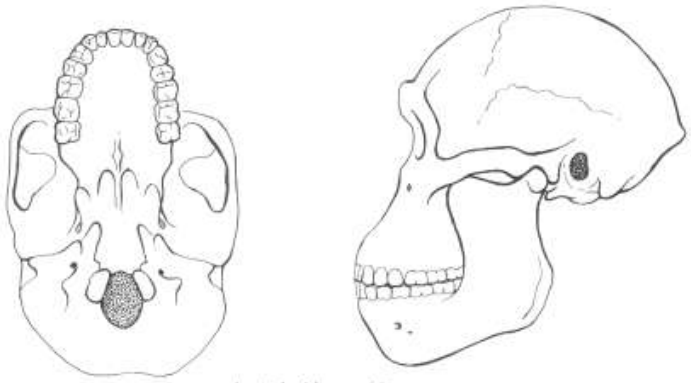
Our Ancestors: Bill Nye

Human Evolution

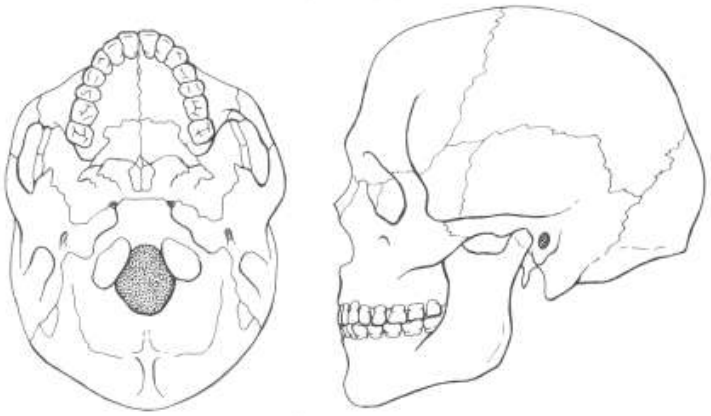
HUMAN EVOLUTION



Female Gorilla



Australopithecus africanus



Homo sapiens