Evolution


The Theory of Evolution
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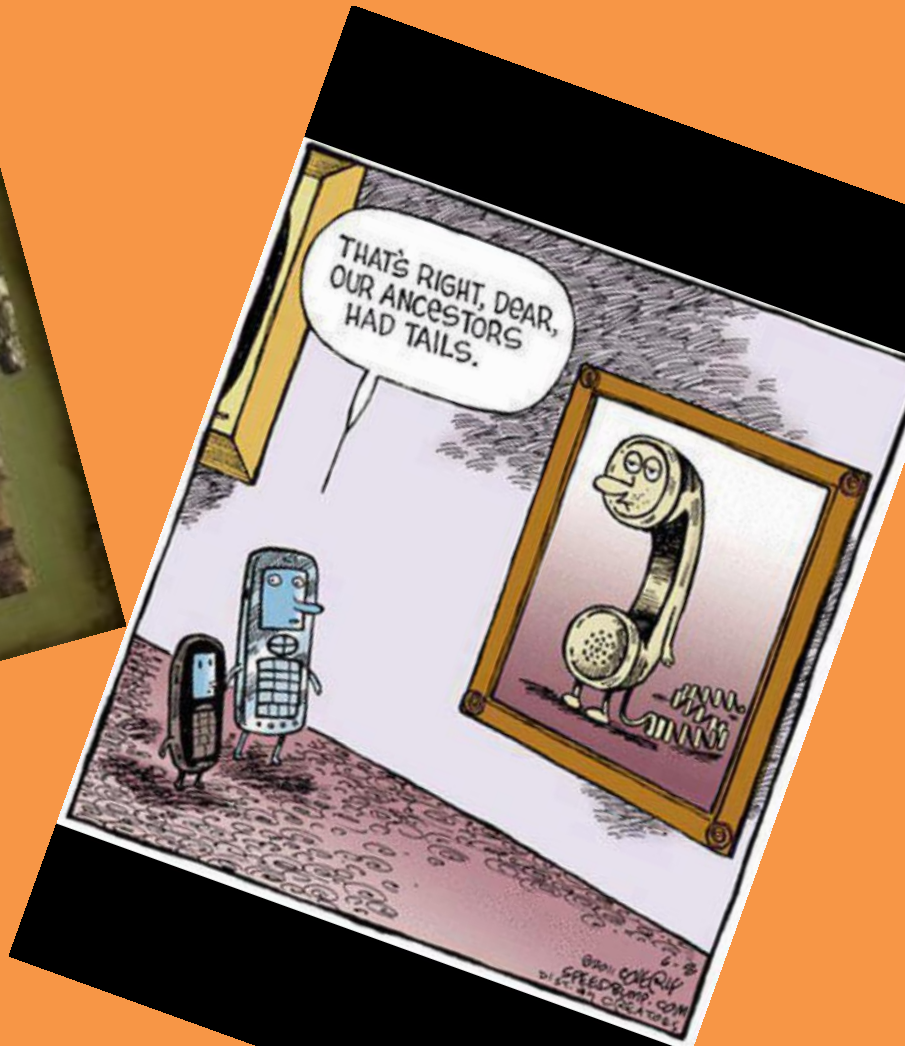
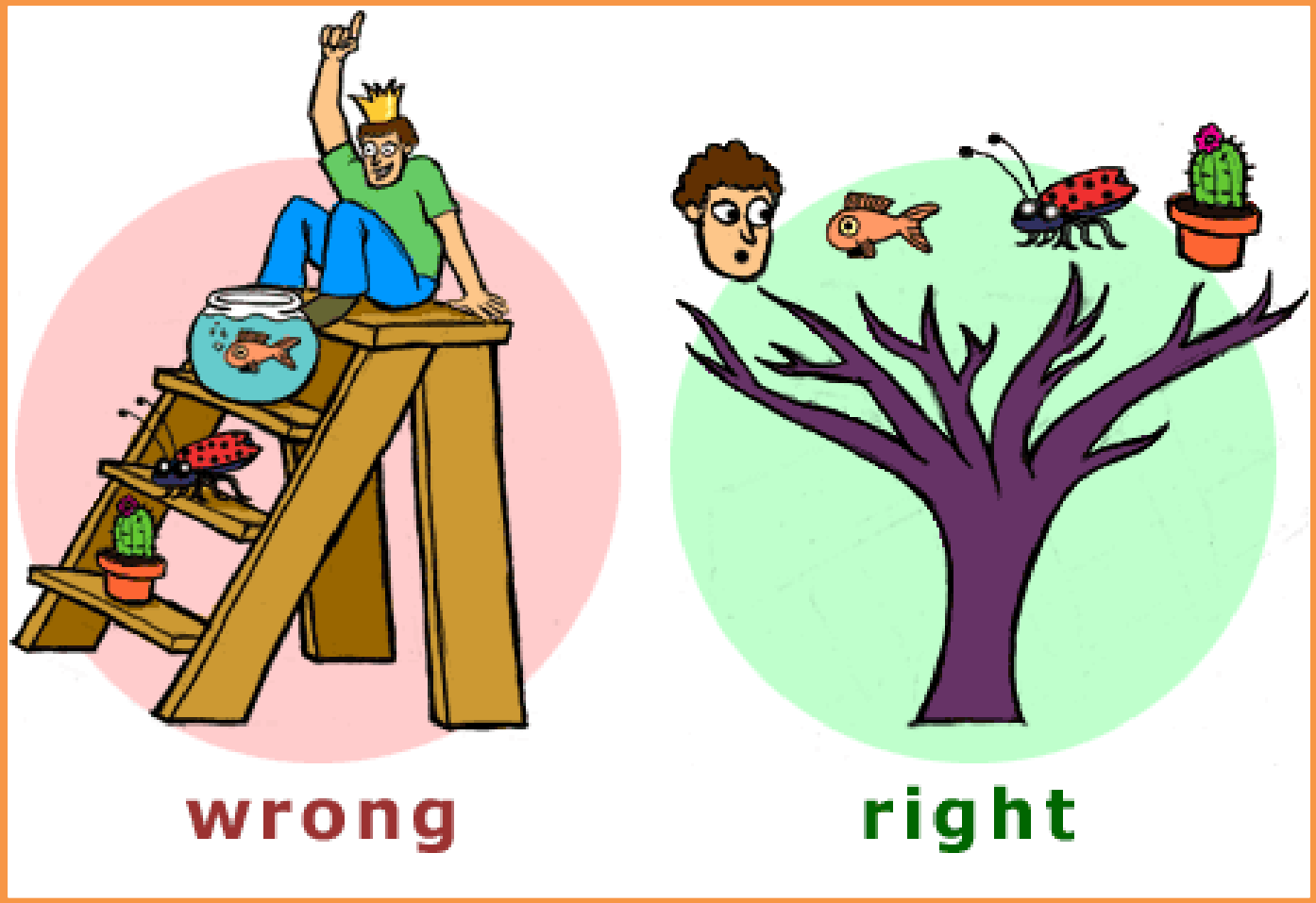

THAT'S RIGHT, DEAR, OUR ANCESTORS HAD TAILS.

The theory of EVOLUTION states that existing forms of life on earth have arisen from earlier forms over long periods of time.

WHAT IS EVOLUTION??????????



Some of the strongest evidence to support evolution is found in the fossil record.

WHAT ARE THESE???

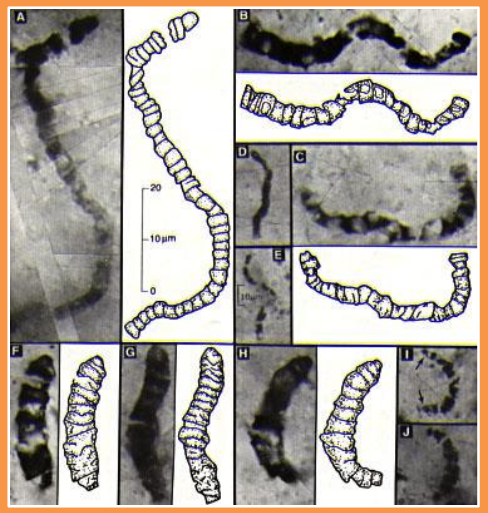
FOSSILS are the preserved remains or traces of organisms from the past.

Geologists estimate the age of the earth to be 4.5 - 5 billion years.

This estimate is based on radioactive dating of the oldest rocks from the earth's crust.

The oldest rocks on Earth are found in Canada.
They are almost 5 billion years old.

The earliest FOSSILS known are traces of bacteria-like organisms that are about 3.5 billion years old.



The age of these fossils was determined by radioactive dating of the rocks in which they were found.

Fossils of intact organisms have been found preserved in ice, in tar, and in amber.

But most fossils are found in sedimentary rock.

When the remains of dead organisms are covered by sediment and the layers of sediment harden, traces of the buried organisms are preserved in the rock.

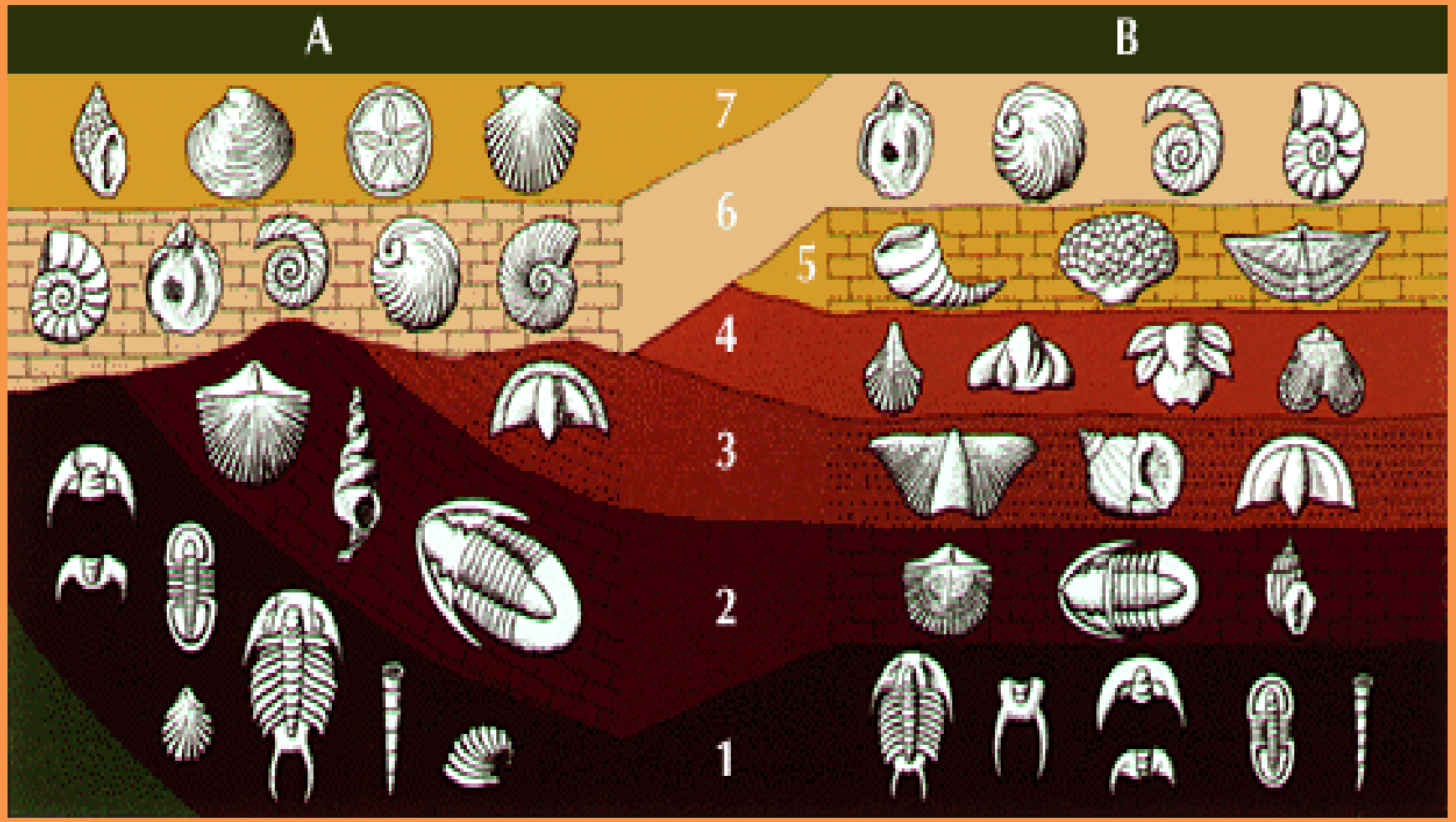
WHAT PARTS OF THE BODY DO WE USUALLY FIND?

Bones, shells, and other hard parts of ancient organisms are most often found

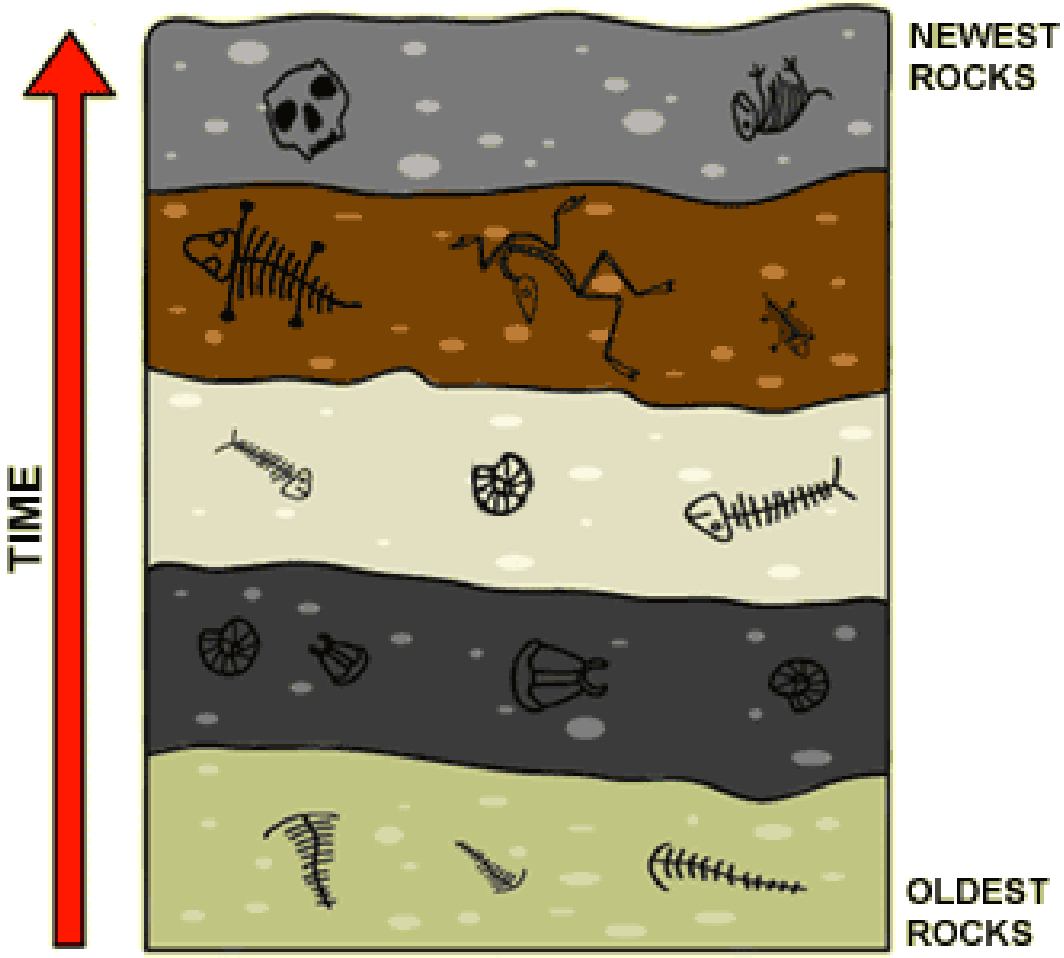
The soft parts generally decay in a short time.

Fossils in lower layers are older than fossils in upper layers.

Which fossils are Older? How can we tell?



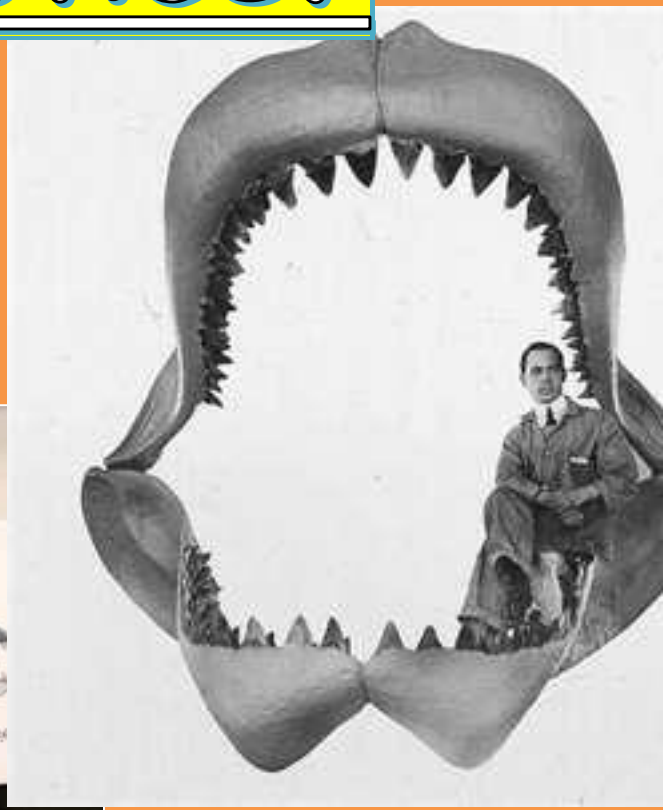
Fossils in the upper layers of rock are generally more complex than fossils in the lower layers.



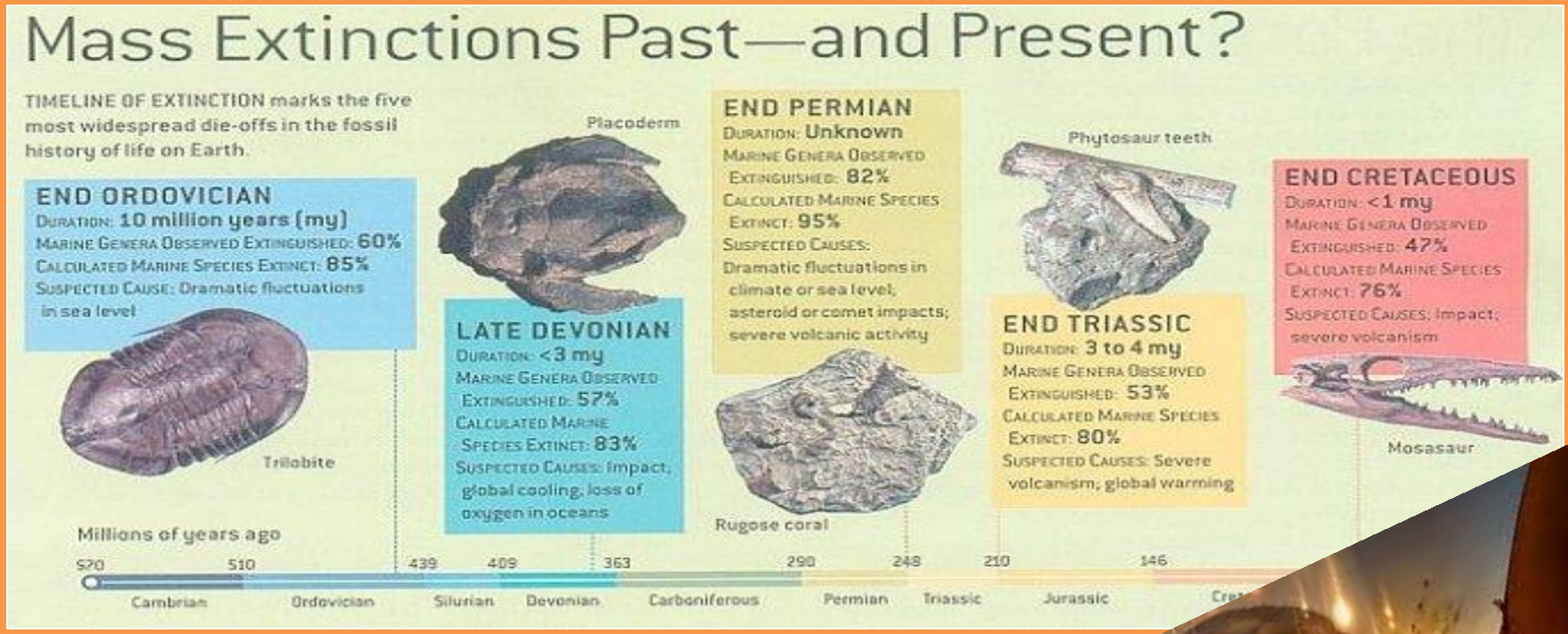
Some things.

This ve died

When we dig up some Of these organisms What do we notice?

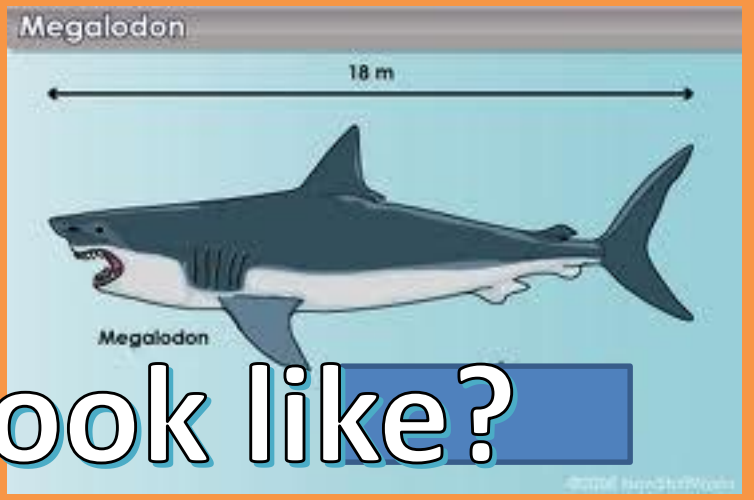


There have been at least 5 major MASS EXTINCTION periods that wiped out many different types of organisms, including the dinosaurs.



1. Climate Change
2. Climate Change
3. Climate Change
4. Climate Change (increased rainfall, Dinosaurs emerge)
5. Meteorite Crashing in to Earth

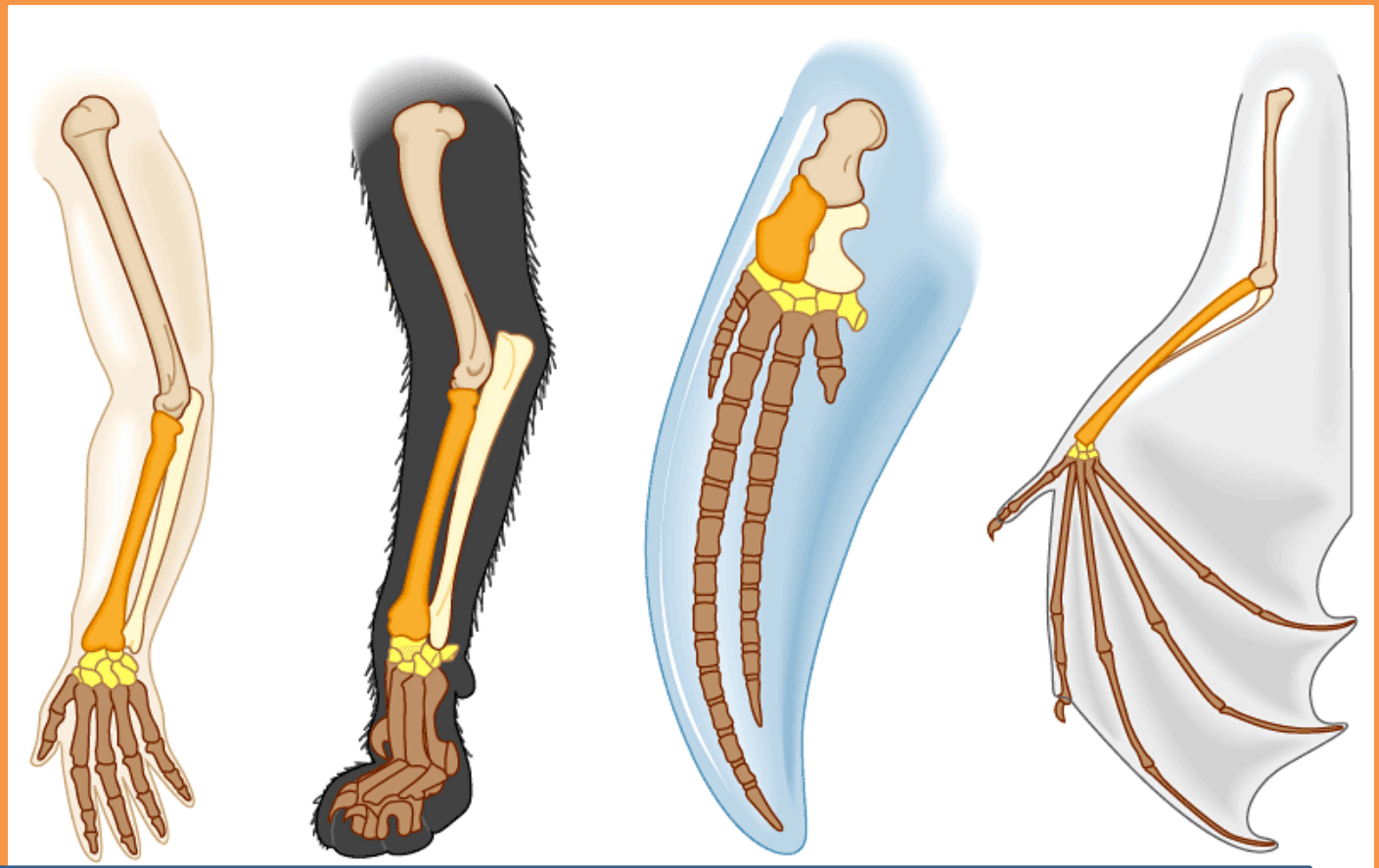
On the other hand, some fossils are very similar to modern life forms, which suggests that some organisms have undergone little evolutionary change.



What do these look like?

More evidence for evolution comes from observations of basic structural similarities between organisms.

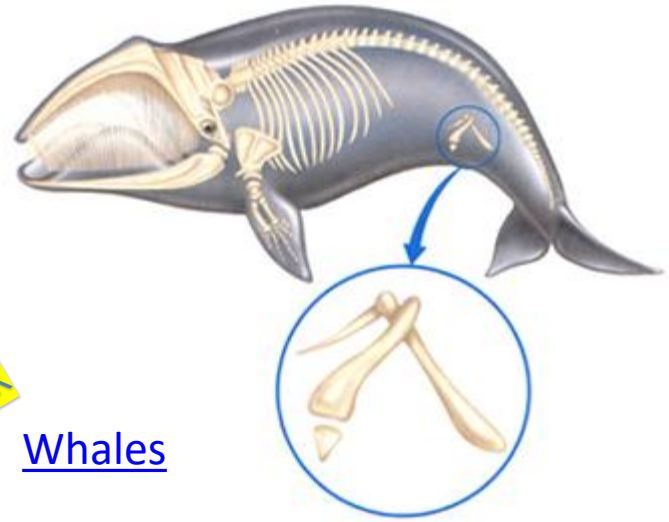
HOMOLOGOUS STRUCTURES are organs that his similar structure but different jobs.

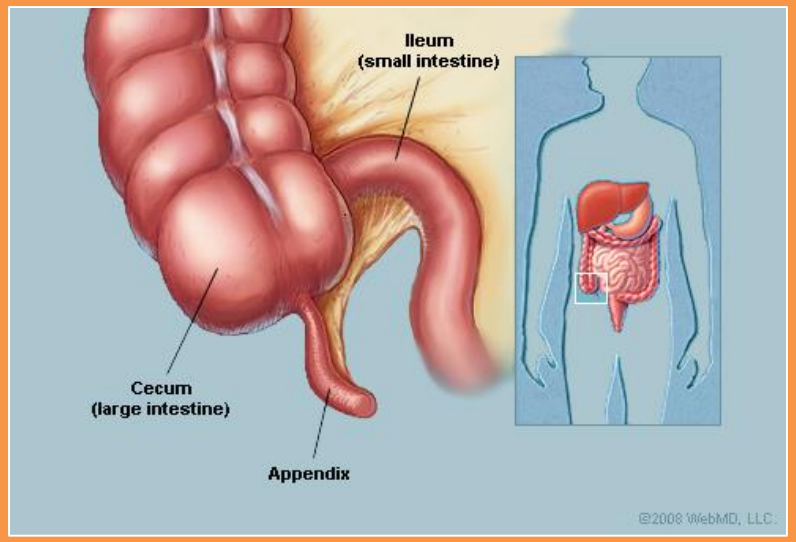


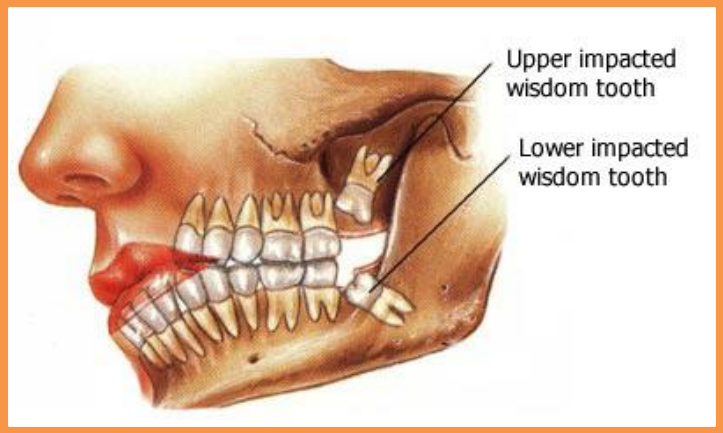
VESTIGIAL STRUCTURES are structures that once had a purpose.

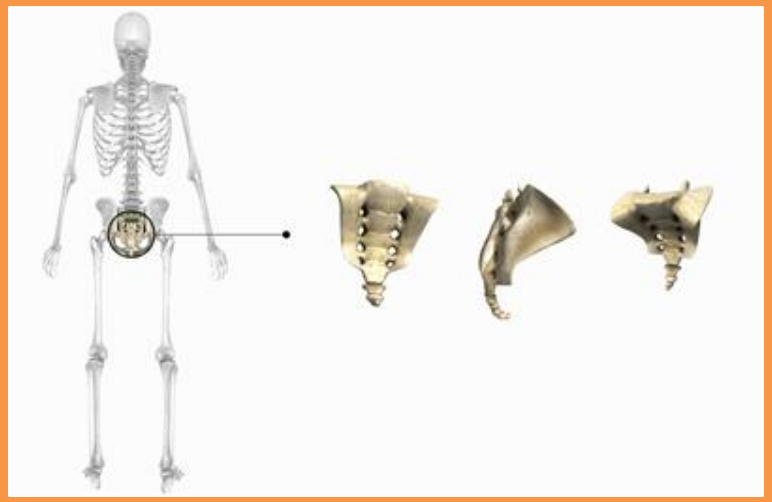
CLICK

Whales

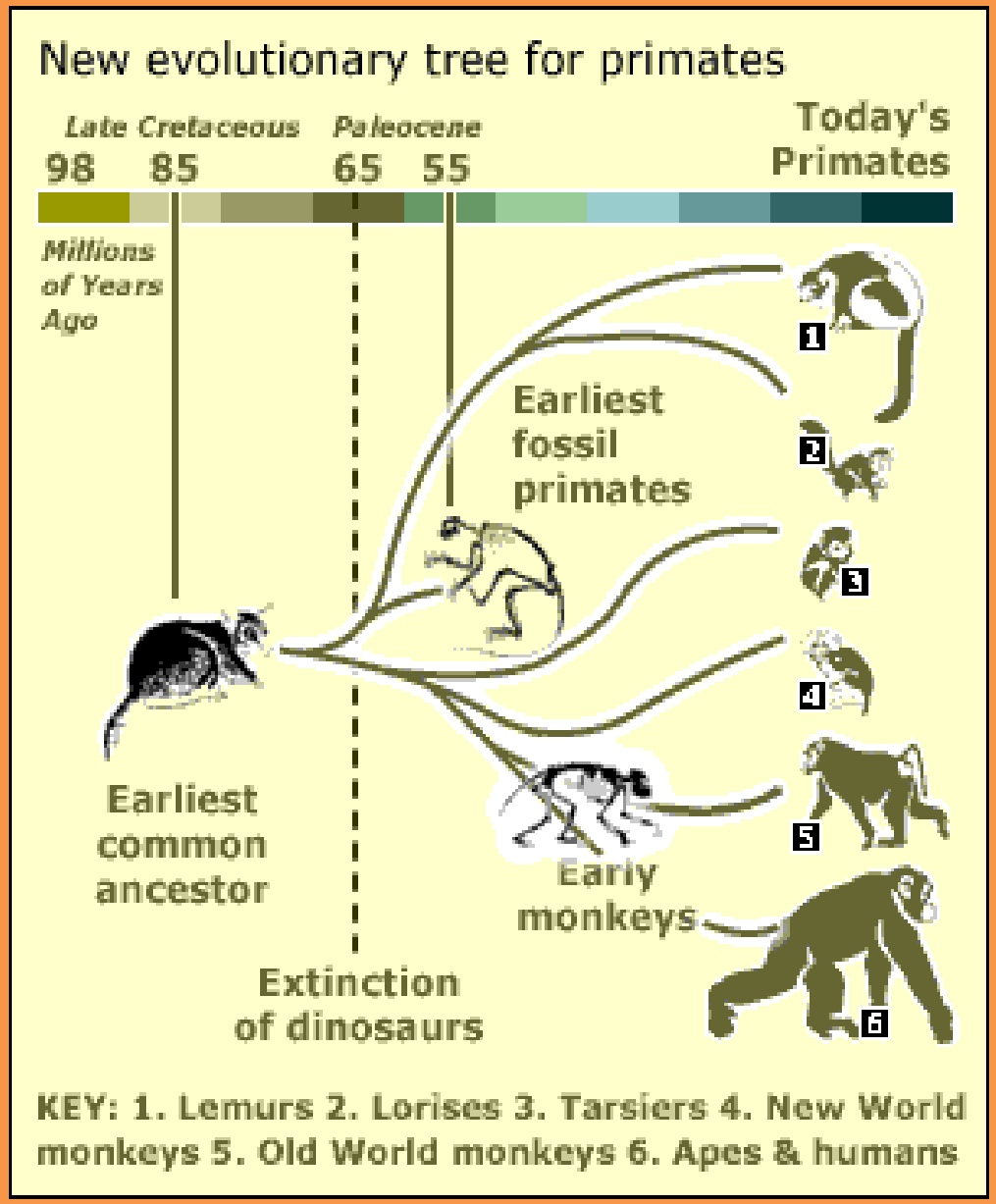






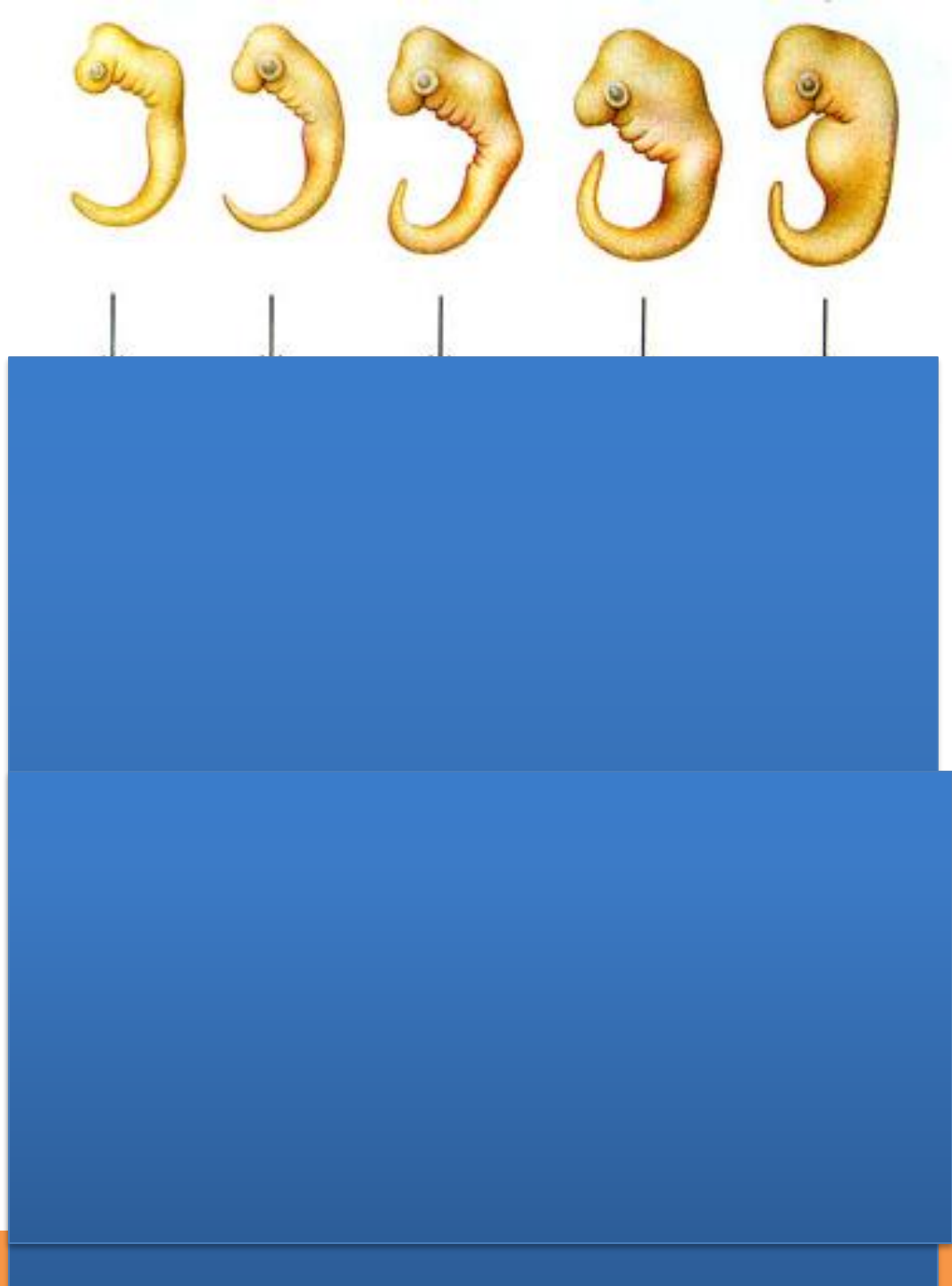


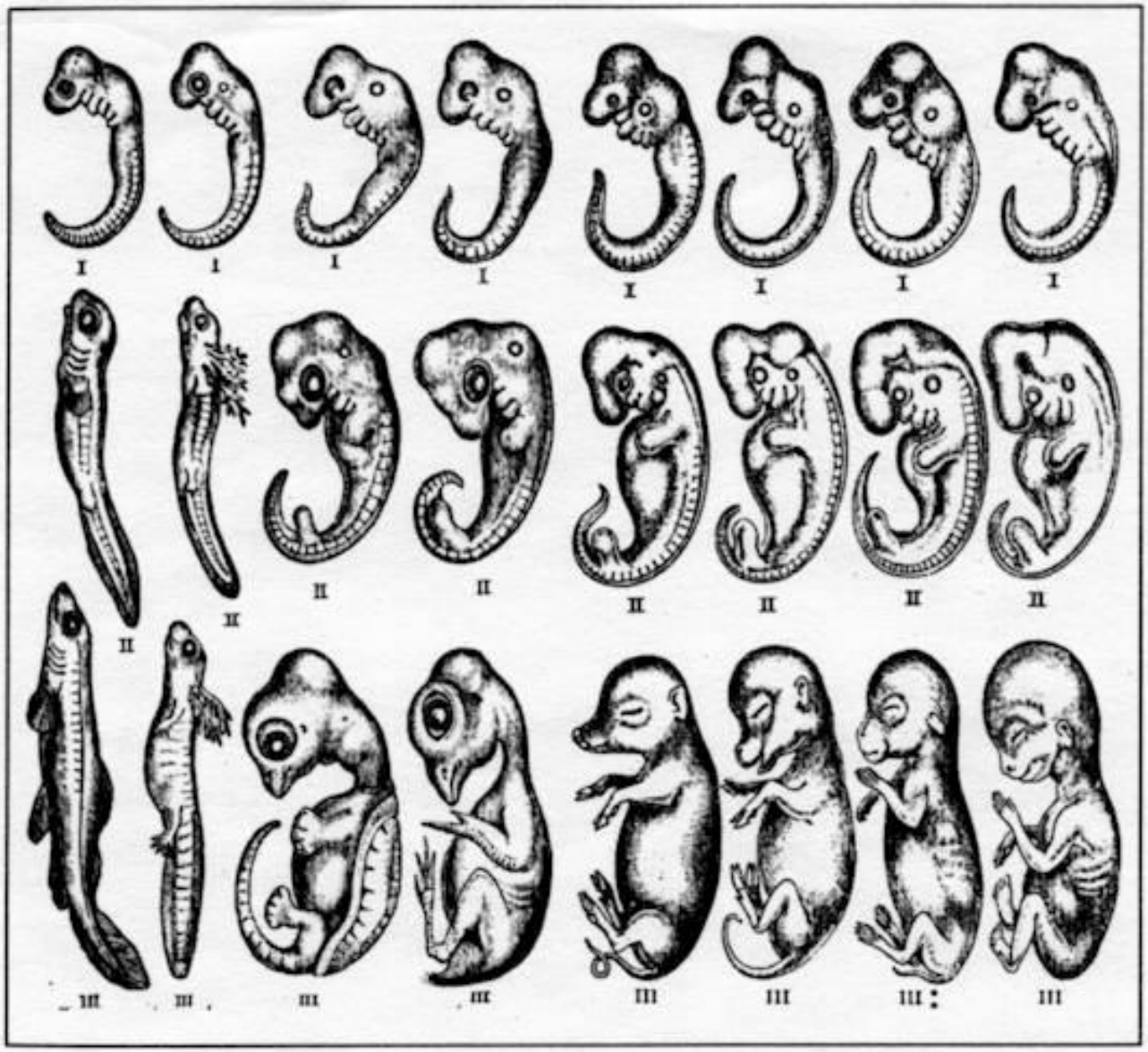
If there are homologous and vestigial structures



EMBRYONIC DEVELOPMENT

may show similarities that suggest a common ancestry even though the adult organisms may be very different from each other.

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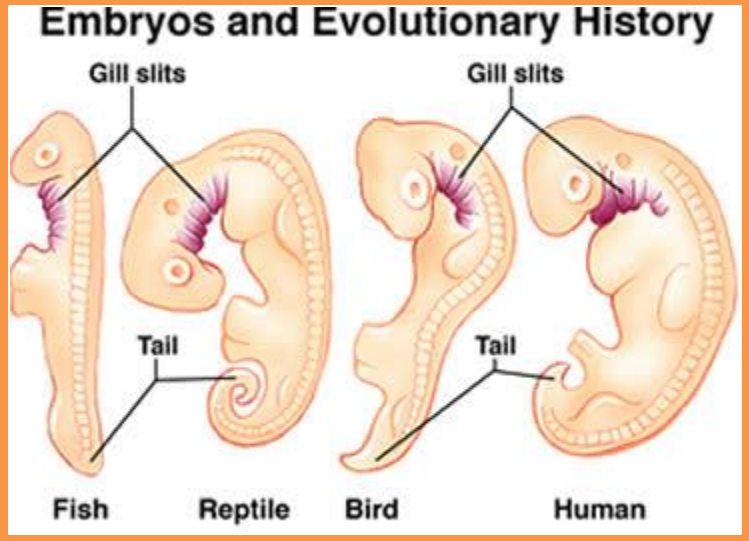
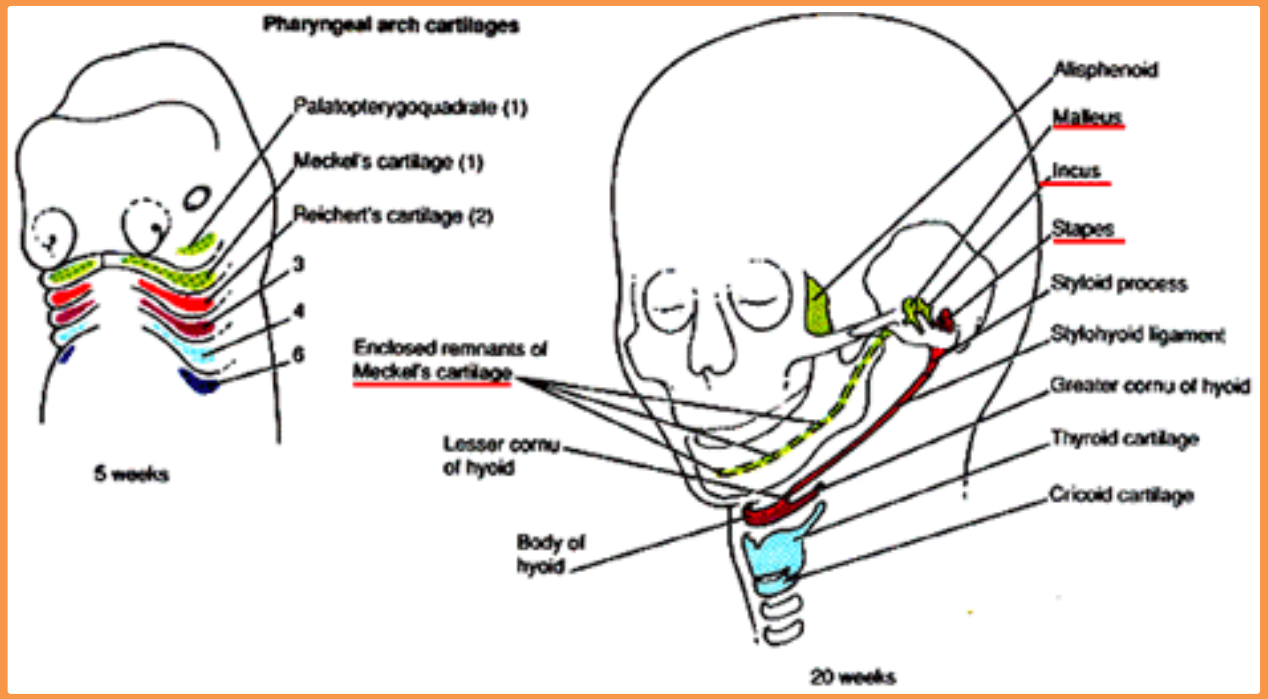

Embryos and Evolutionary History
Gill slits
Gill slits
Tail
Tail
Fish
Reptile
Bird
Human


Pharyngeal arch cartilages
Palatopterygoquadrate (1)
Meckel's cartilage (1)
Reichert's cartilage (2)
3
4
6
5 weeks
Alisphenoid
Malleus
Incus
Stapes
Styloid process
Stylohyoid ligament
Greater cornu of hyoid
Thyroid cartilage
Cricoid cartilage
Enclosed remnants of Meckel's cartilage
Lesser cornu of hyoid
Body of hyoid
20 weeks

All living things contain similar biochemical compounds.

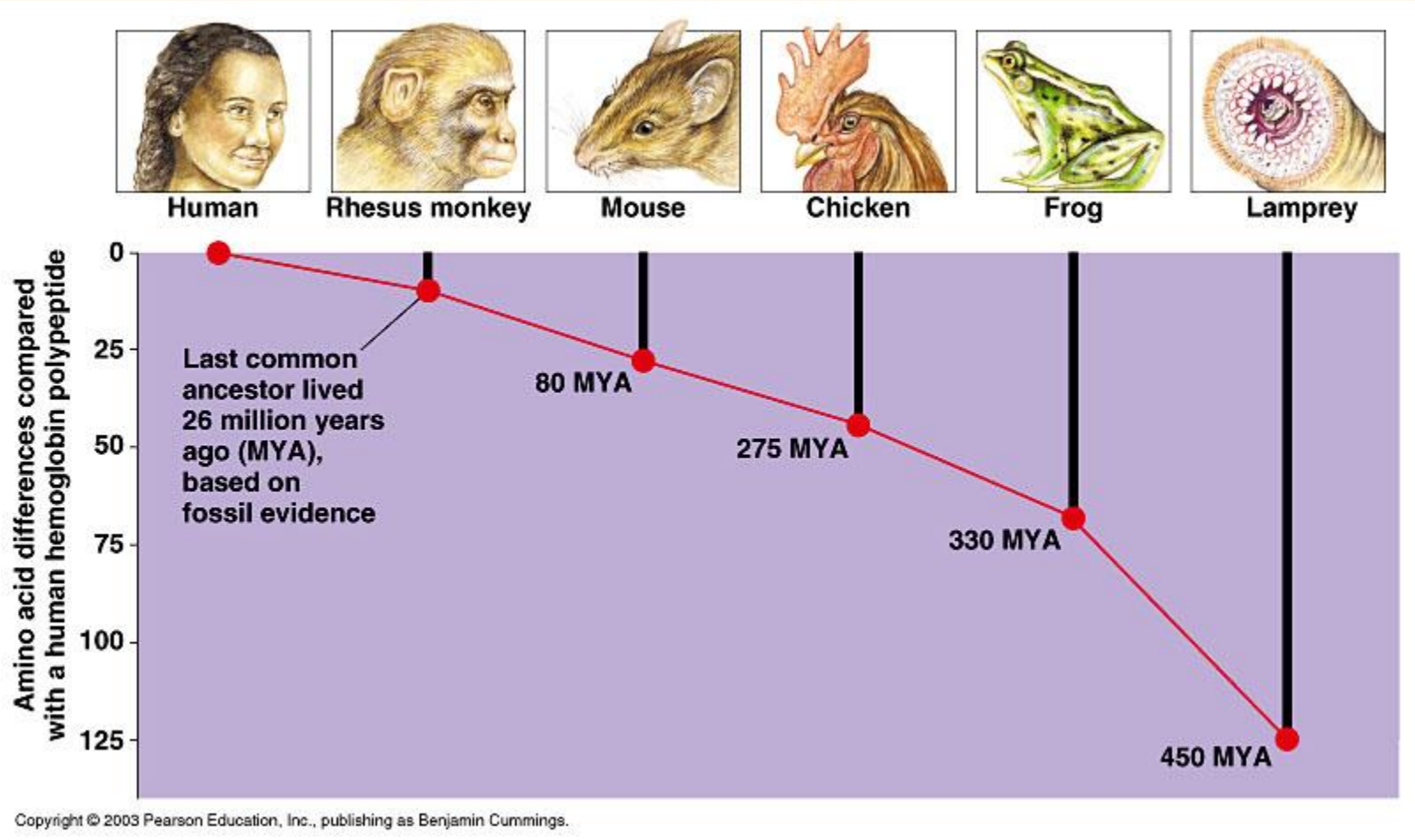
The structure and function of DNA, RNA, and proteins (including enzymes) are similar in all organisms.

Table 22.1 Molecular Data and the Evolutionary Relationships of Vertebrates

Species	Number of Amino Acids That Differ from a Human Hemoglobin Polypeptide (Total Chain Length = 146 Amino Acids)
Human 	0
Rhesus monkey 	8
Mouse 	27
Chicken 	45
Frog 	67
Lamprey 	125

Greater biochemical similarity between organisms indicates a closer relationship between them.

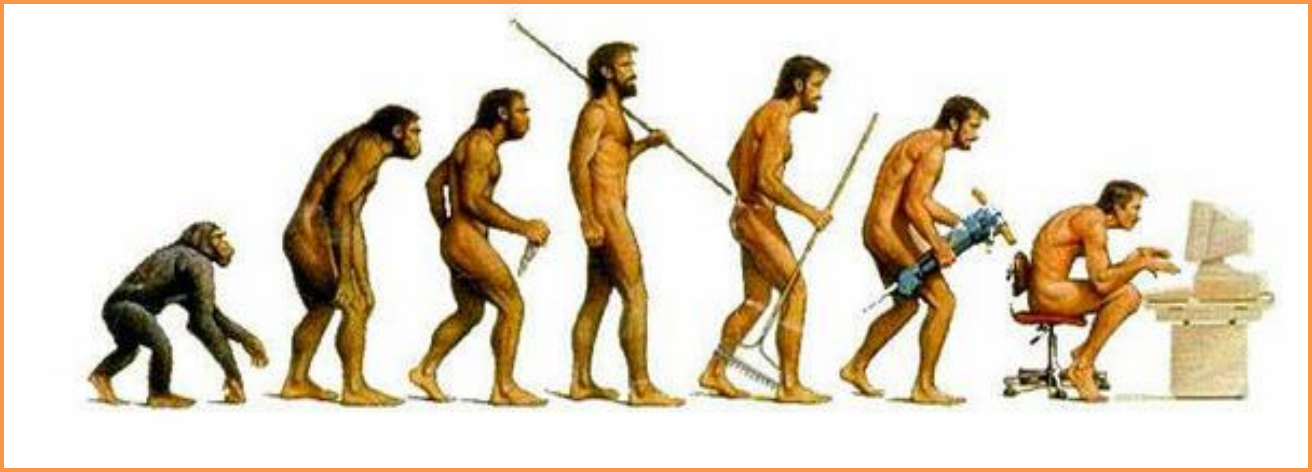
And a more recent COMMON ANCESTOR.



All of these similarities in

the FOSSIL RECORD
ANATOMY
EMBRYOLOGY
and BIOCHEMISTRY

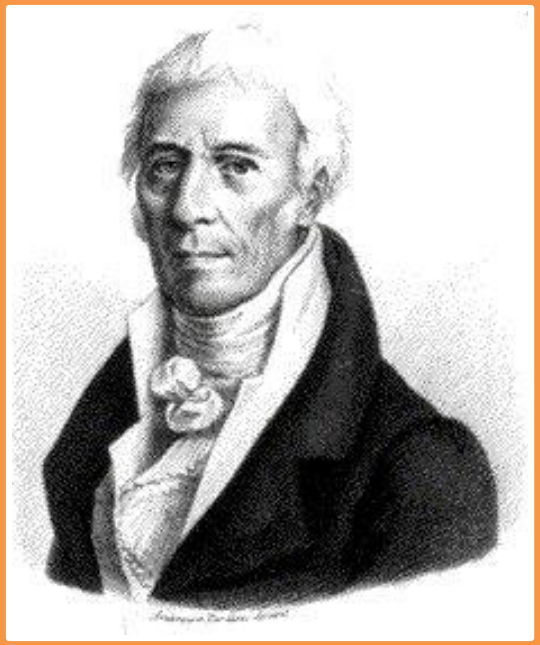
show RELATIONSHIPS BETWEEN ORGANISMS
and provide evidence that organisms have developed
through EVOLUTION over millions of years.



Theories of evolution attempt to explain HOW the similarities and differences among species came about.

Some early ideas were proposed by LAMARCK in 1809.

Lamarck suggested that organisms develop organs that they NEED and lose organs that they don't need based on how they are used.

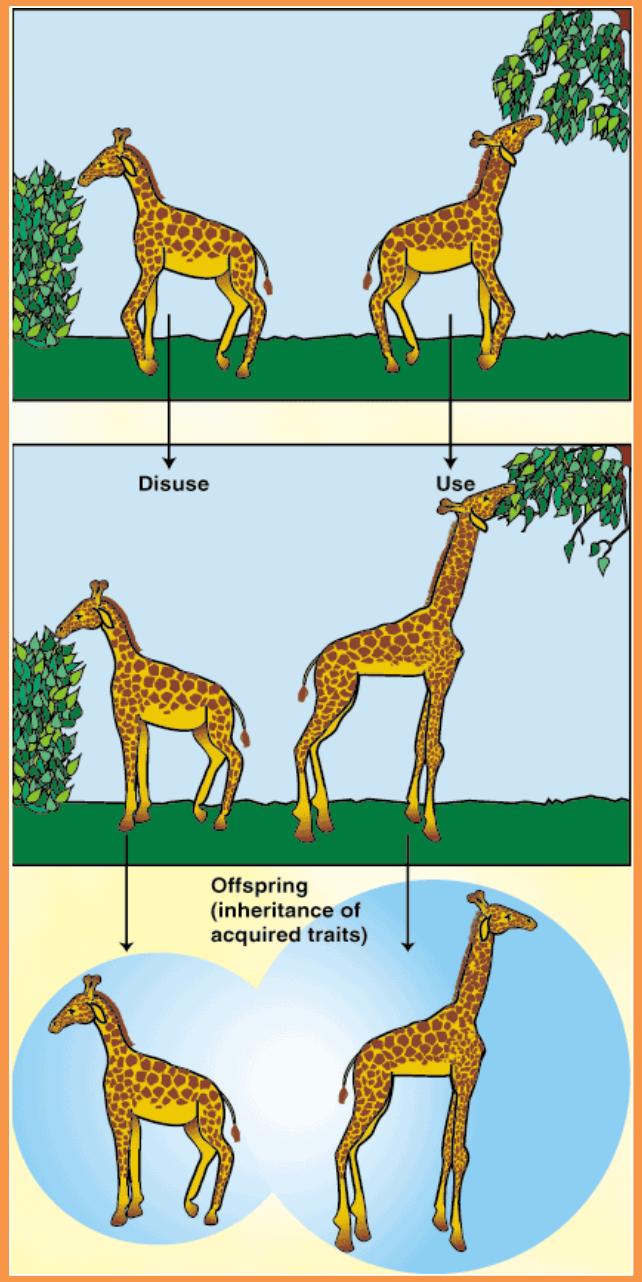


USE OR DISUSE:

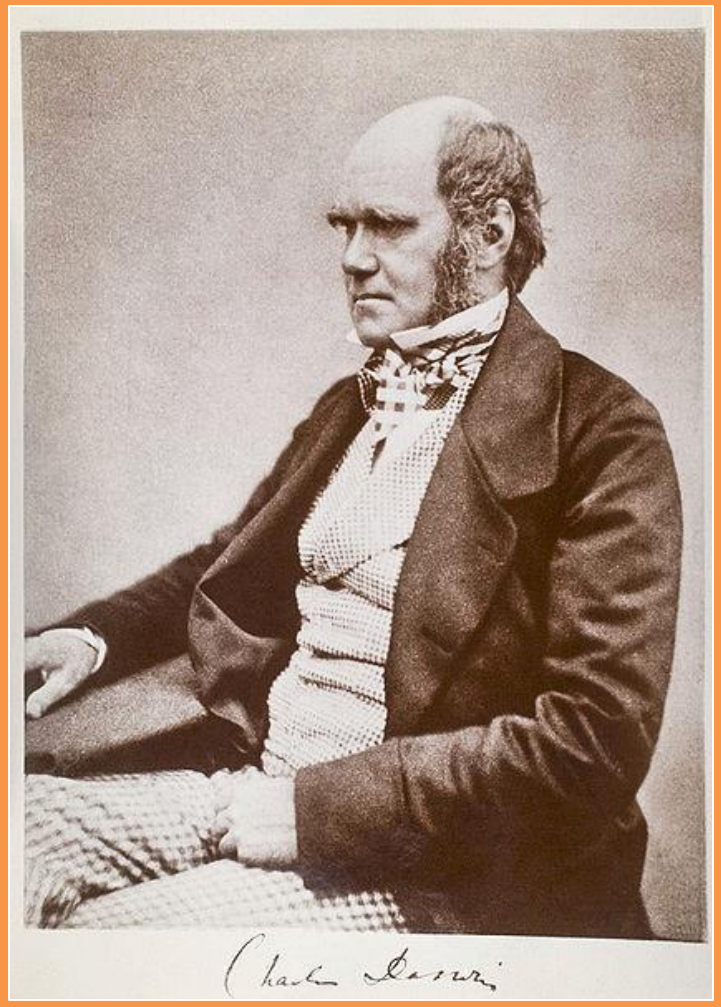
1. The parts used become stronger and more developed.

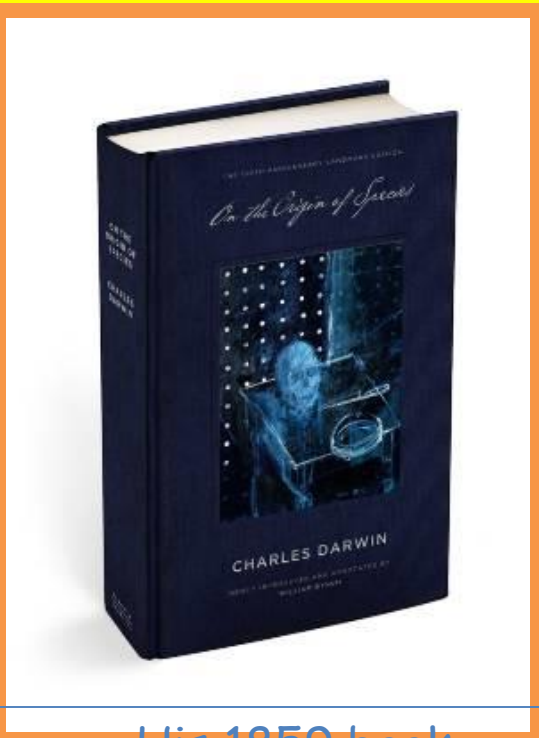
2. The parts you don't use become weaker and less pronounced.

INHERITANCE OF ACQUIRED CHARACTERISTICS:
The things changed by use and disuse are passed down through the generations.



DARWIN presented evidence that all species of life have evolved over time from common ancestors, through the process he called NATURAL SELECTION.

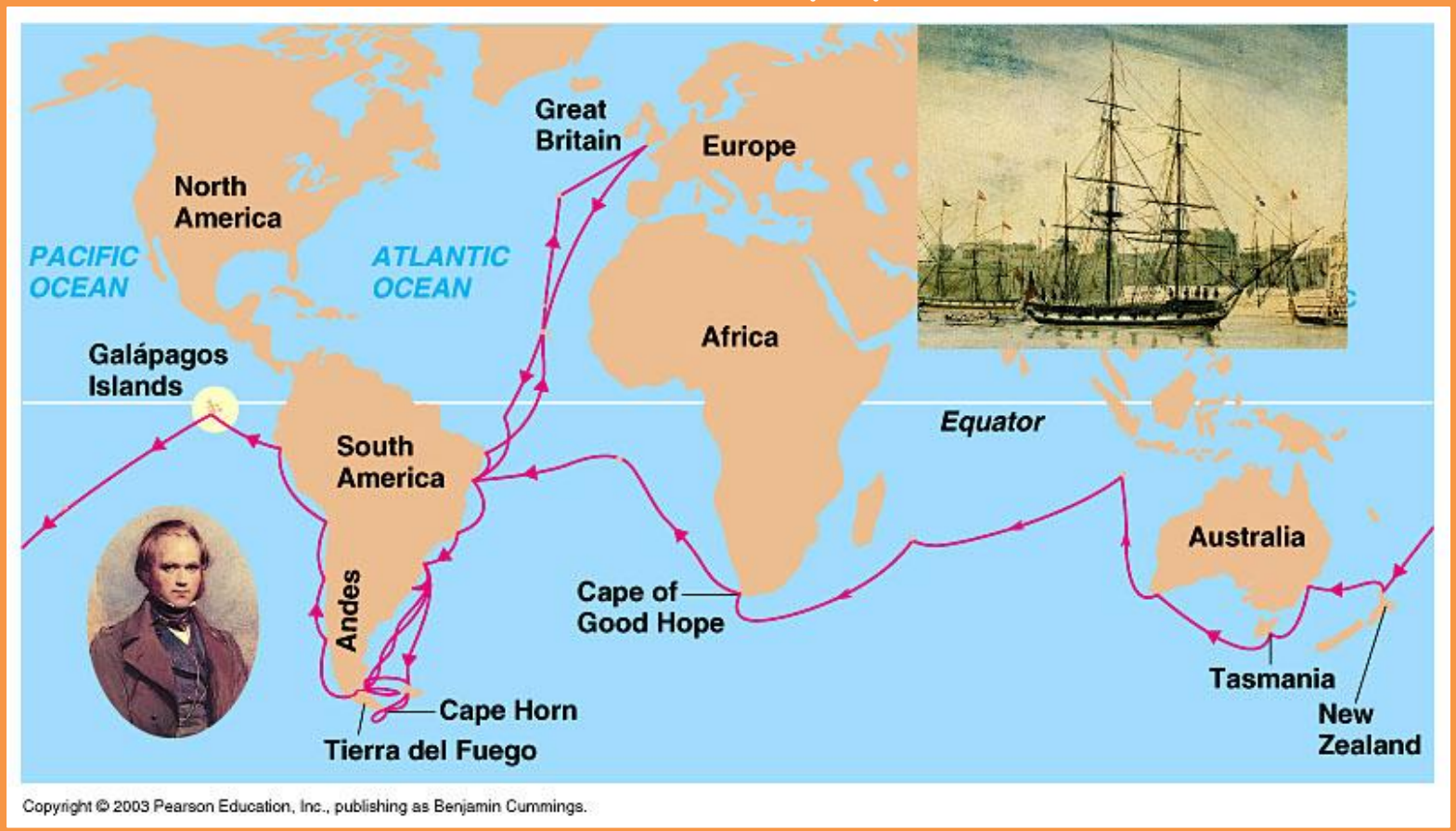




His 1859 book
On the Origin of Species
established evolution as the dominant scientific explanation of the diversity of living things.

CHARLES DARWIN took a 5 year voyage on the HMS Beagle during which he visited the Galapagos Islands.

The publication of his journal about the voyage made him famous as a popular author.



Darwin's theory of EVOLUTION by NATURAL SELECTION has six important components.

1. Overpopulation
2. Variation
3. Competition
4. Natural selection
5. Reproduction
6. Speciation

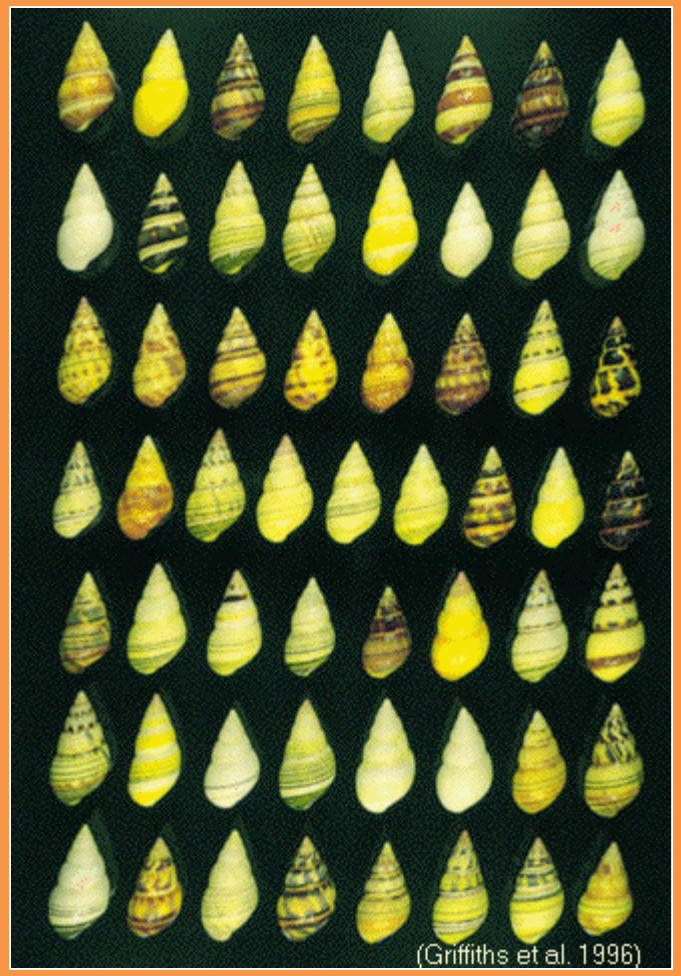
1. OVERPOPULATION

Within a population, there are more offspring produced in each generation than can possibly survive.

What factors limit the survival of a population?

2. VARIATIONS EXIST

Within a population, the individual organisms are different from one another.



3. COMPETITION
Natural resources are limited.

There is competition between the members of the populations for these resources.

What natural resources are limited?

In what ways do organisms compete for these resources?

4. NATURAL SELECTION

Some members of a population are better adapted to the environment than others.

The environment acts as the SELECTING AGENT. It determines which adaptations or variations are helpful and which are harmful.

For example, in an environment that is unusually cold, animals born with fur that is thicker than normal will survive more easily than animals with less fur.

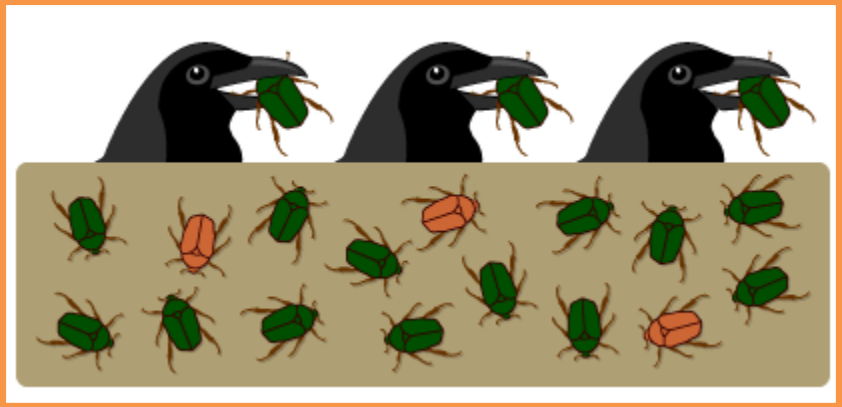
In this case, the variation (thicker fur) helps the organism handle the environmental pressure.

Beneficial variations are called ADAPTATIONS.
Characteristics that have adaptive value in one environment might actually be harmful in another environment.

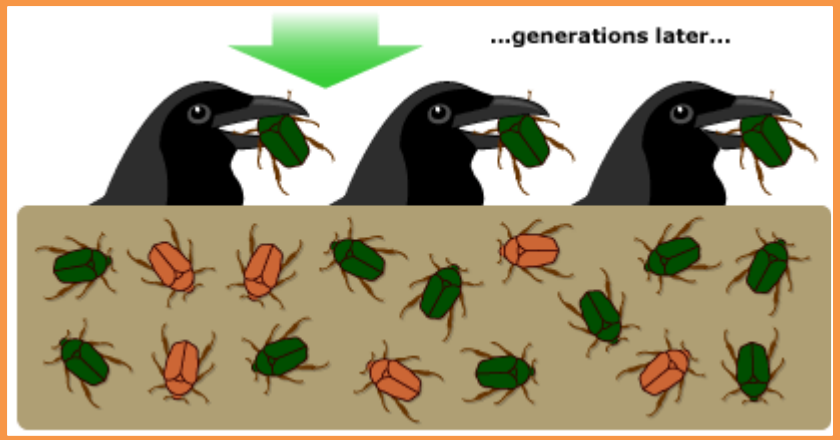
5. REPRODUCTION

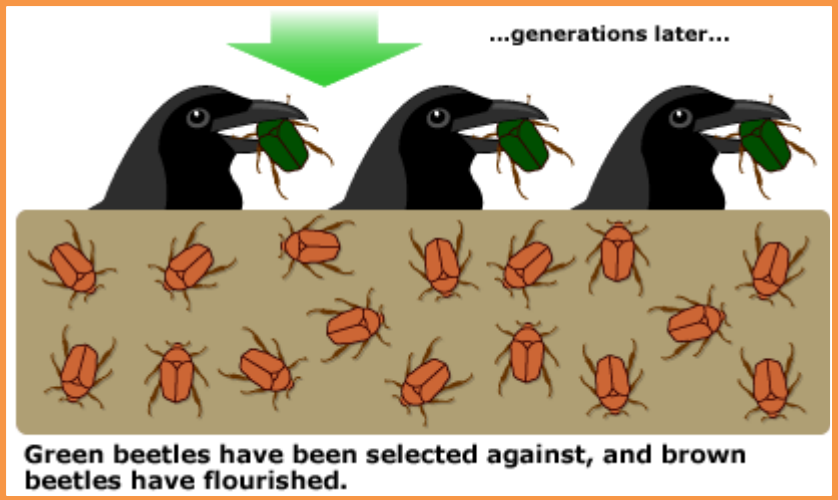
Individuals with helpful variations tend to reproduce more than those with less helpful variations.

They transmit the helpful variations to their offspring.

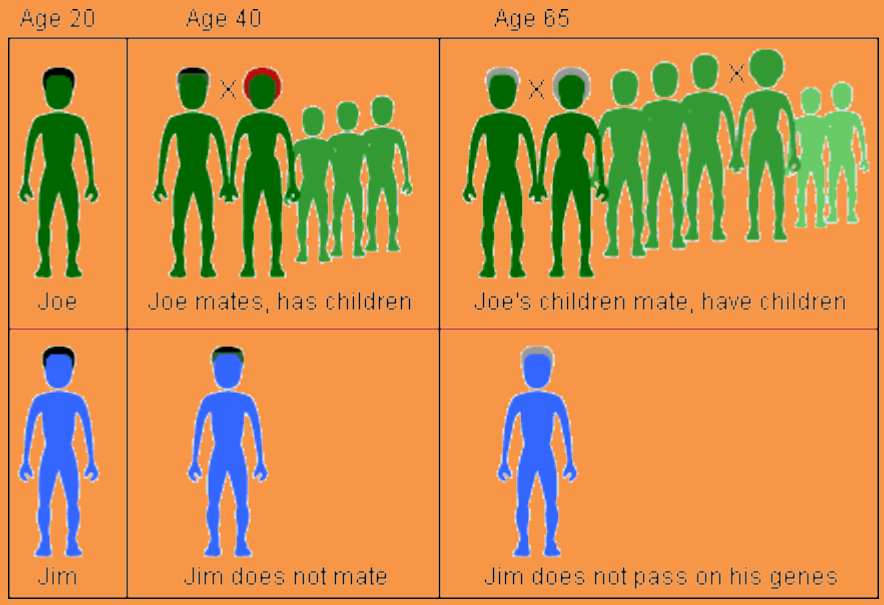


The best-adapted individuals pass their genes to the next generation more often than less-well-adapted individuals do.





"Survival of the Fittest" is a lot less about survival than it is about REPRODUCTION.



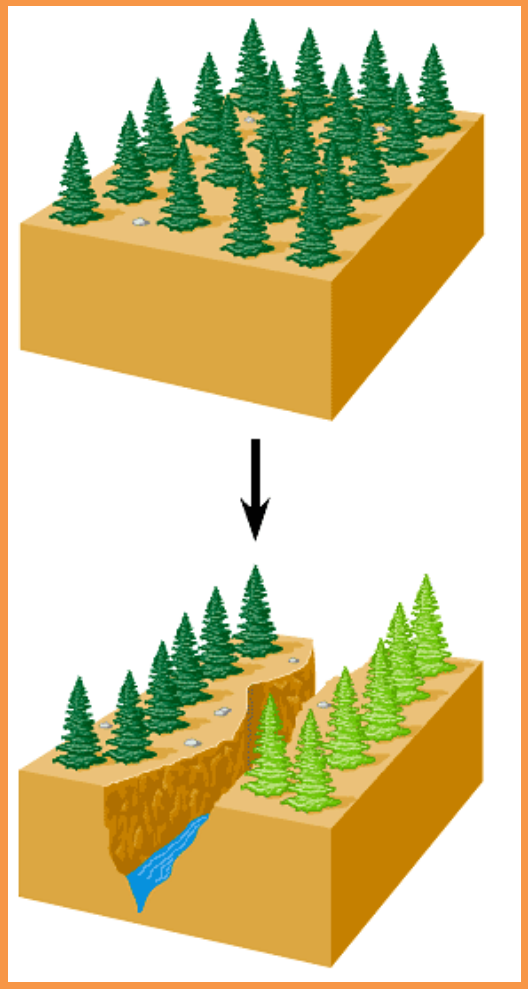
Darwin's theory of Natural Selection would be more properly nicknamed REPRODUCTION of the fittest.

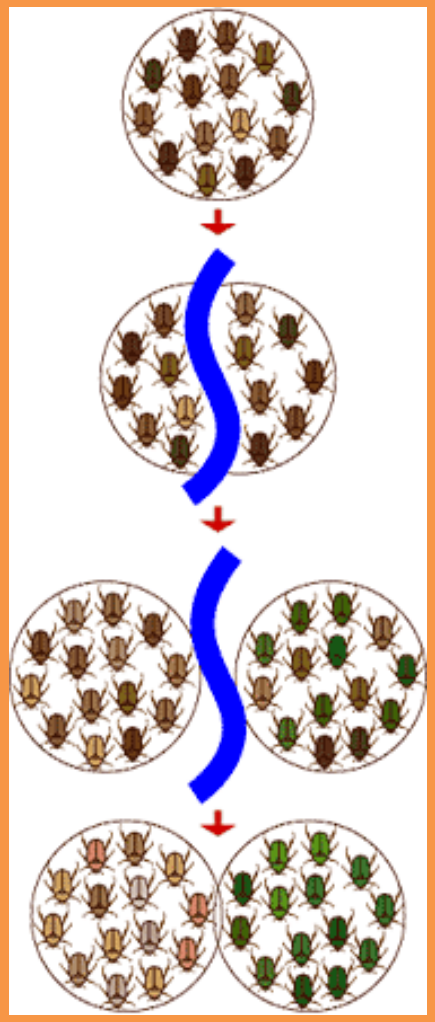
6. SPECIATION

The development of new species occurs as variations or adaptations accumulate in a population over many generations.

A biological SPECIES is a group of interbreeding populations that are REPRODUCTIVELY ISOLATED from other species in natural environments.

Speciation is often the result of GEOGRAPHIC ISOLATION – when a population is divided into two groups that are prevented from mating with each other.

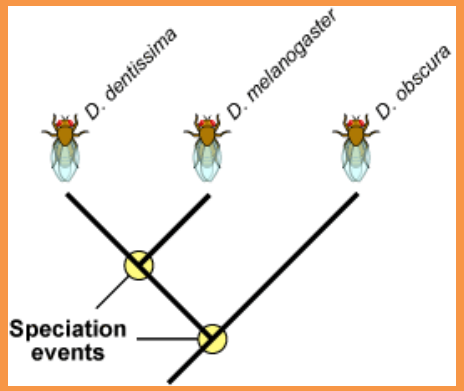




Differences between the two groups accumulate until they are so different that they can no longer interbreed even if they get back together.

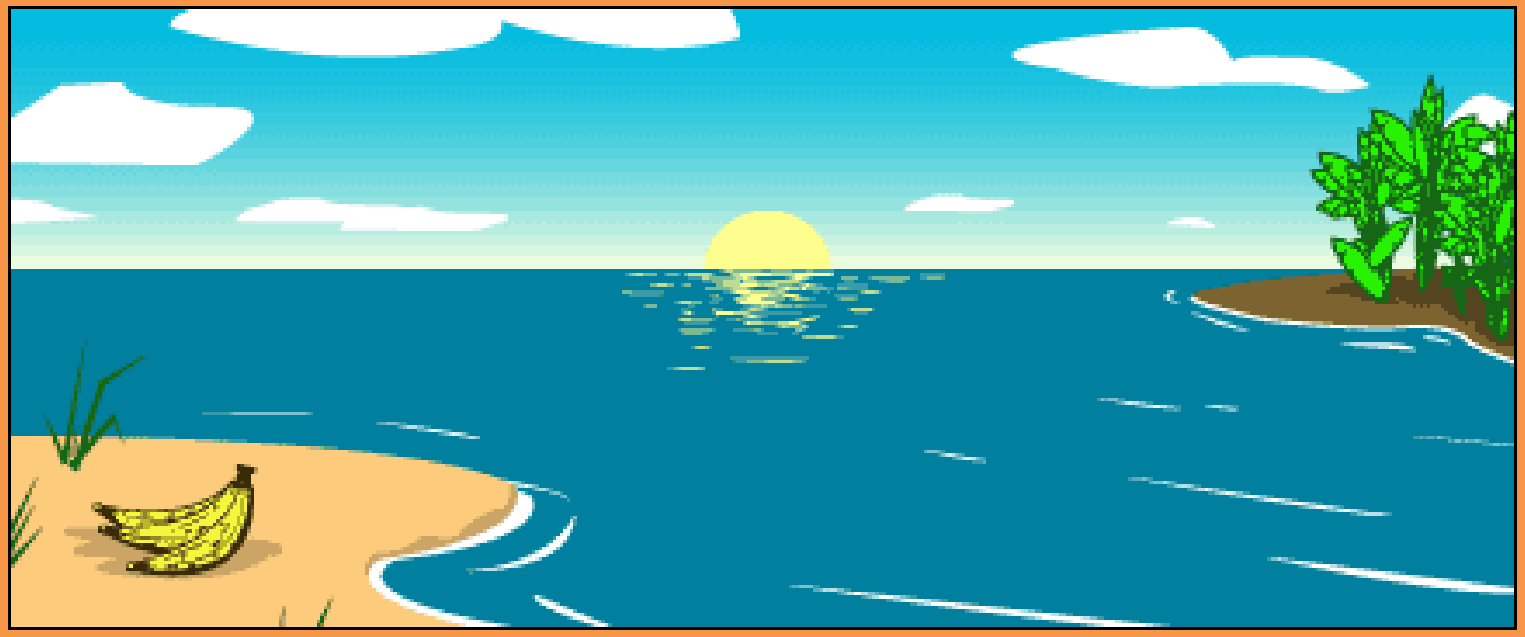
Island chains like the Galapagos provide a perfect example of how organisms can be geographically isolated.

https://www.youtube.com/watch?v=ynT61_hLRZ0&t=76s

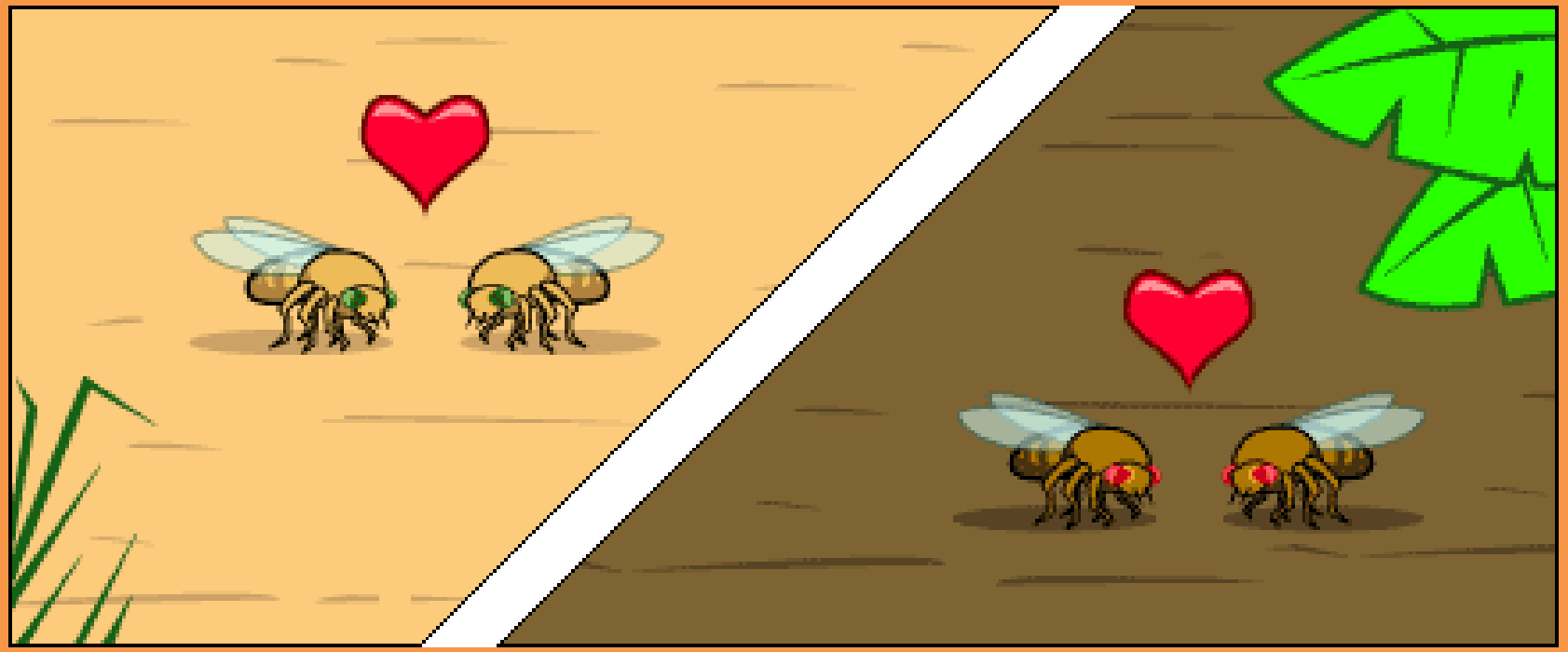


Ancestral species

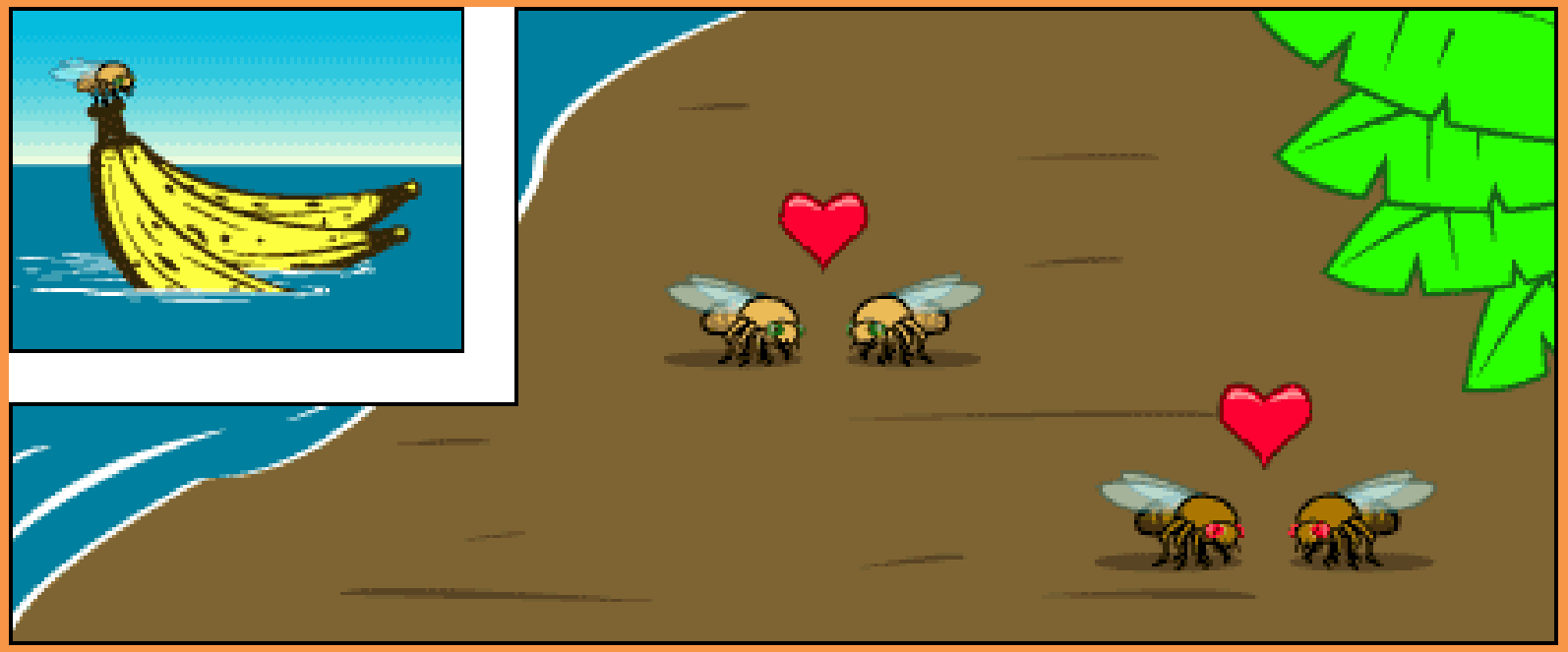
Storm isolates a small population.



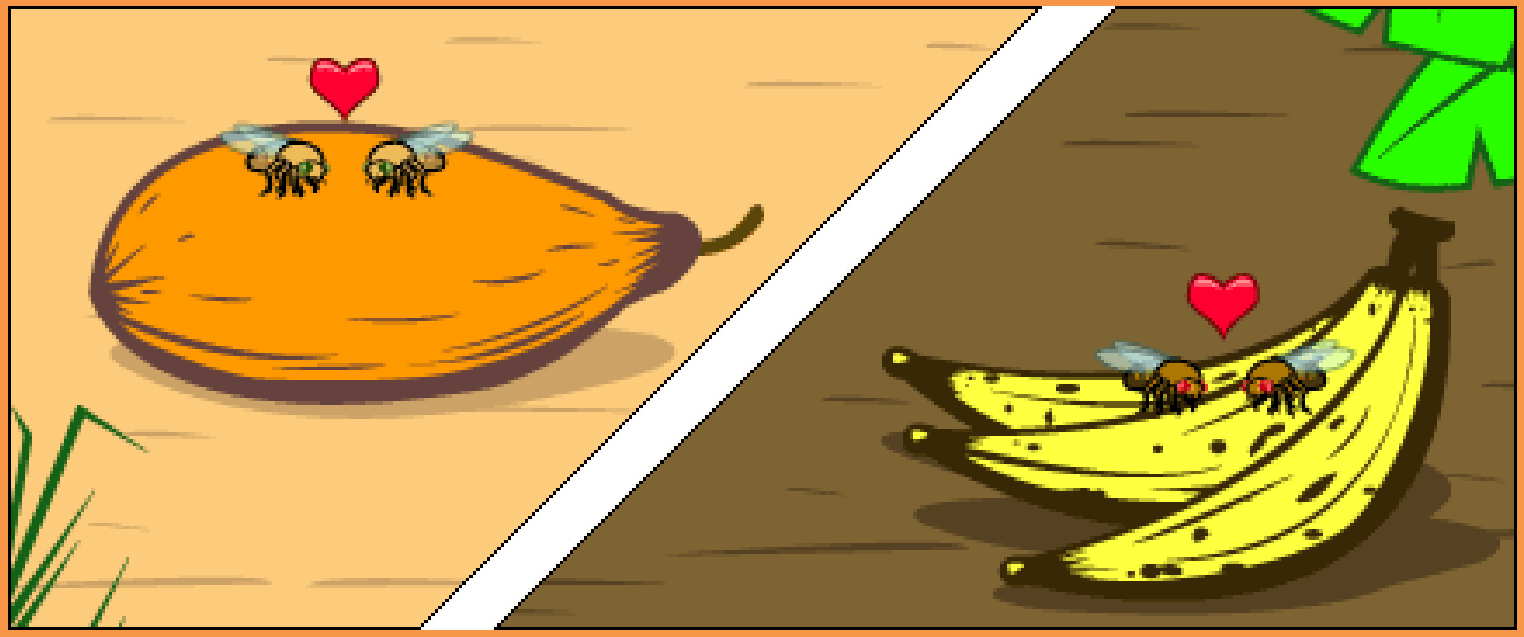
Mating rituals change over time –
leading to different behavior in each population.



When reunited, the flies do not recognize members of the other population as the same species.

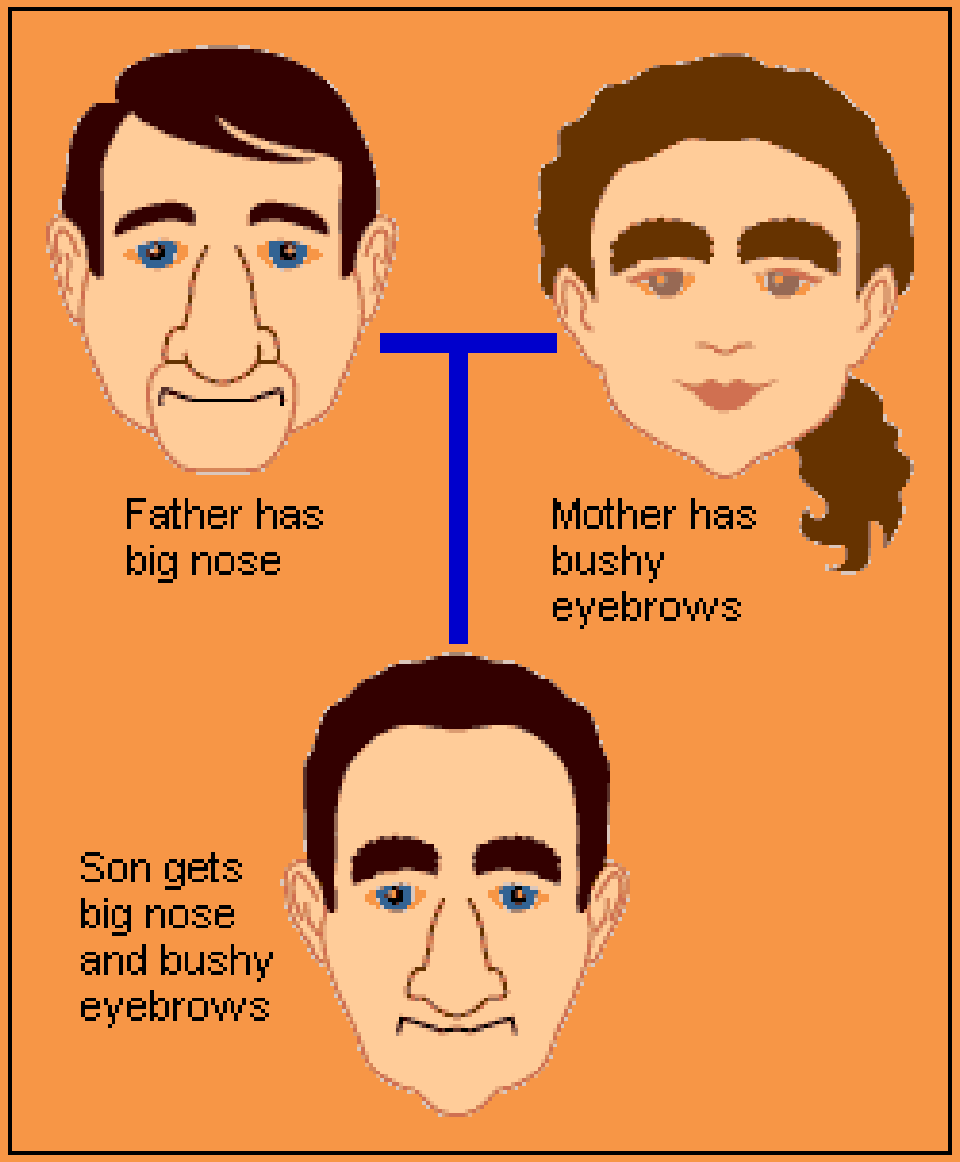


If there had been a different food source on the island….



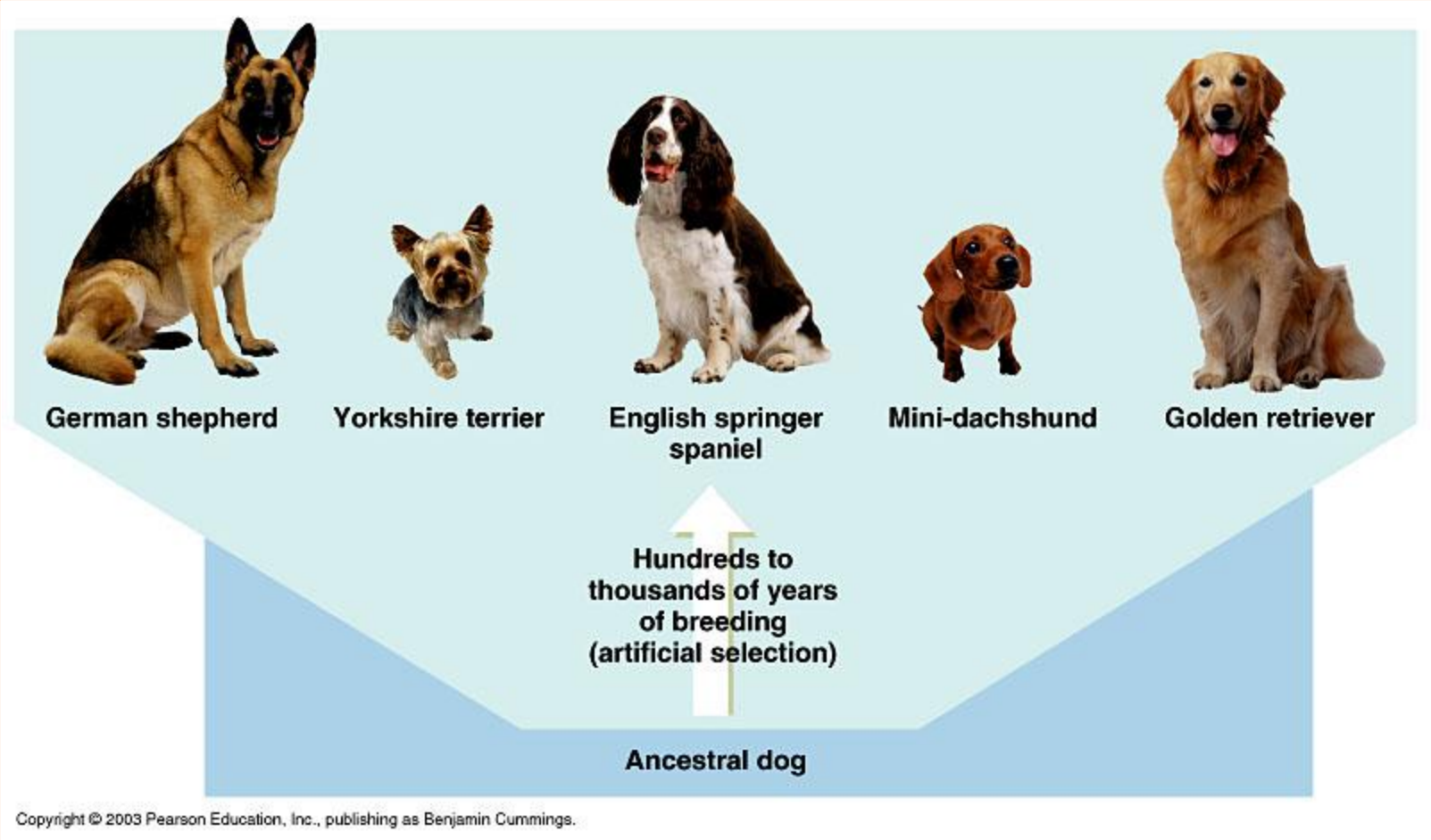
The flies might recognize one another, but would spend so much time where their favorite food is, that they wouldn’t encounter each other much.

Variation in a population is increased by SEXUAL REPRODUCTION.



Natural selection throughout billions of years of the Earth's history has resulted in the formation of millions of different species.

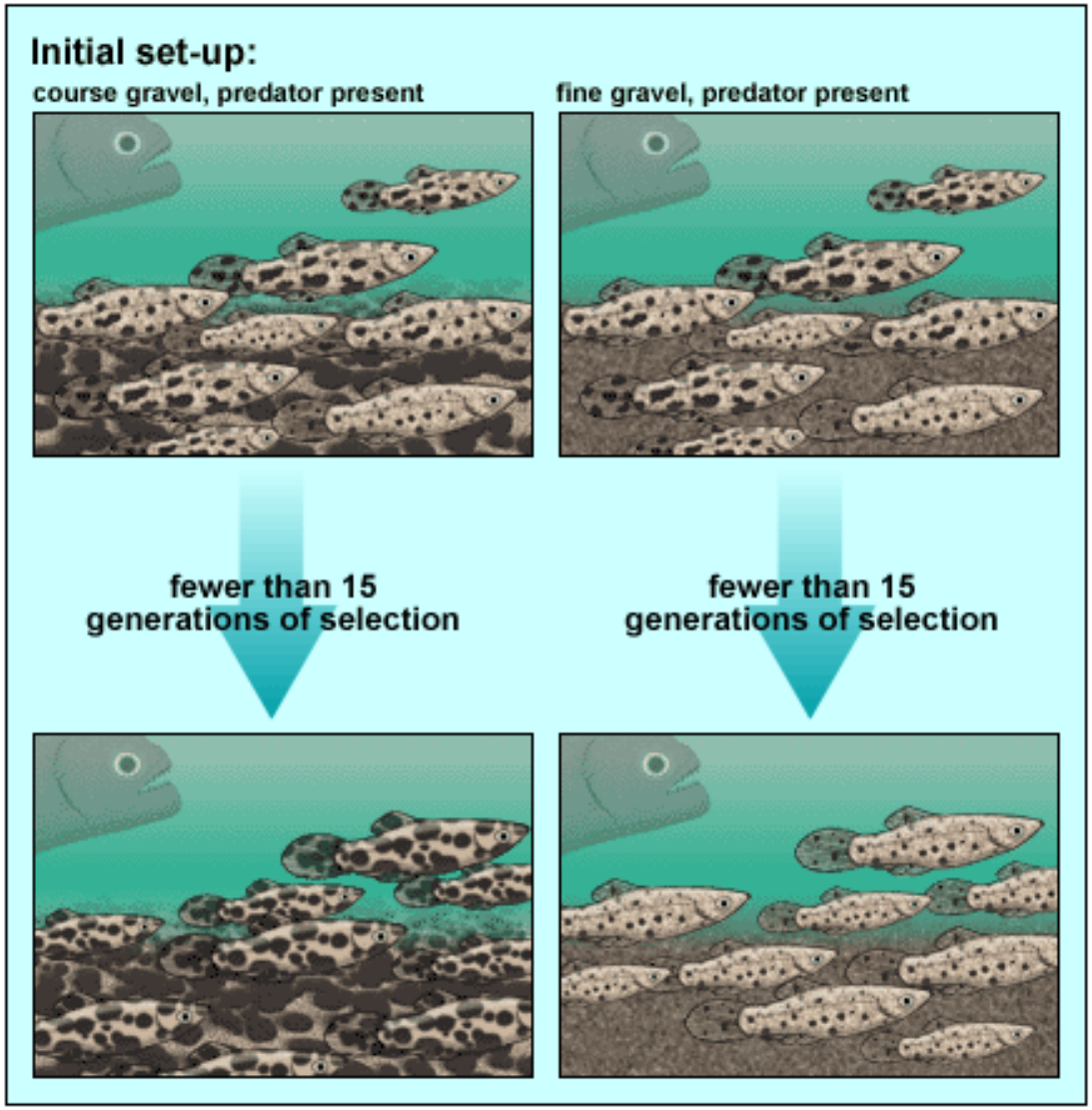
People have used their knowledge of patterns of inheritance to influence the development of organisms in the same way through ARTIFICIAL SELECTION aka SELECTIVE BREEDING.

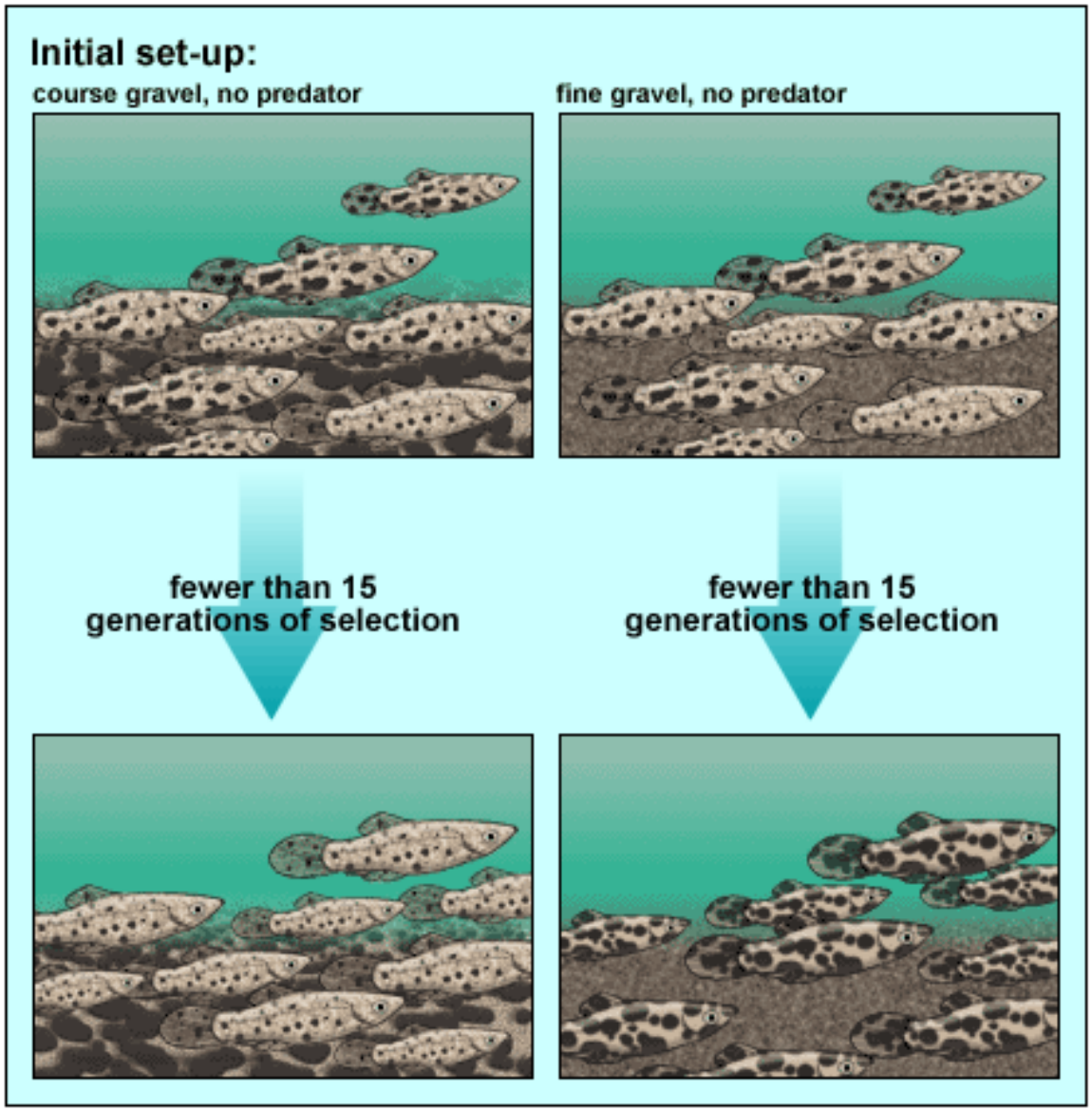


In many cases, scientists have carefully documented evolution through artificial selection in the lab.

This diagram shows the work of Canadian scientist John Endler:

In the presence of predators, guppies evolved to blend in with their background.





Without predators, there was SEXUAL SELECTION for male guppies that stood out from their background and attracted the attention of the females.

Biston betularia typica

Biston betularia carbonaria

INDUSTRIAL MELANISM

The number of rare dark moths increased as the trees became blackened with soot in the late 1800's.

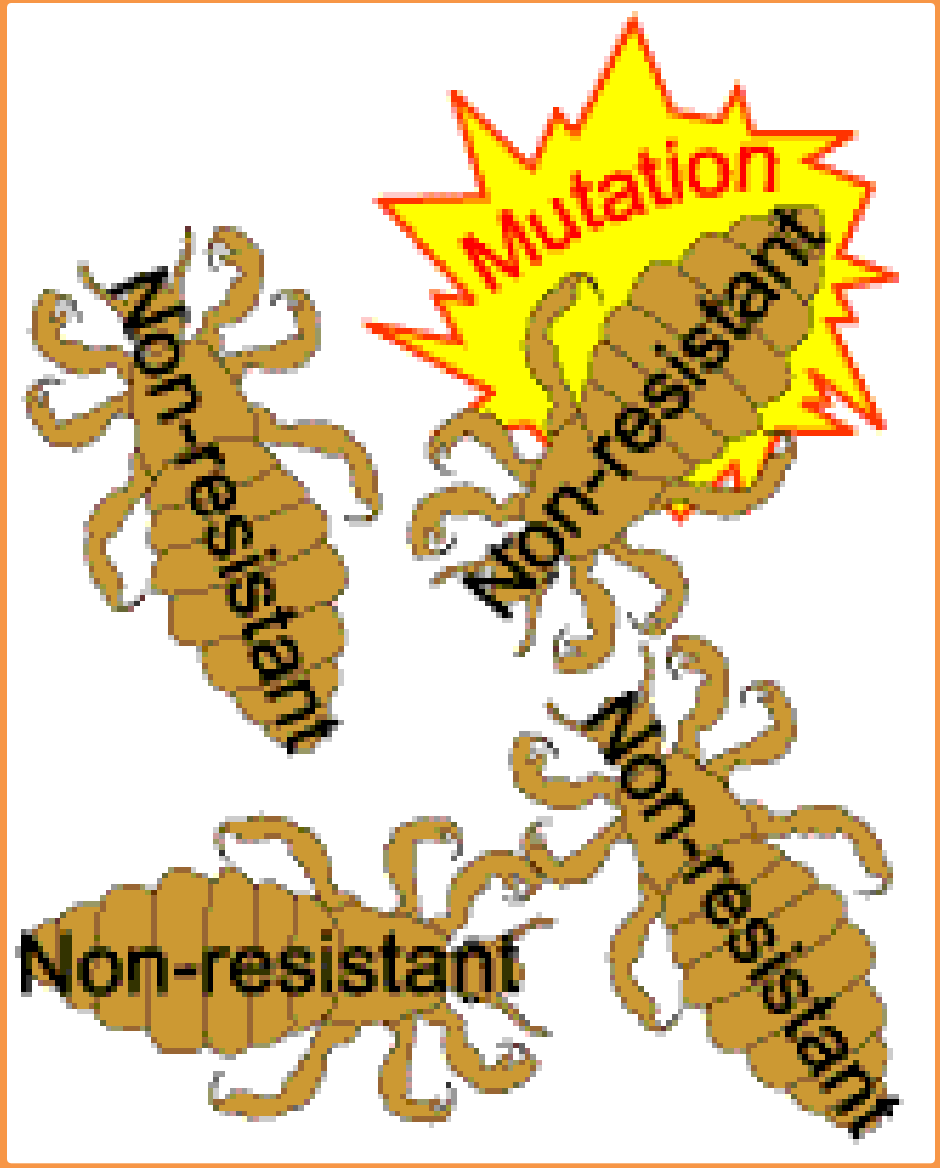
Today, Clean Air laws have reduced the soot output from industry, and the dark moths are becoming rare once again.

You have to be careful about the way you think about mutations.

Mutations occur RANDOMLY.

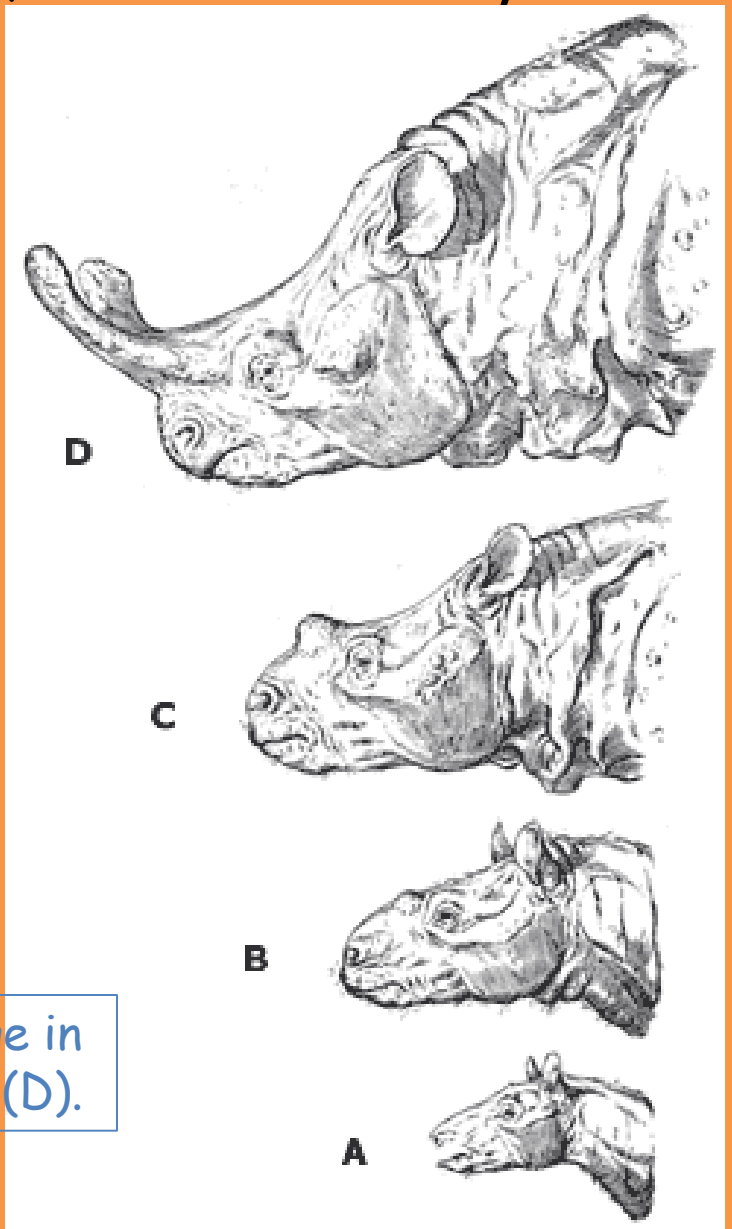
They are not CAUSED by exposure to chemicals.

Resistance only becomes apparent because of the chemical exposure.



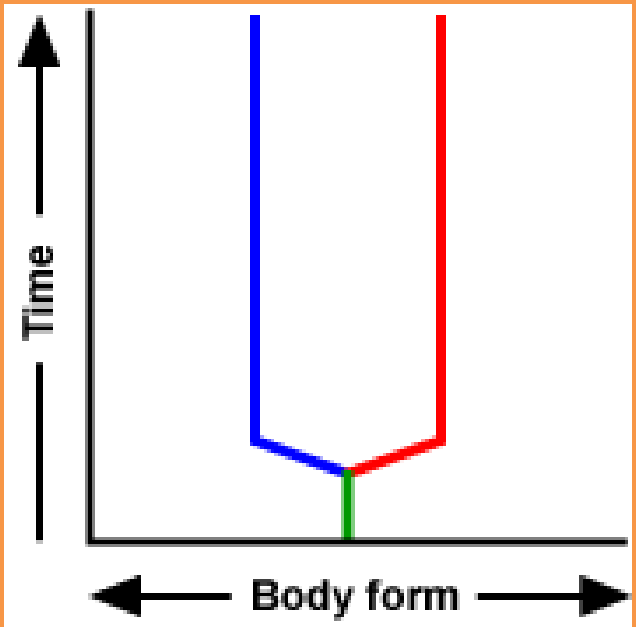
GRADUALISM is the theory that evolutionary change occurs slowly, gradually, and continuously.

The gradual accumulation of small variations eventually causes reproductive isolation and a new species arises.

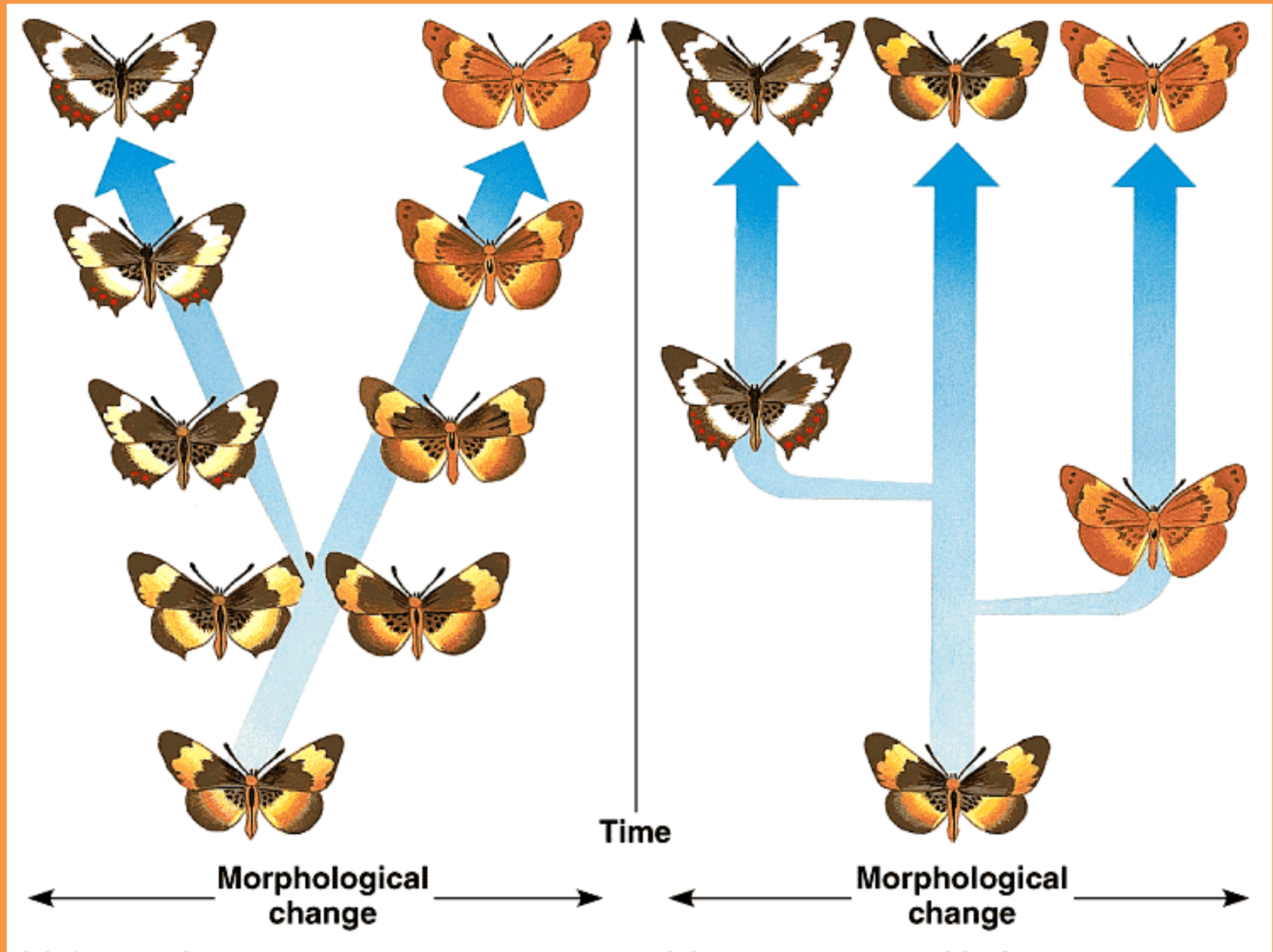


The TITANOTHERES shown here range in time from about 55 mya (A) to 35 mya (D).

The theory of PUNCTUATED EQUILIBRIUM proposes that species have long periods of stability interrupted by brief periods of major change.



The coelacanth exhibits about 80 million years' worth of morphological stability.



(a) Gradualism model

(b) Punctuated equilibrium model