THEORIES OF EVOLUTION

EARLY BELIEFS

- Dating back as far as Aristotle (384-322 BCE), it was believed that all living things were immutable
- **Immutable** – the idea that species cannot change
- Most natural phenomena were explained using religious beliefs

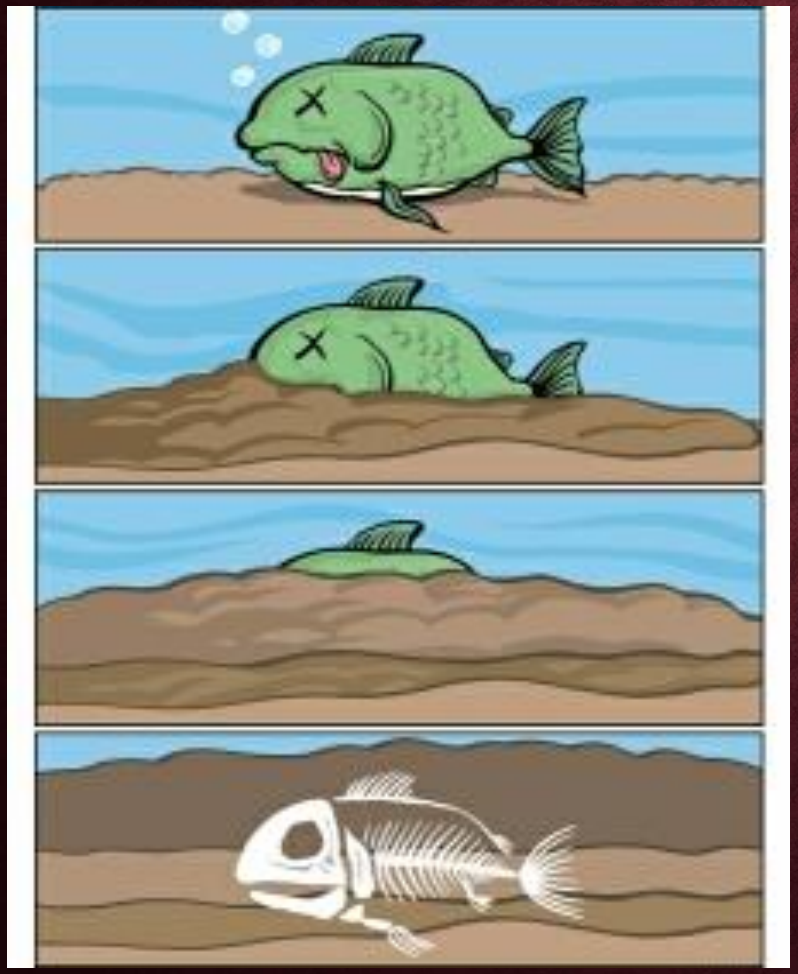
MODERN FINDINGS

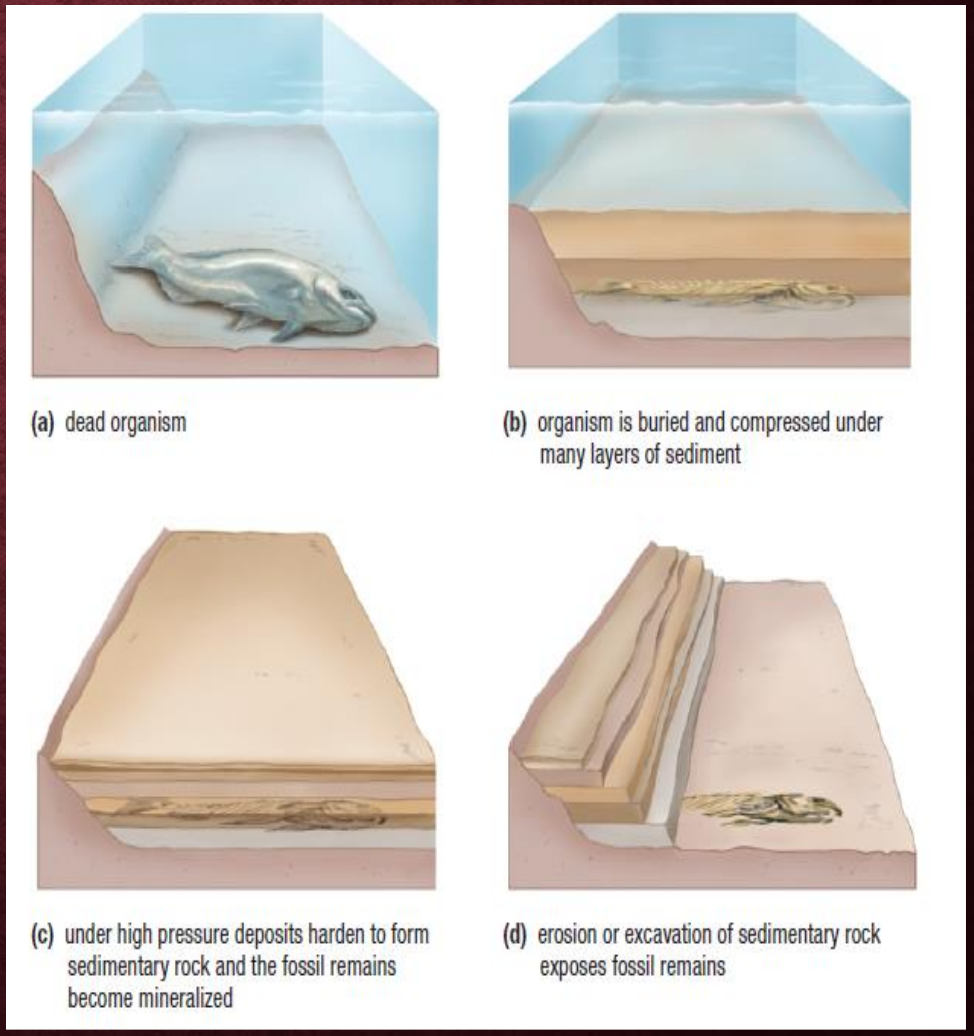
- Life on earth began about 4 billion years ago
- Earth's organisms were microscopic and unicellular (very simple)
- Prokaryotes are the earliest organisms (proven in fossil history). Their simple structure is supported by the fossil record
- Complex organisms now present. They must have originated from somewhere

EVIDENCE FROM FOSSIL RECORD

- **Fossil**- any ancient remains, impressions or traces of an organism or traces of its activity that have been preserved in rocks or other mineral deposits
- 1. Over long periods of time, the body becomes mineralized (remains are replaced by mineral deposits) and a fossil is formed
- 2. New layers of sediment cover older ones and compress them into layers of rock called strata
- 3. Fossils within layers show that a succession of organisms has populated earth throughout time

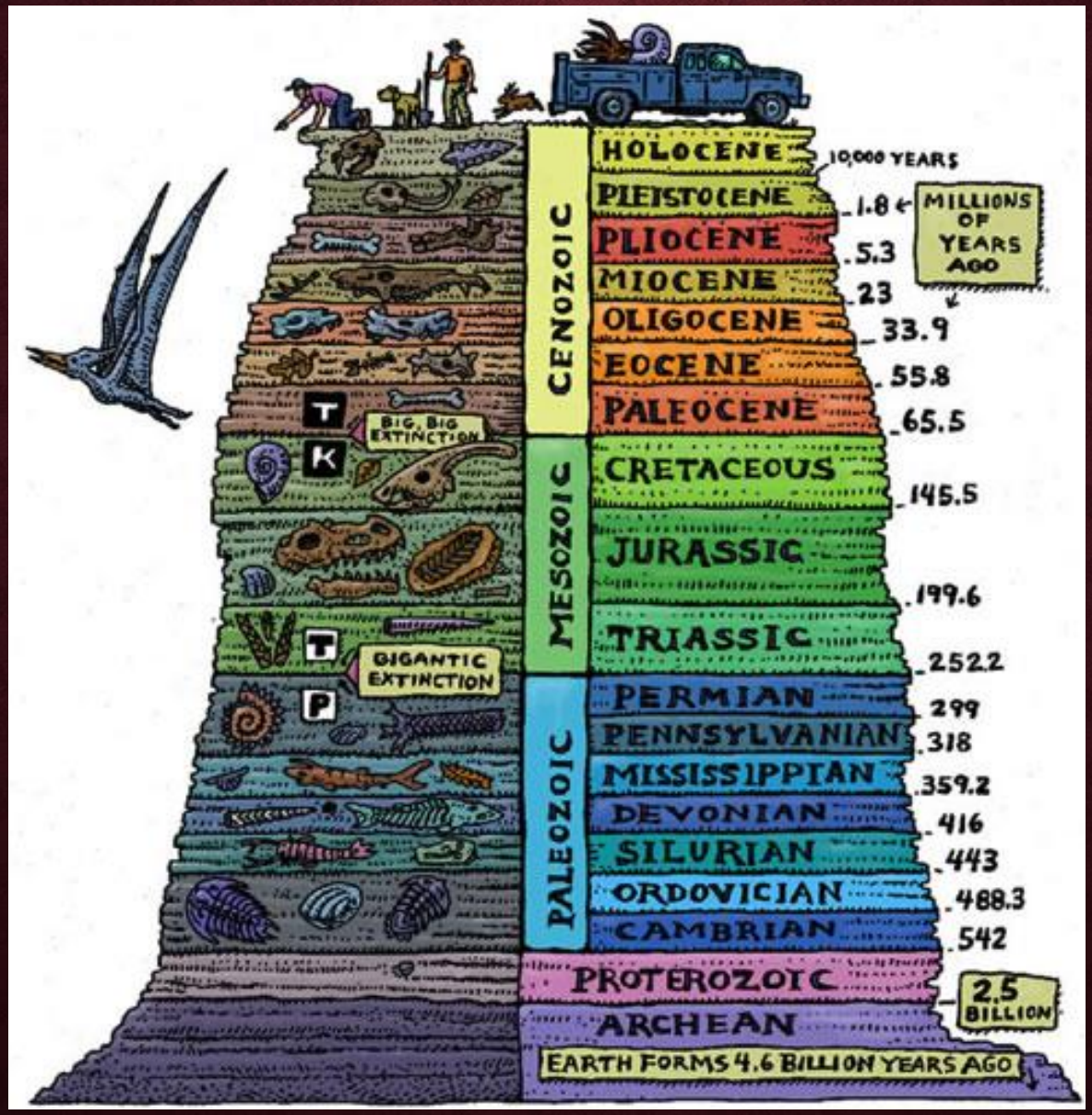
FORMATION




(a) dead organism
(b) organism is buried and compressed under many layers of sediment
(c) under high pressure deposits harden to form sedimentary rock and the fossil remains become mineralized
(d) erosion or excavation of sedimentary rock exposes fossil remains

FOSSILS CONTINUED

- Fossils were of great interest to early scientists because there:
  - appeared to be of unusual, unknown organisms that were no longer living
  - are no fossils of most living species
  - buried very deep within rock > 1 km
  - can be found in unexpected locations (example: marine life fossils found high in mountains)


CENOZOIC
MESOZOIC
PALEOZOIC
HOLOCENE
10,000 YEARS
PLEISTOCENE
1.8
PLIOCENE
5.3
MIOCENE
23
OLIGOCENE
33.9
EOCENE
55.8
PALEOCENE
65.5
CRETACEOUS
145.5
JURASSIC
199.6
TRIASSIC
252.2
PERMIAN
299
PENNSYLVANIAN
318
MISSISSIPPIAN
359.2
DEVONIAN
416
SILURIAN
443
ORDOVICIAN
488.3
CAMBRIAN
542
PROTEROZOIC
2.5 BILLION
ARCHEAN
EARTH FORMS 4.6 BILLION YEARS AGO
MILLIONS OF YEARS AGO
T
K
BIG, BIG EXTINCTION
T
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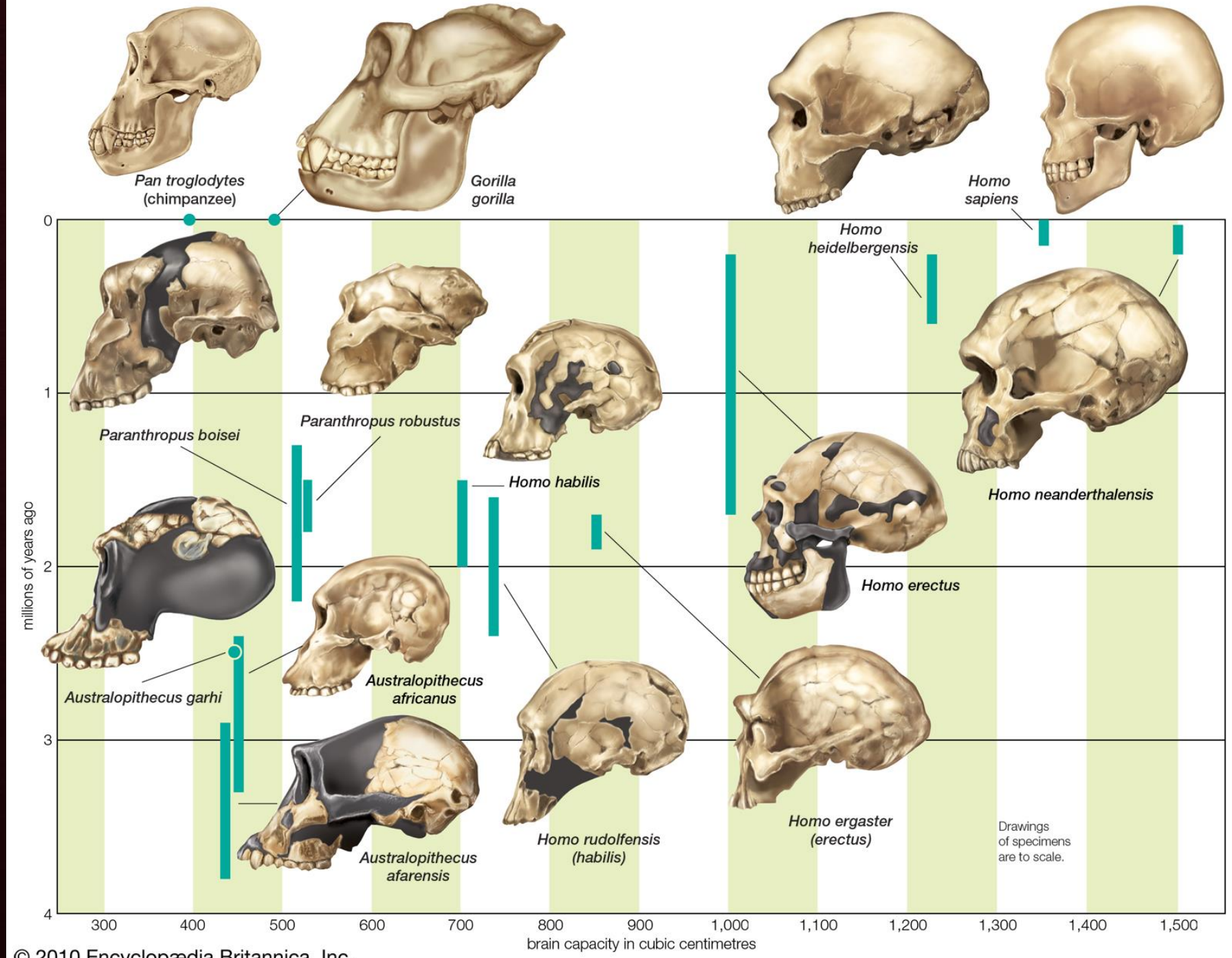
GIGANTIC EXTINCTION



THEORIES THAT HELPED CLEAR THE PATH FOR DARWIN

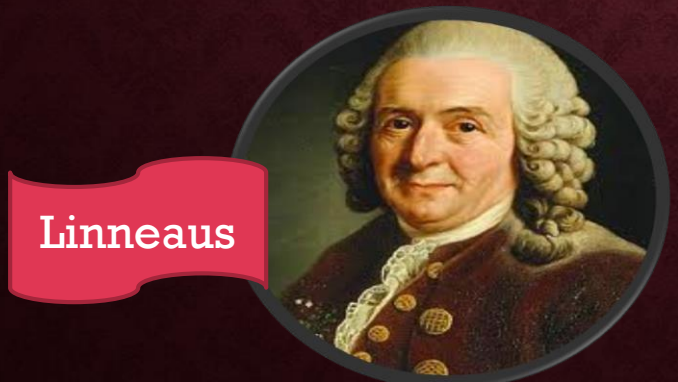
- Throughout history, various scientists have proposed theories of evolution.
- Darwin used the ideas of many of these scientists to help him formulate his own theory

COMTE (COUNT) GEORGE-LOUIS LECLERC DU BUFFON

- A french scientist that was one of the earliest scientist to compare anatomical features of animals using the scientific method
- Was puzzled by the presence of anatomical structures that served no apparent purpose (Ex. Pigs with toes that do not touch the ground)

CARL LINNEAUS AND ERASMUS DARWIN

- Suggested that all life had the ability to change
- Linneaus organized organisms based on common ancestors
- Erasmus Darwin (grandfather of Charles Darwin) even proposed it was possible that all life originated from a common ancestor



GEORGES CUVIER

1769-1832

- Georges Curvier was a French paleontologist, naturalist and zoologist
- was instrumental in establishing the fields of comparative anatomy and paleontology through his work in comparing living animals with fossils
- well known for establishing **extinction** as a fact.

CUVIER CONTINUED

- Observations seems to support that life evolved from more simple to more complex forms
- Yet Cuvier believed that species did not change
- Proposed the "Theory of Catastrophism"
  - global catastrophies cause widespread extinction
  - extinct species replaced by newly created species
- Theory did not explain why fossils became more complex over time

JAMES HUTTON
1726-1797

- Hutton was a Scottish naturalist and geologist
- He is known as the founder of modern geology
- Hutton proposed that the same geological processes occurring in the present also occurred in the past and that geological landforms are the result of extremely slow processes that are ongoing today

CHARLES LYELL
1797-1875

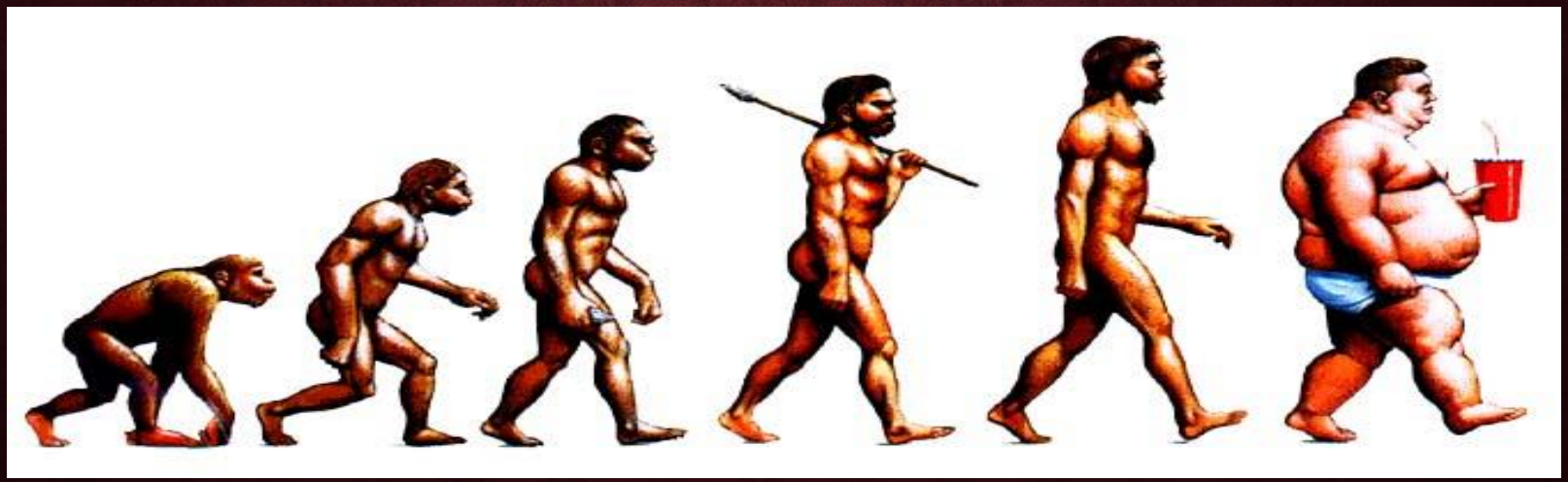
- Charles Lyell was a Brittish geologist
- His is considered the leading geologist of his time
- His book "The Principles of Geology" was read by Darwin on his voyage aboard the Beagle

CHARLES LYELL CONTINUED…

- Lyell provided evidence for Hutton's ideas
- In his book he laid out the principles of uniformitarianism
- Uniformitarianism – the theory that Earth's surface has always changed and continues to change through similar, uniform and gradual processes
- This idea challenged that of catastrophism proposing that geological change is slow and gradual rather than sudden and catastrophic

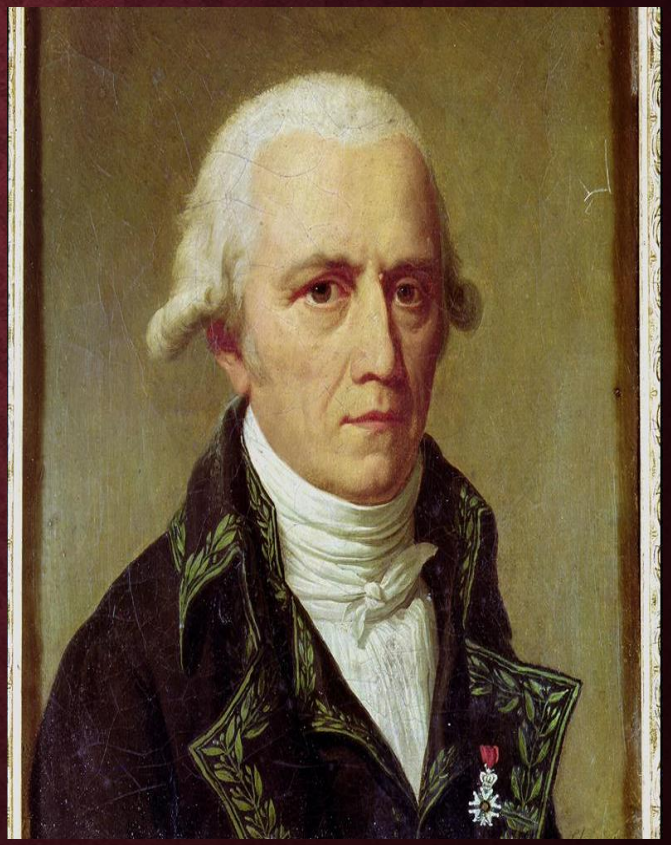
CHARLES LYELL CONTINUED…

- These ideas were very radical
- Suggested that the earth was not static and was in fact very old (current belief was that the earth was only 6000 years old)
- Dramatic change could result over such extremes of time through slow, slight processes



JEAN BAPTISTE LAMARCK

1744-1829



- Lamarck was a French naturalist
- Lamarck is known for proposing the Theory of Acquired Characteristics - one of the first theories of evolution

JEAN-BAPTISTE LAMARCK

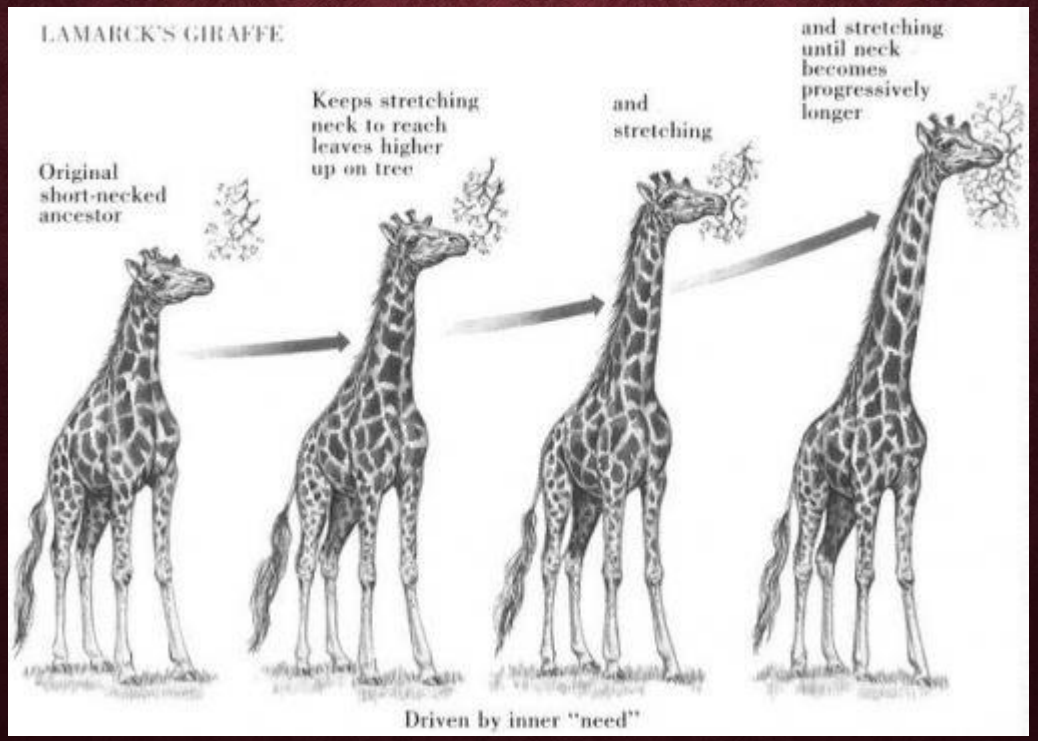
- Lamarck believed the environment played a key role in evolution of species
- Life has evolved as environments changed
- His theory was based on two principles:
- #1: Use and Disuse – Anatomical structures an individual used became larger and stronger. While those that were unused became smaller and weaker.

LAMARCK CONTINUED…

- #2: Inheritance of Acquired Characteristics - modifications an organism acquired during its lifetime could be passed along to its offspring.
- For example, the long neck of the giraffe evolved gradually as the cumulative product of a great many generations of ancestors stretching even higher
- However, there is no evidence suggesting that acquired characteristics can be inherited
- These traits do not change genes transmitted by gametes

EXAMPLES…

- A giraffe that stretched its neck slightly during its lifetime would have offspring with slightly longer necks



EXAMPLE….

- If there was a cooling of climate then an individual could adapt and evolve to grow a thicker coat. Its offspring would then be born better adapted to the cooling climate with a thicker coat

Do these acquired characteristics support the theory of evolution according to Lamarck?

CONTRIBUTIONS…

- No evidence that acquired characteristics can be inherited
- Although flawed, Lamarck's theory still contributed a valuable starting point for scientists by introducing the following ideas
  - All species evolve over time
  - A species evolves in response to its environment and can become better adapted
  - Changes (mutations) are passed from one generation to another (just not acquired ones)

CONCLUSIONS…

- Today, our planet has been shaped by occasional catastrophic events, such as bombardment of large meteors, in addition to the comparatively slower natural processes suggested by uniformitarianism. All of these events have potentially affected the rate and direction of biological evolution.
- *George Cuvier and Charles Lyell strongly disagreed about how the earth got to be the way it is today, they both rejected the idea of biological evolution.*
- All scientists made valuable contributions to our modern idea of evolution