UNIT 8: EVOLUTION & CLASSIFICATION
TOPIC 1: HISTORY OF LIFE

TOPIC 1 LEARNING TARGETS

- Describe the methods used in each of the origin of life experiments and explain the results of each experiment.

- Create a basic timeline of the history of living organisms.

What happened during Earth's early history?

THINK ABOUT IT

What if you awoke in the morning to find tree branches broken and the power out?

How would you determine what might have happened?

How is that similar to scientists figuring out the process by which Earth may have formed?

As we move through this topic, keep a list of evidence that scientists used to learn about Earth's early history.

THE MYSTERIES OF LIFE'S ORIGINS

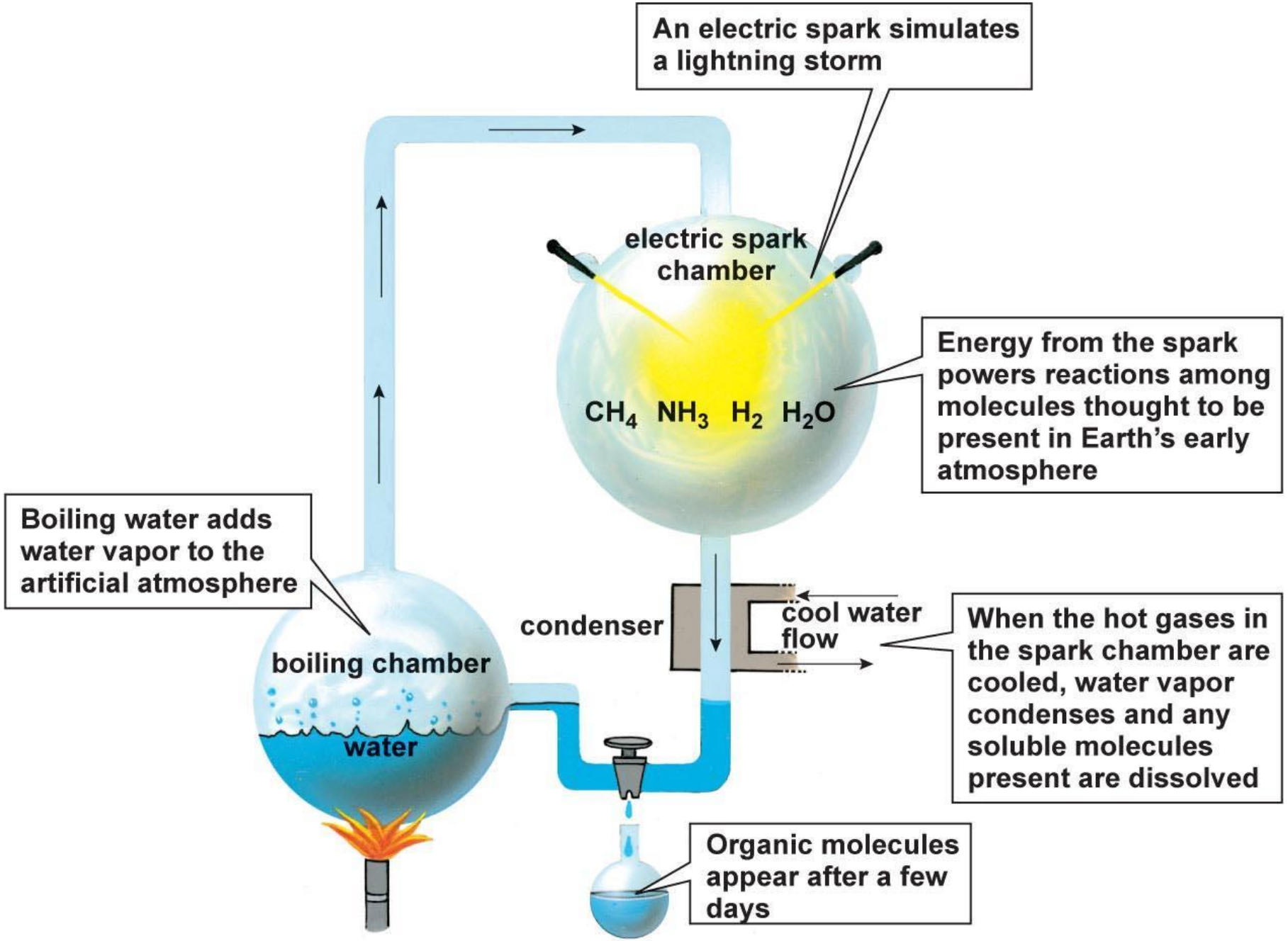
What do scientists hypothesize about early Earth and the origin of life?

- Earth's early atmosphere contained little or no oxygen.
- It was principally composed of carbon dioxide, water vapor, and nitrogen, with lesser amounts of carbon monoxide, hydrogen sulfide, and hydrogen cyanide.

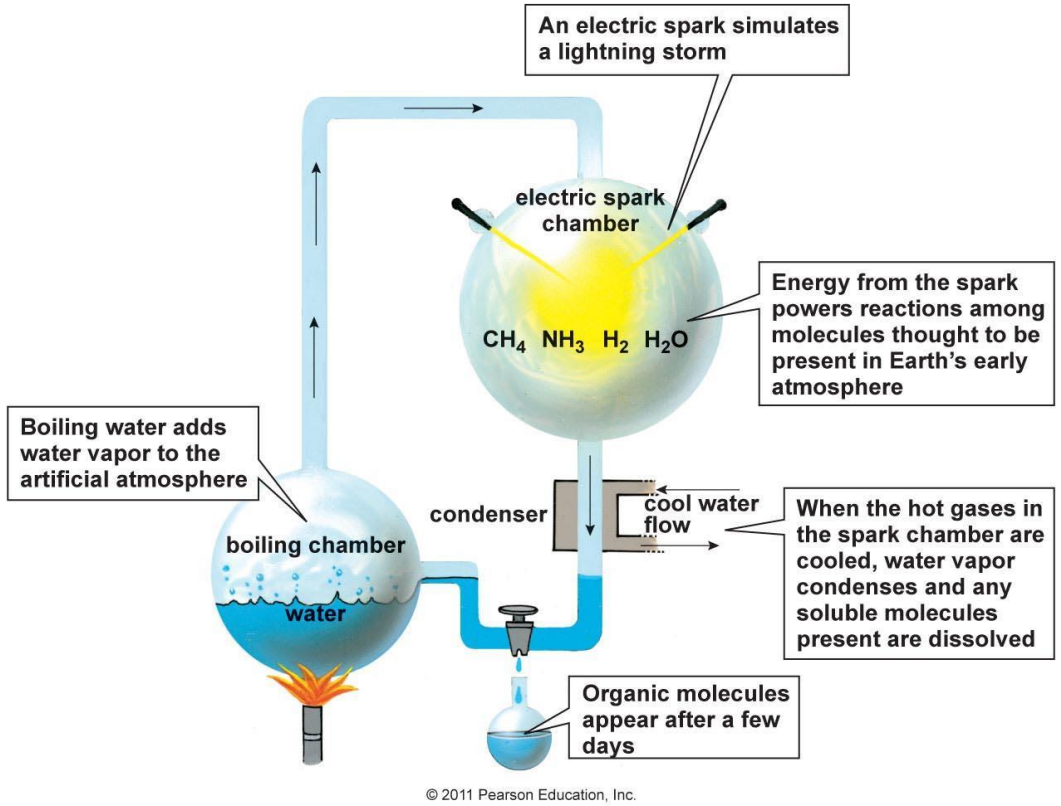
THE FIRST ORGANIC MOLECULES

In 1953, Miller and Urey's experiment suggested how mixtures of the organic compounds necessary for life could have arisen from simpler compounds on a primitive earth.

They produced amino acids, which are needed to make proteins, by passing sparks through a mixture of hydrogen, methane, ammonia, and water vapor.



THE MILLER-UREY EXPERIMENT



1. How did Miller and Urey model conditions that existed on early Earth in their experiments?

2. What question did Miller and Urey's experiment seek to answer?

3. What were the results of their experiment?

HOW MIGHT CELLS HAVE ORIGINATED?

Geological evidence suggests that during the Archean Eon, 200 to 300 million years after Earth cooled enough to carry liquid water, cells similar to bacteria were common.

Large organic molecules form tiny bubbles called proteinoid microspheres under certain conditions. These were not cells, but had some characteristics of living systems.

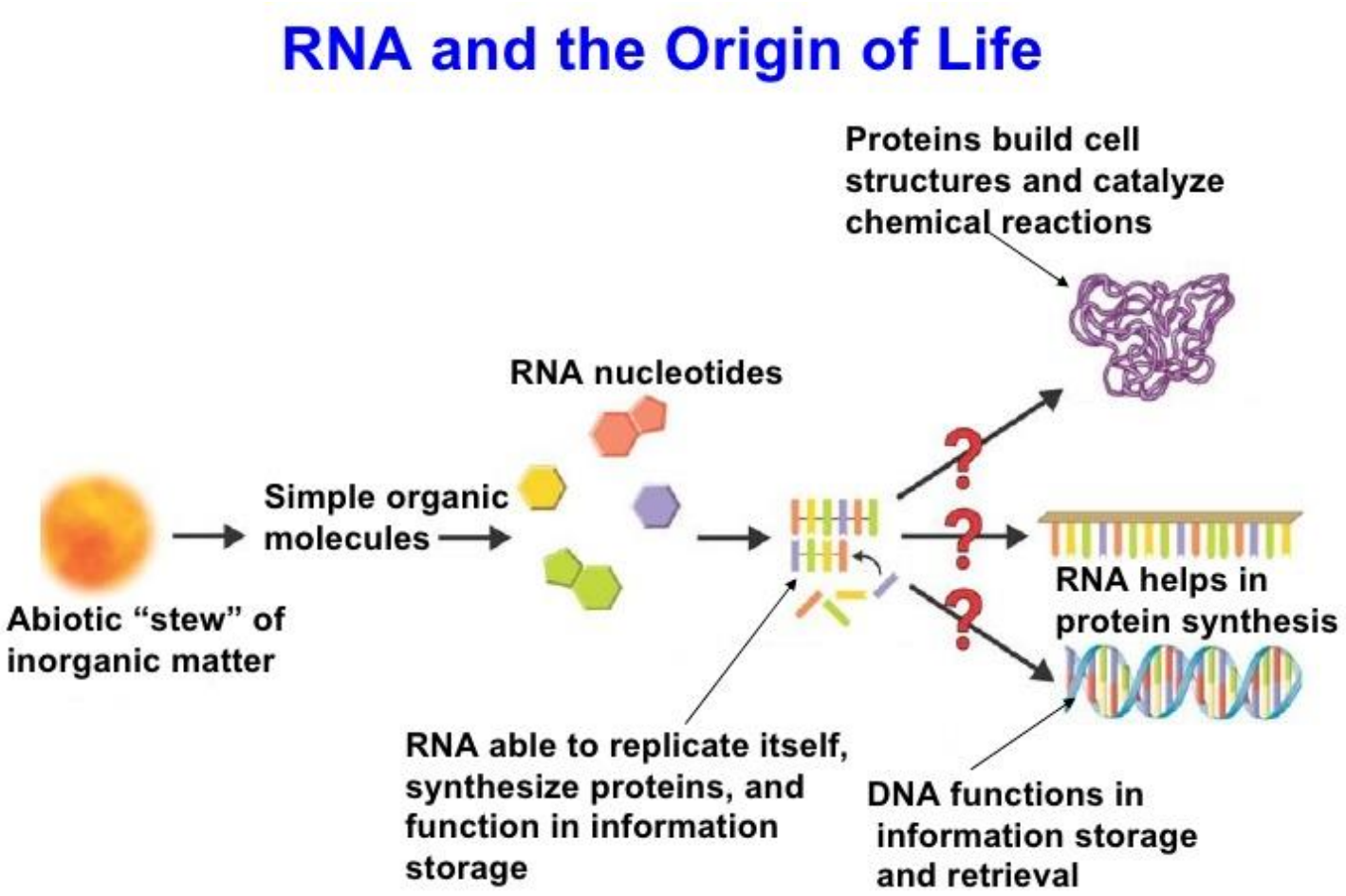
Several hypotheses are out there about how these microspheres acquired the characteristics of living cells as early as 3.8 billion years ago.

EVOLUTION OF RNA AND DNA

Cells are controlled by information stored in DNA, which is transcribed into RNA and then translated into proteins.

How could this complex biochemical machinery have evolved?

The "RNA world" hypothesis proposes that RNA existed by itself before DNA. From this simple RNA-based system, several steps could have led to DNA-directed protein synthesis.

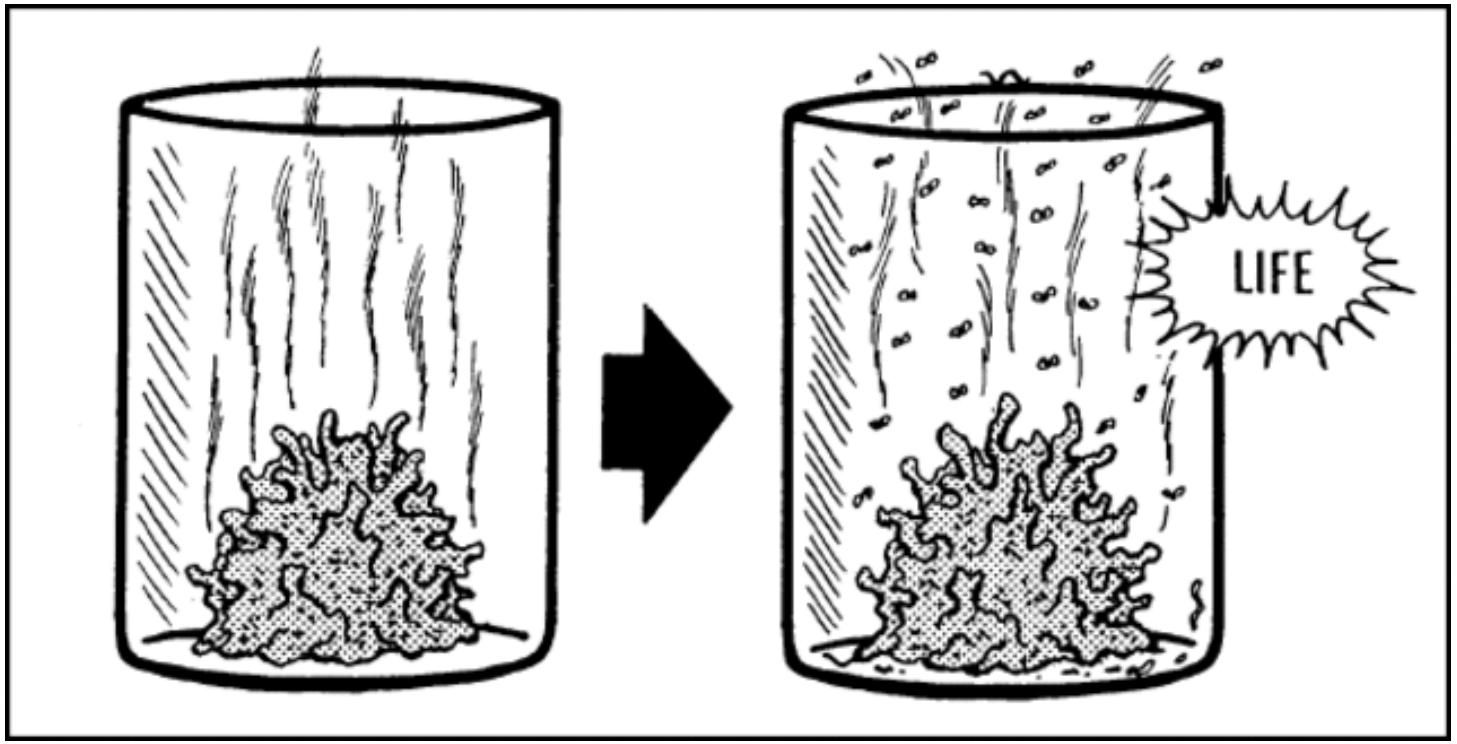


UNDER THE RIGHT CONDITIONS

- Some RNA sequences help DNA replicate.
- Others process messenger RNA after transcription.
- Still other RNA sequences catalyze chemical reactions.
- Some even grow and replicate on their own.

How would RNA have stored genetic information?

SPONTANEOUS GENERATION

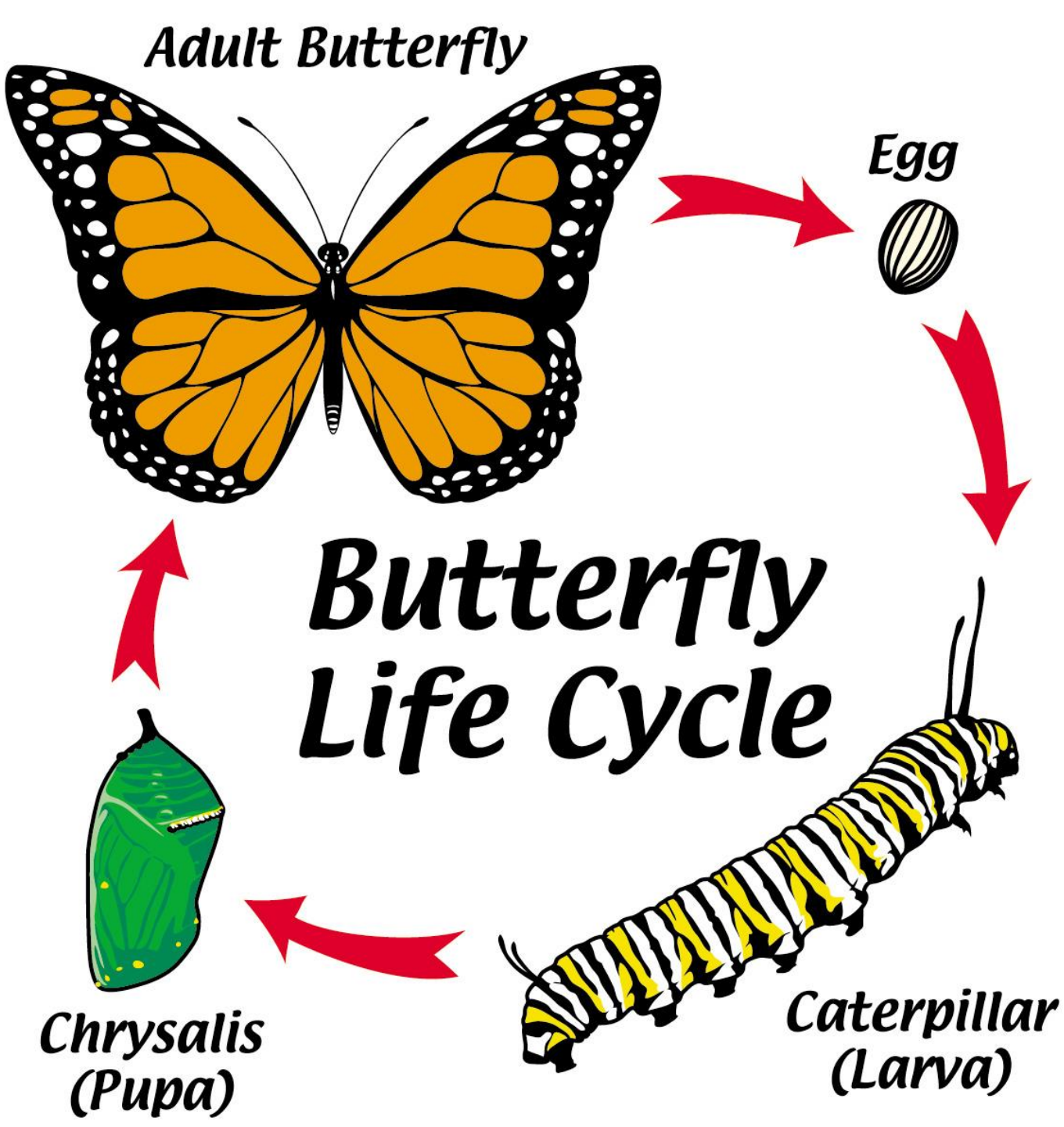


Until 1860, it was believed that life arose from nonliving things.

- Frogs arise from mud
- Flies arise from rotting meat
- Mice arise from dirty underwear

The church approved this belief and people trusted the church.

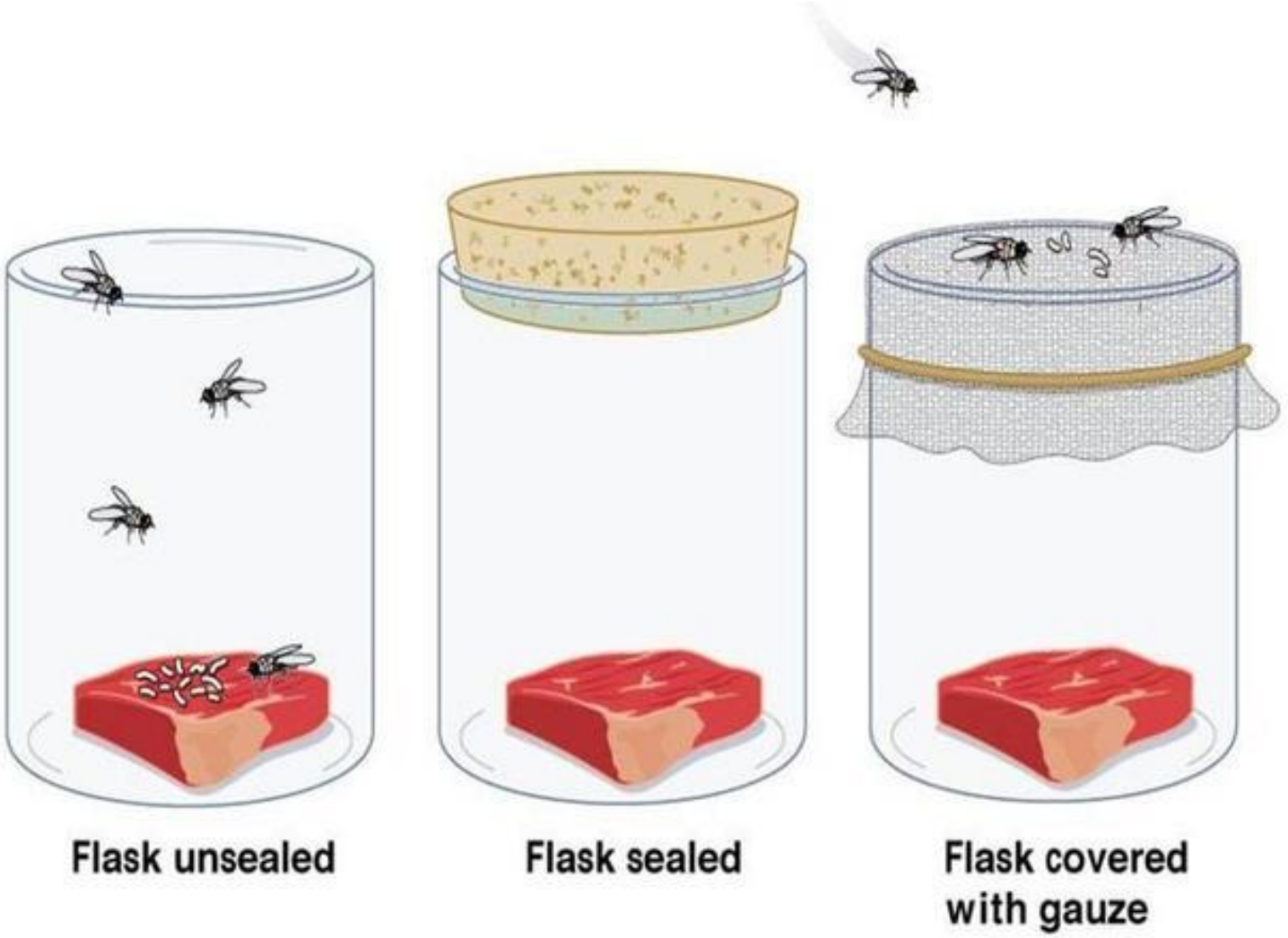
However, it wasn't until the man, Francesco Redi, conducted an experiment in 1668 that evidence was found for biogenesis.



BIOGENESIS

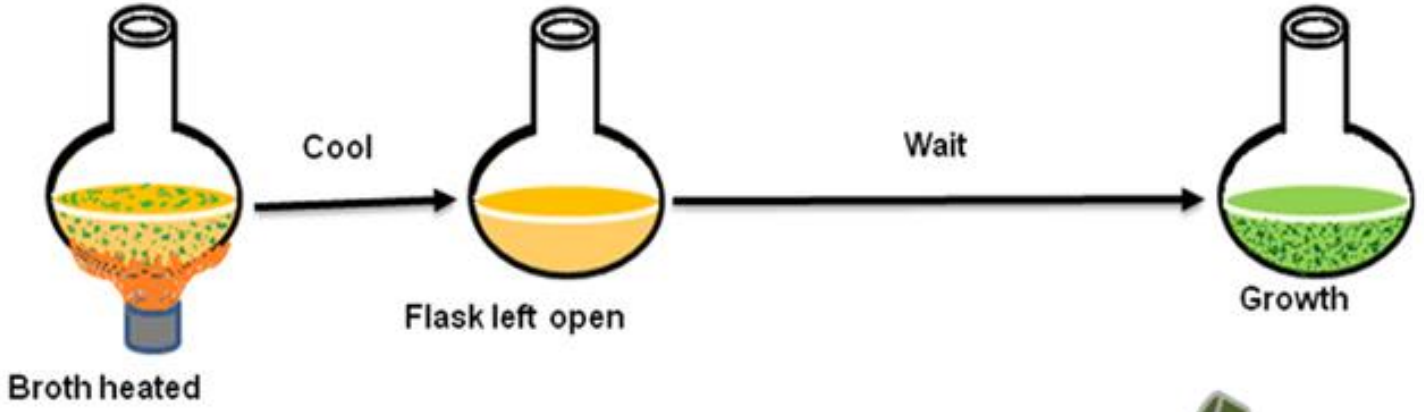
All life comes from life.

REDI'S EXPERIMENT

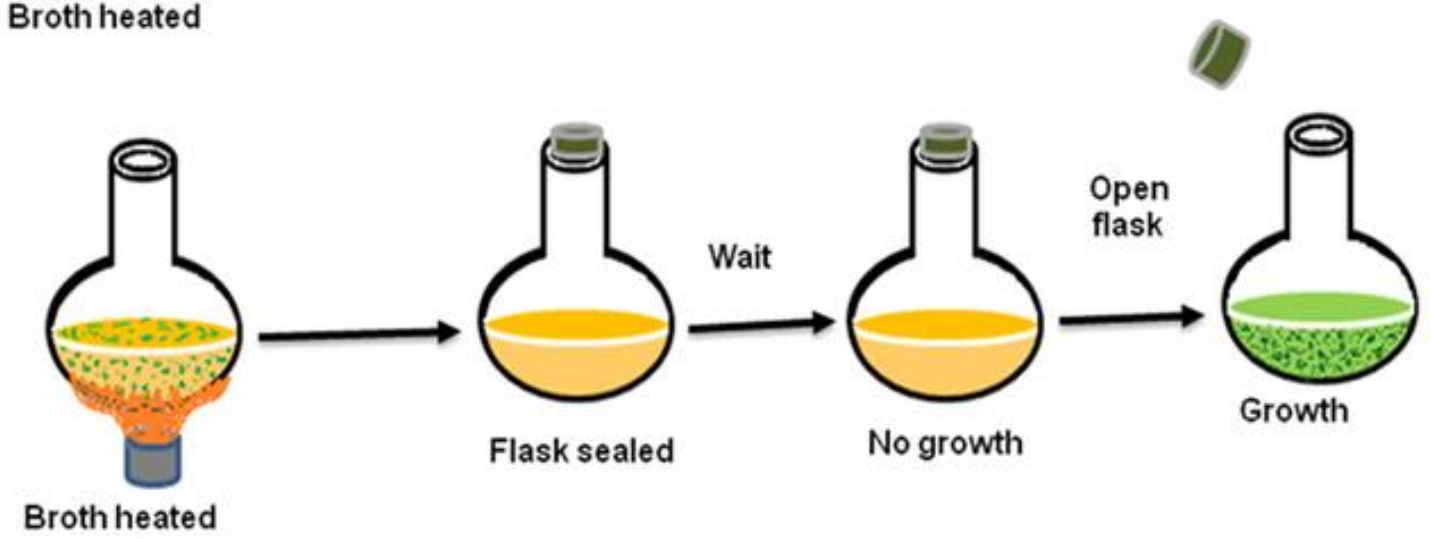


WIDELY DEBATED!

John Needham (1748) supported spontaneous generation with experiment.

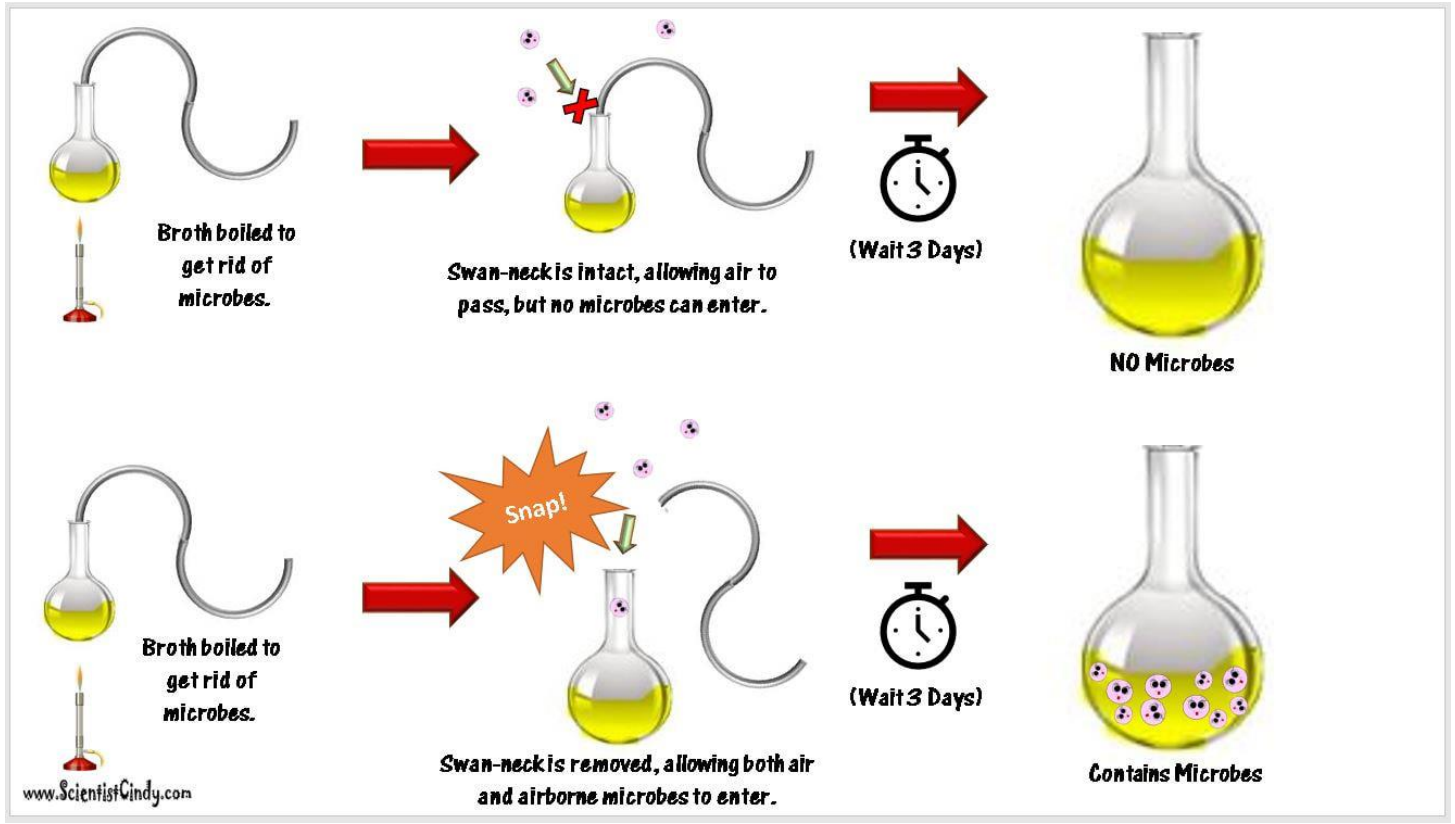


Lazzaro Spallanzani (1770) supported biogenesis with similar experiment.



PASTEUR'S EXPERIMENT

Louis Pasteur (1862-1864) supported biogenesis with his own experiment.



CREATE A FOLDABLE

Create a foldable that details the following scientists, their experiments, and their contributions from their experiments.

Harold Urey & Stanley Miller

Francesco Redi

John Needham

Lazzaro Spallanzani

Louis Pasteur

TOPIC 1 LEARNING TARGETS

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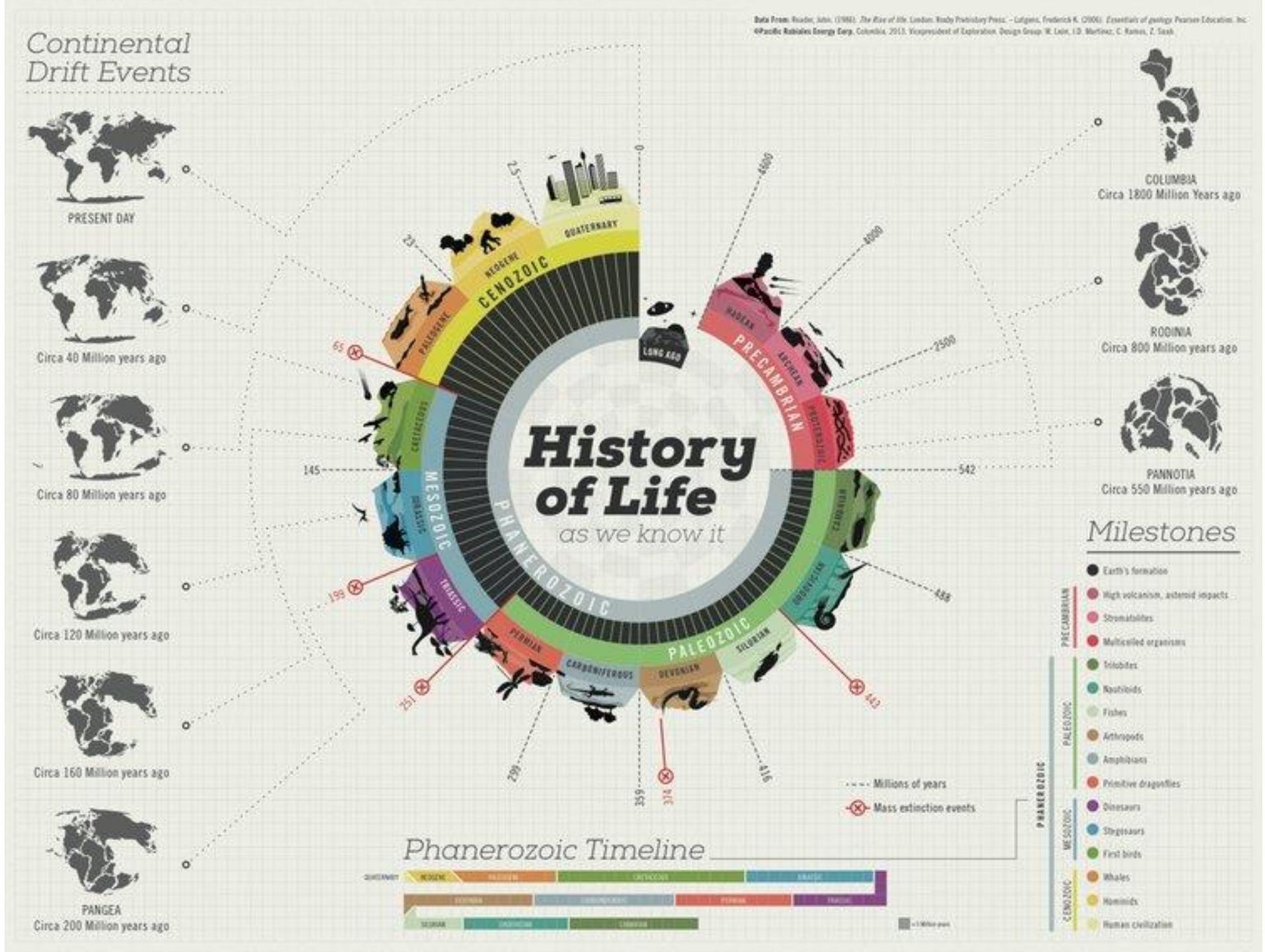
- Create a basic timeline of the history of living organisms.


Continental Drift Events
PRESENT DAY
Circa 40 Million years ago
Circa 80 Million years ago
Circa 120 Million years ago
Circa 160 Million years ago
PANGEA
Circa 200 Million years ago
COLUMBIA
Circa 1800 Million Years ago
RODINIA
Circa 800 Million years ago
PANNOTIA
Circa 550 Million years ago
History of Life
as we know it
CENOZOIC
MESOZOIC
PALEOZOIC
PRECAMBRIAN
PHANEROZOIC
QUATERNARY
NEOGENE
PALEOGENE
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
CARBONIFEROUS
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
PROTEROZOIC
ARCHEAN
HADEAN
LUNG AGO
Millions of years
Mass extinction events
Milestones
Earth's formation
High volcanism, asteroid impacts
Stromatolites
Multicelled organisms
Trilobites
Nautiloids
Fishes
Arthropods
Amphibians
Primitive dragonflies
Dinosaurs
Stegosaurs
First birds
Whales
Hominids
Human civilization
Phanerozoic Timeline

DATING EARTH'S HISTORY

Relative dating

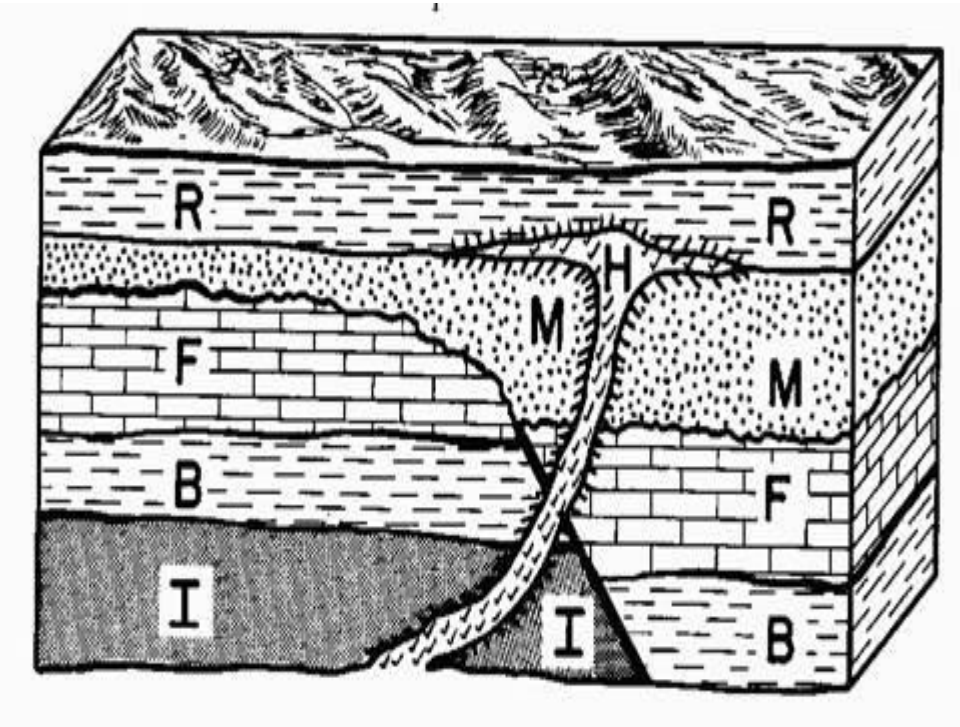
- Allows paleontologists to determine whether a fossil is older or younger than other fossils.
- Relies on understanding index fossils to find relative age

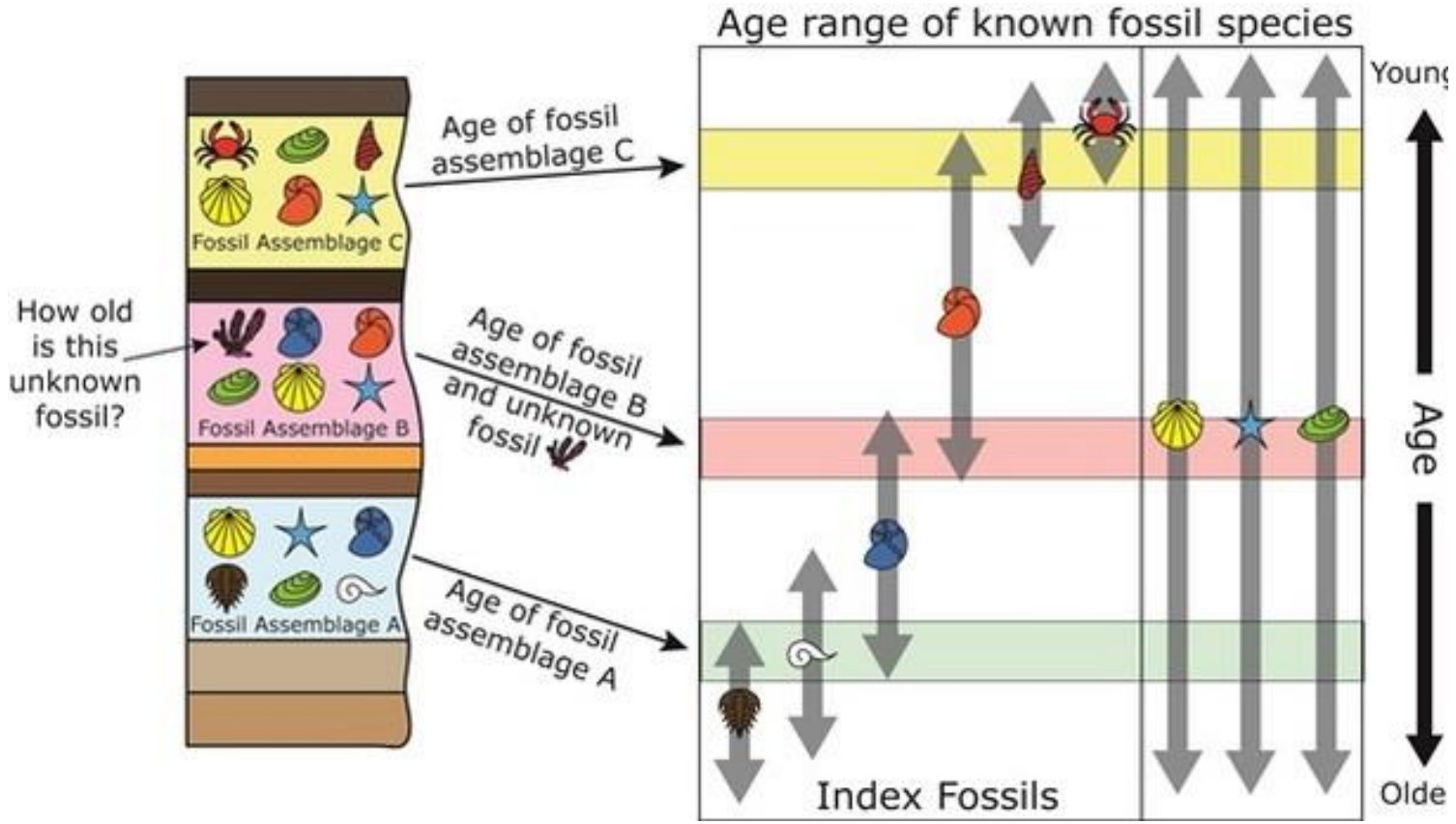
Index fossils are distinctive fossils used to establish and compare the relative ages of rock layers and the fossils they contain.

Absolute dating (Radiometric)

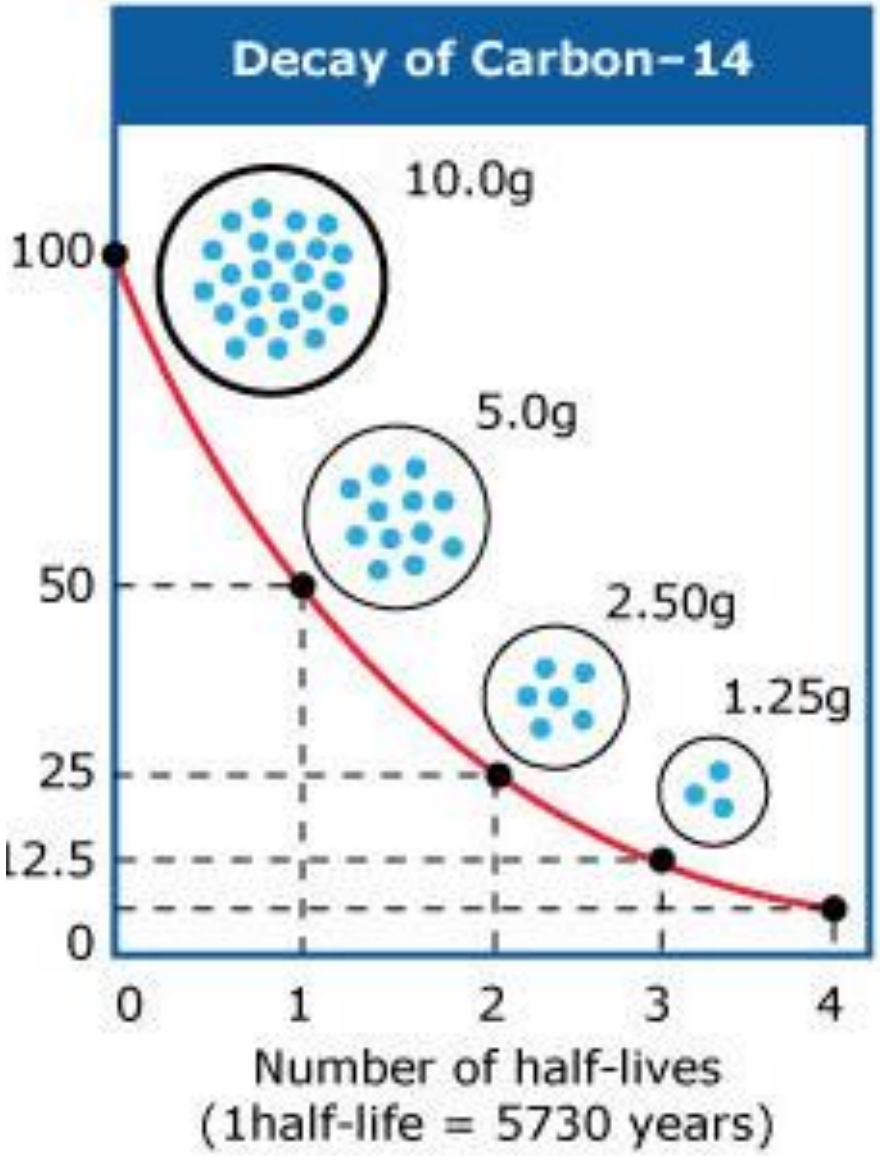
- Uses the proportion of radioactive to stable isotopes to calculate the age of a sample.
- Relies on understanding isotopes and their half-lives to find absolute age

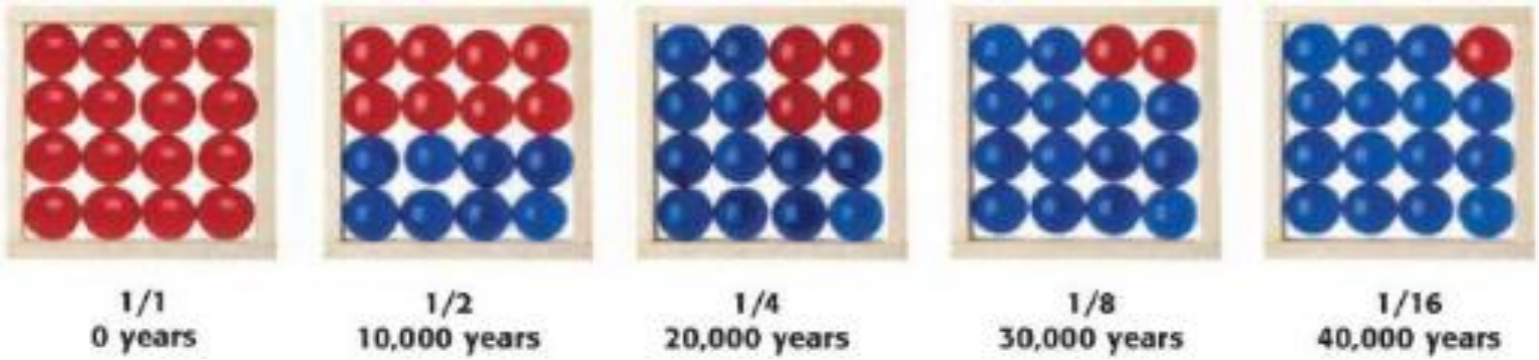
A half-life is the time required for half of the radioactive atoms in a sample to decay.





RELATIVE DATING

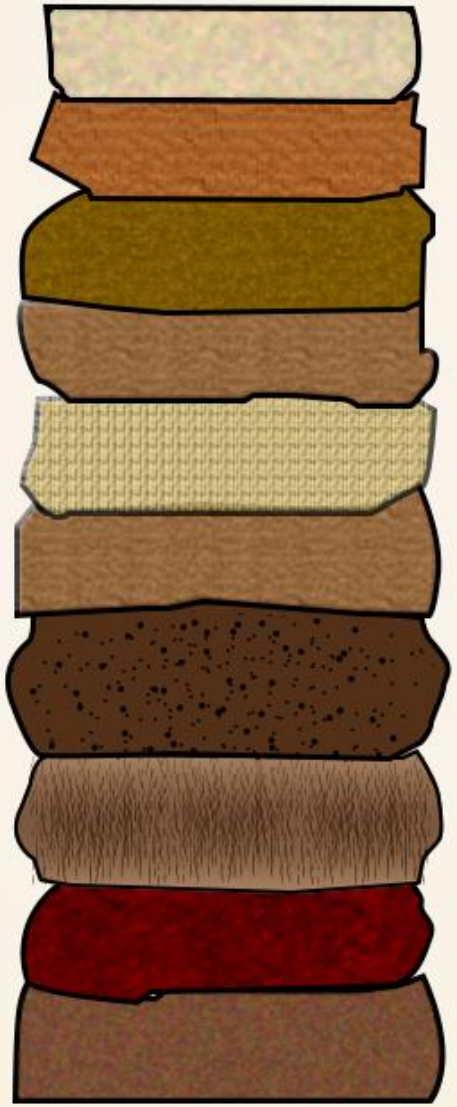




ABSOLUTE DATING

Relative Dating

Youngest



Oldest

Absolute Dating

← 120 ± 5 million years

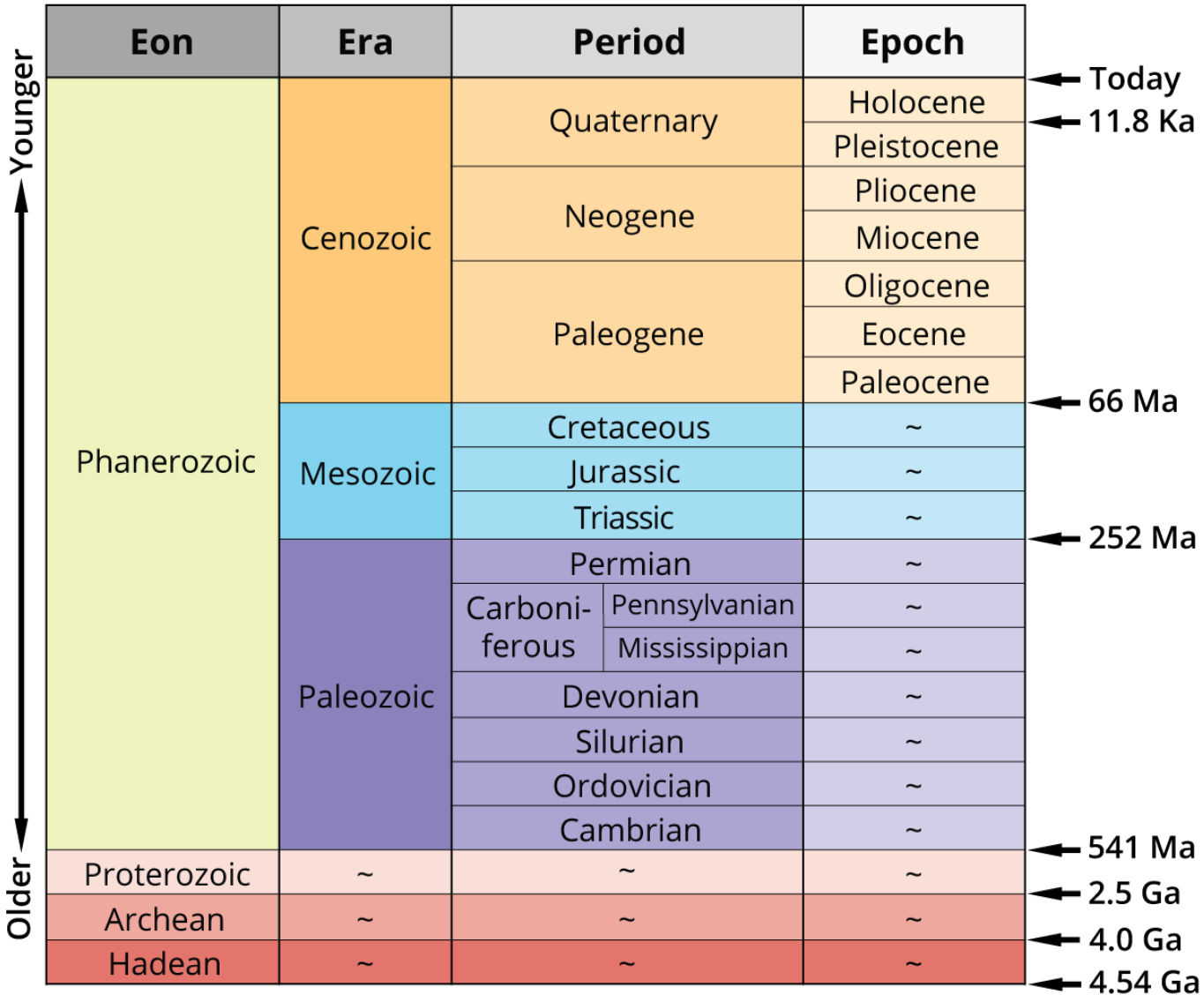
← 140 ± 10 million years

WHAT CAME FIRST?

At home, on my kitchen table, there is a teacup on of a half-written lesson plan, which is on top of an open biology textbook, which is on top of a birthday card for my brother. At the very bottom of the pile, is a monthly credit card bill.

- Which happened first the teacup or the lesson plan and what evidence do you have for it?

- What could you infer about the date of my brother's birthday?



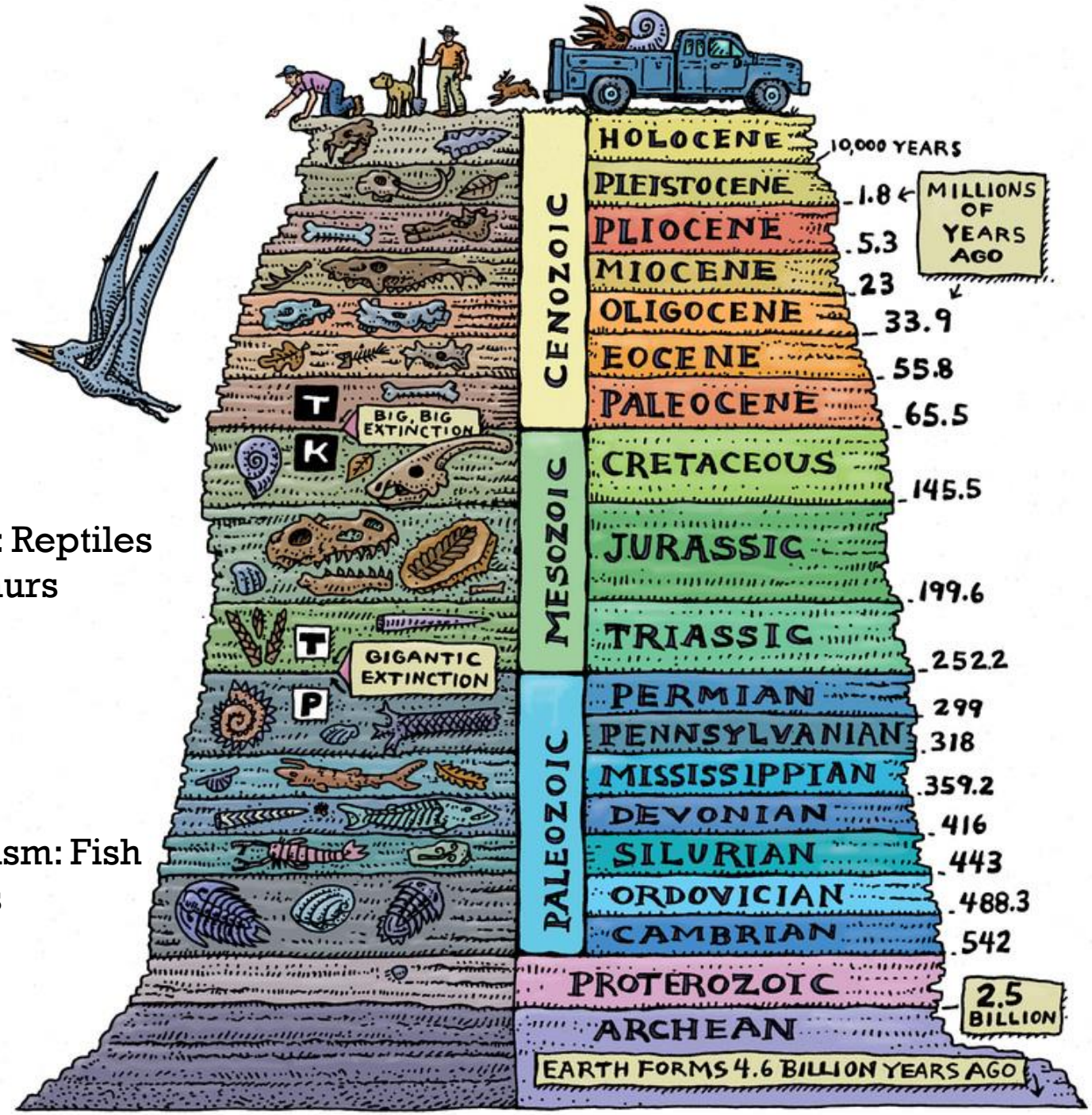
GEOLOGIC TIME SCALE

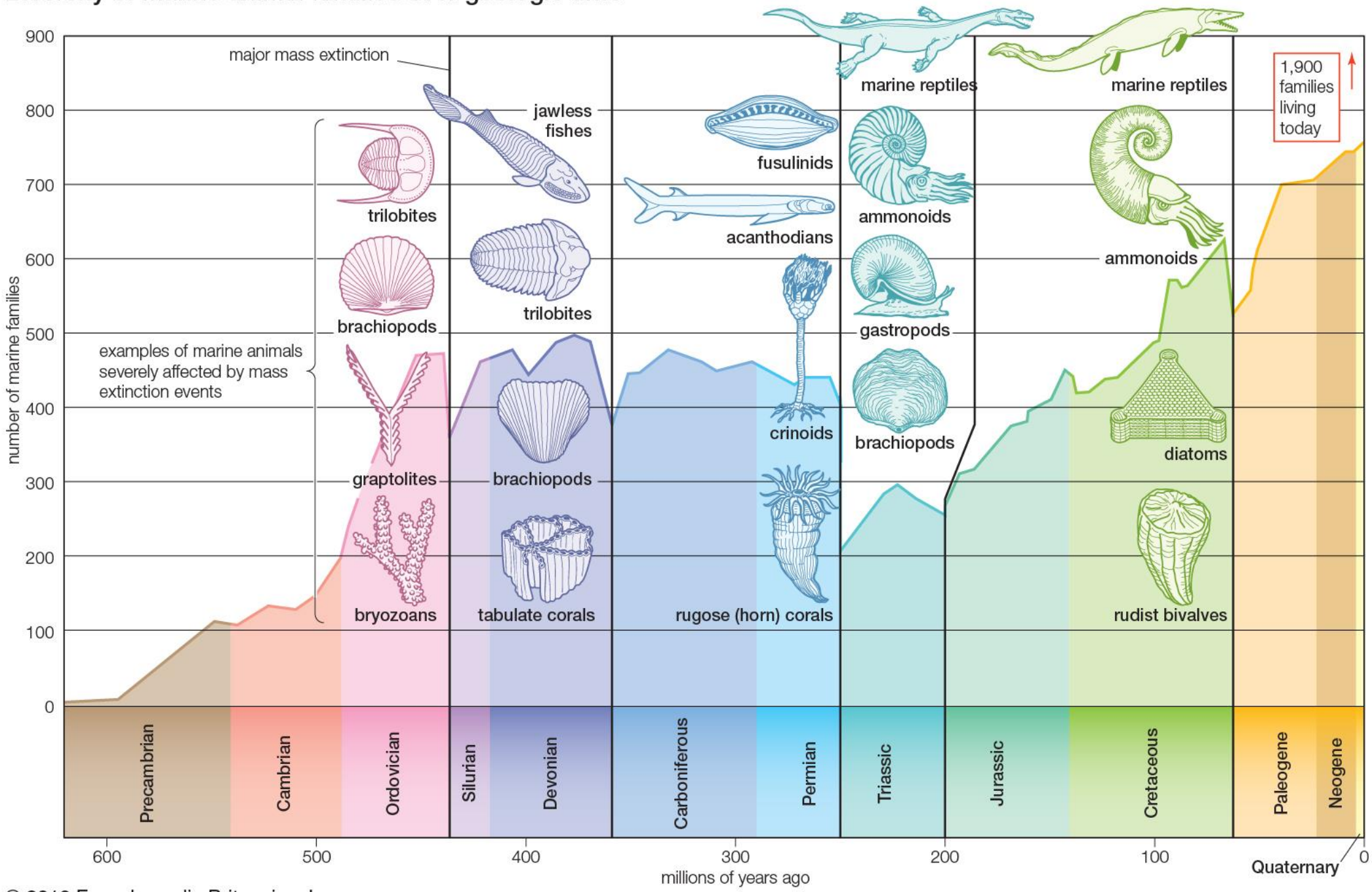
- The timeline for Earth's history is called the geologic time scale.
- We know that Earth is around 4.6 billion years old based on both relative and absolute dating.
- The major divisions on the geologic time scale are eons, eras, and periods.

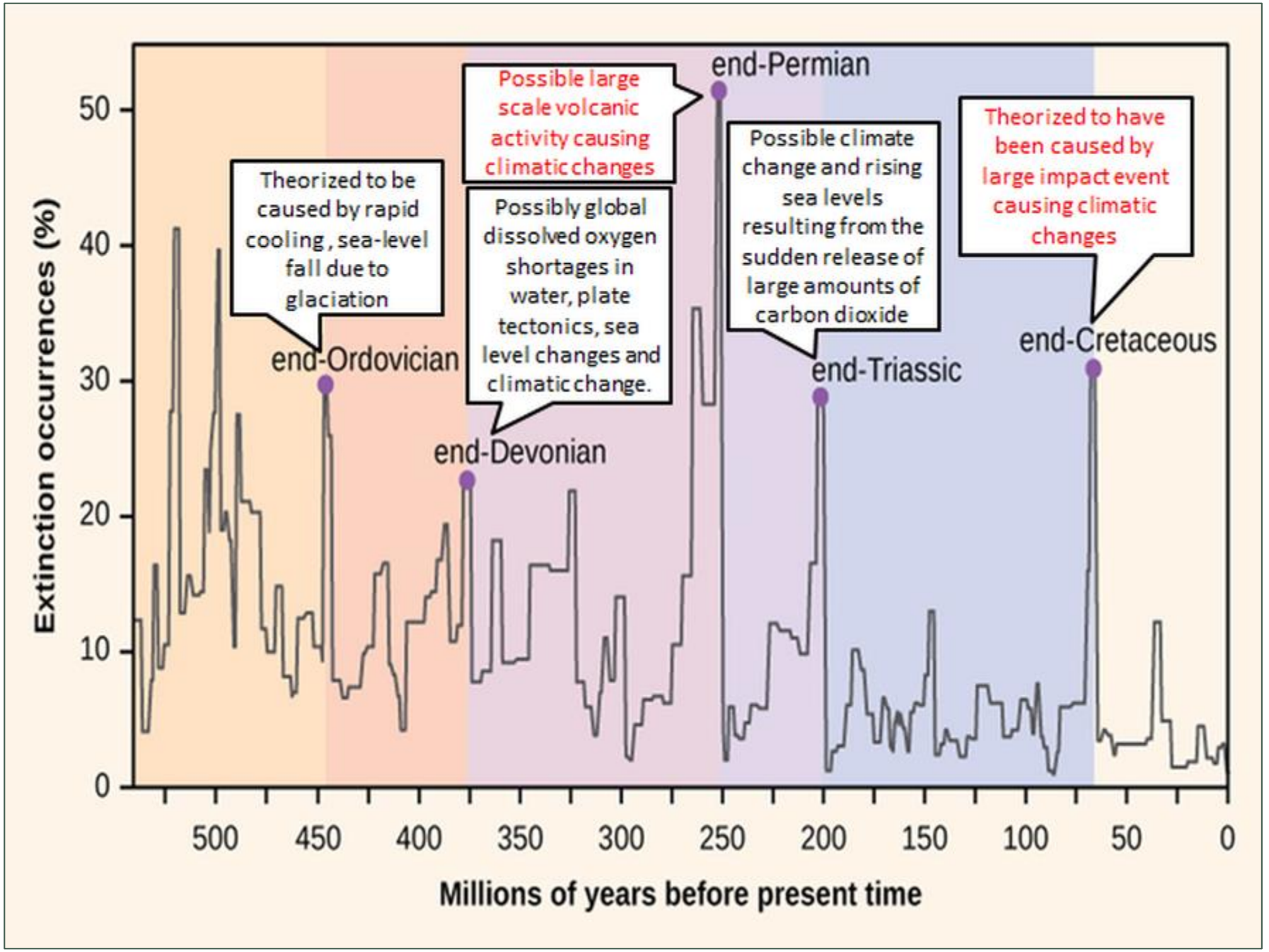
Cenozoic Era (62 MYA-Present
Dominant animal life: Mammals
~2 MYA: Humans evolved
with fire, culture, tools

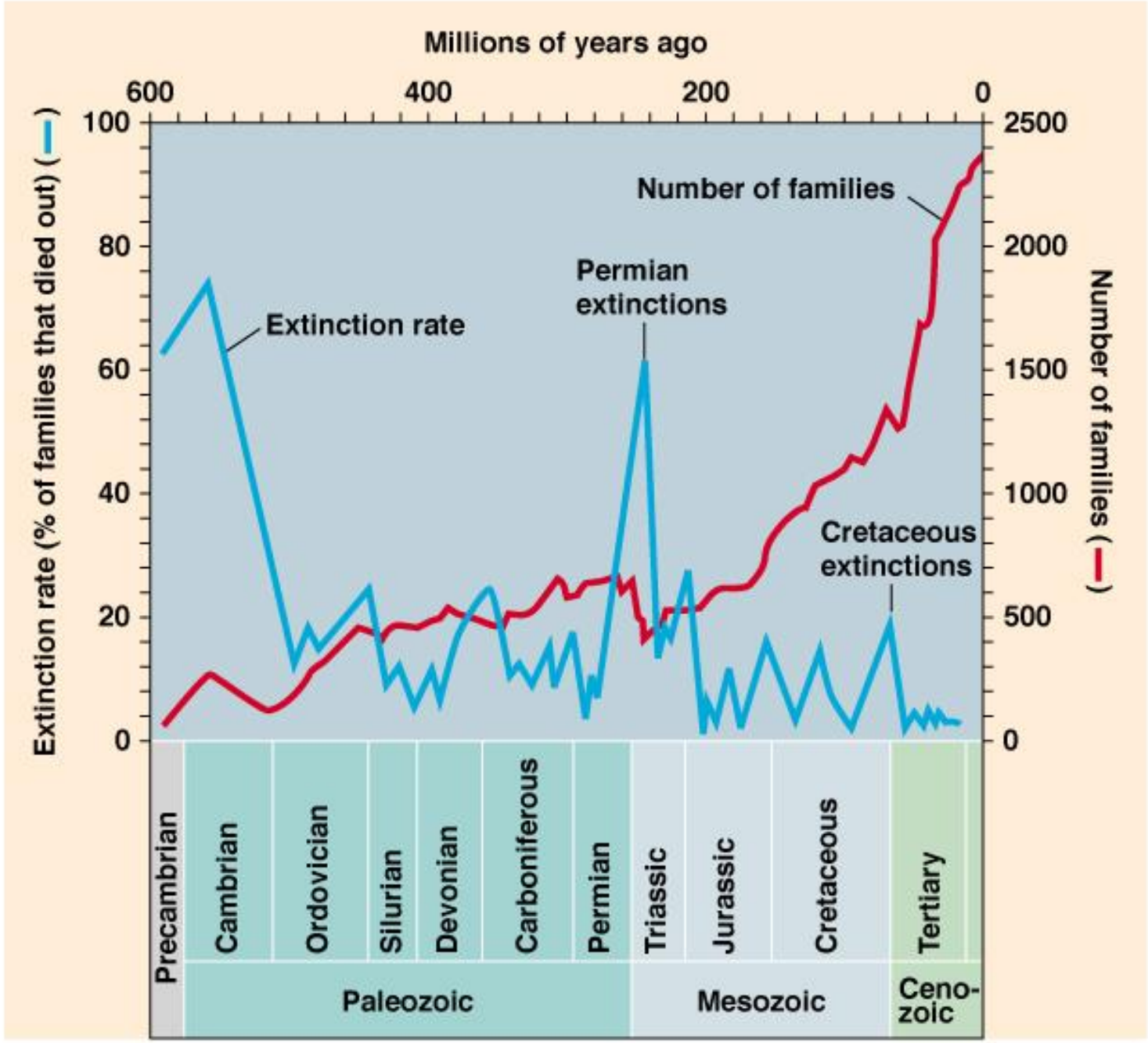
Mesozoic Era (62-245 MYA)
First 150 MY dominant animal life: Reptiles
155 MYA Birds evolve from dinosaurs
Mammals arise, but small

Paleozoic Era (245-542 MYA)
First complex multicellular organism: Fish
Dominant animal life: Amphibians






Extinction occurrences (%)
50
40
30
20
10
0
500
450
400
350
300
250
200
150
100
50
0
Millions of years before present time
Theorized to be caused by rapid cooling , sea-level fall due to glaciation
end-Ordovician
Possible large scale volcanic activity causing climatic changes
Possibly global dissolved oxygen shortages in water, plate tectonics, sea level changes and climatic change.
end-Devonian
end-Permian
Possible climate change and rising sea levels resulting from the sudden release of large amounts of carbon dioxide
end-Triassic
Theorized to have been caused by large impact event causing climatic changes
end-Cretaceous



CREATE A TIMELINE

Working with a partner, use the words and descriptions to create Earth's geologic time scale.

When completed, raise your hand to get your answer checked.

EARTH'S EARLY HISTORY

- More than 3.5 billion years ago, the first life forms, archaebacteria (prokaryotes), evolved in the absence of oxygen.
- By 2.2 billion years ago, photosynthetic bacteria (known as cyanobacteria and blue green algae) became common and started producing oxygen.
- Initially, the oxygen combined with iron in the ocean, producing iron oxide, or rust which sank to the ocean flor, forming great bands of iron that are the source of most iron ore mined today.
- Without iron, the oceans changed color from brown to blue-green.

CHANGE IN THE ATMOSPHERE

1

Oxygen gas began to accumulate in the atmosphere.

2

The ozone layer began to form, and the skies turned to their present shade of blue.

3

After several hundred million years, oxygen reached today's levels.

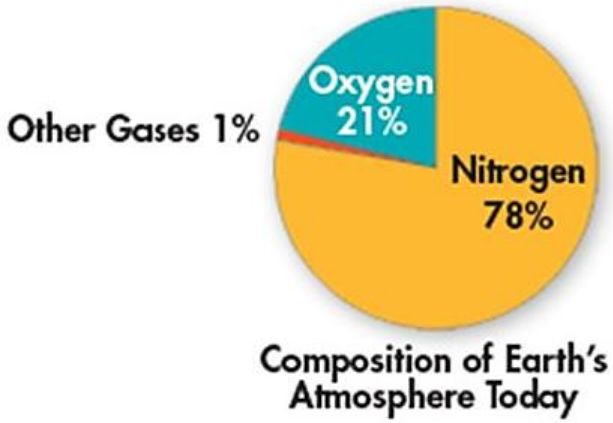
4

How did the rise in oxygen affect early life forms?

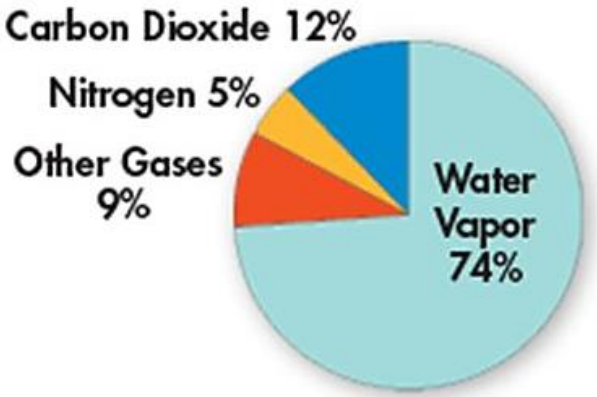
1 MINUTE RESPONSE

How would Earth be different today if photosynthesis had not evolved?

ANALYZING DATA



Composition of Earth's Atmosphere Today



Composition of Gases From Volcanoes

Many scientists think that Earth's early atmosphere may have been similar to the gases released by a volcano today. The graphs show the composition of the atmosphere today and the composition of gases released by a volcano.

1. Which gas is most abundant in Earth's atmosphere today? What percentage of that gas may have been present in the early atmosphere?

2. Which gas was probably most abundant in the early atmosphere?

3. Where did the water in today's oceans probably come from?

Eukaryotic vs. Prokaryotic

Eukaryotic

Eukaryotic cells are found in humans. They are also found in plants, animals, fungi, and insects.

Prokaryotic

Prokaryotic cells are found in bacteria. They are less complex than Eukaryotic cells.

Nucleus

Eukaryotic cells have nuclei and other membrane bound organelles.

No Nucleus

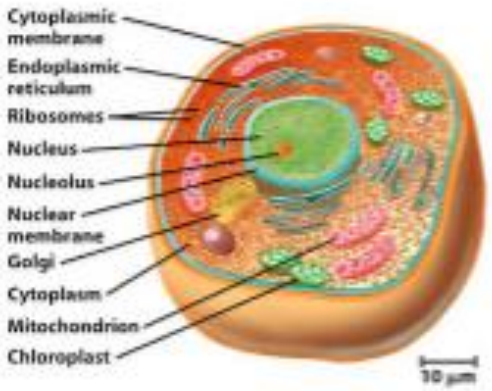
Prokaryotic cells do not have a nucleus. They also do not have any membrane bound organelles.

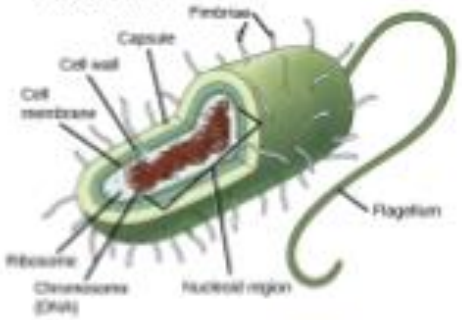
DNA of Eukaryotic cells

Eukaryotic cells have linear strands of DNA.

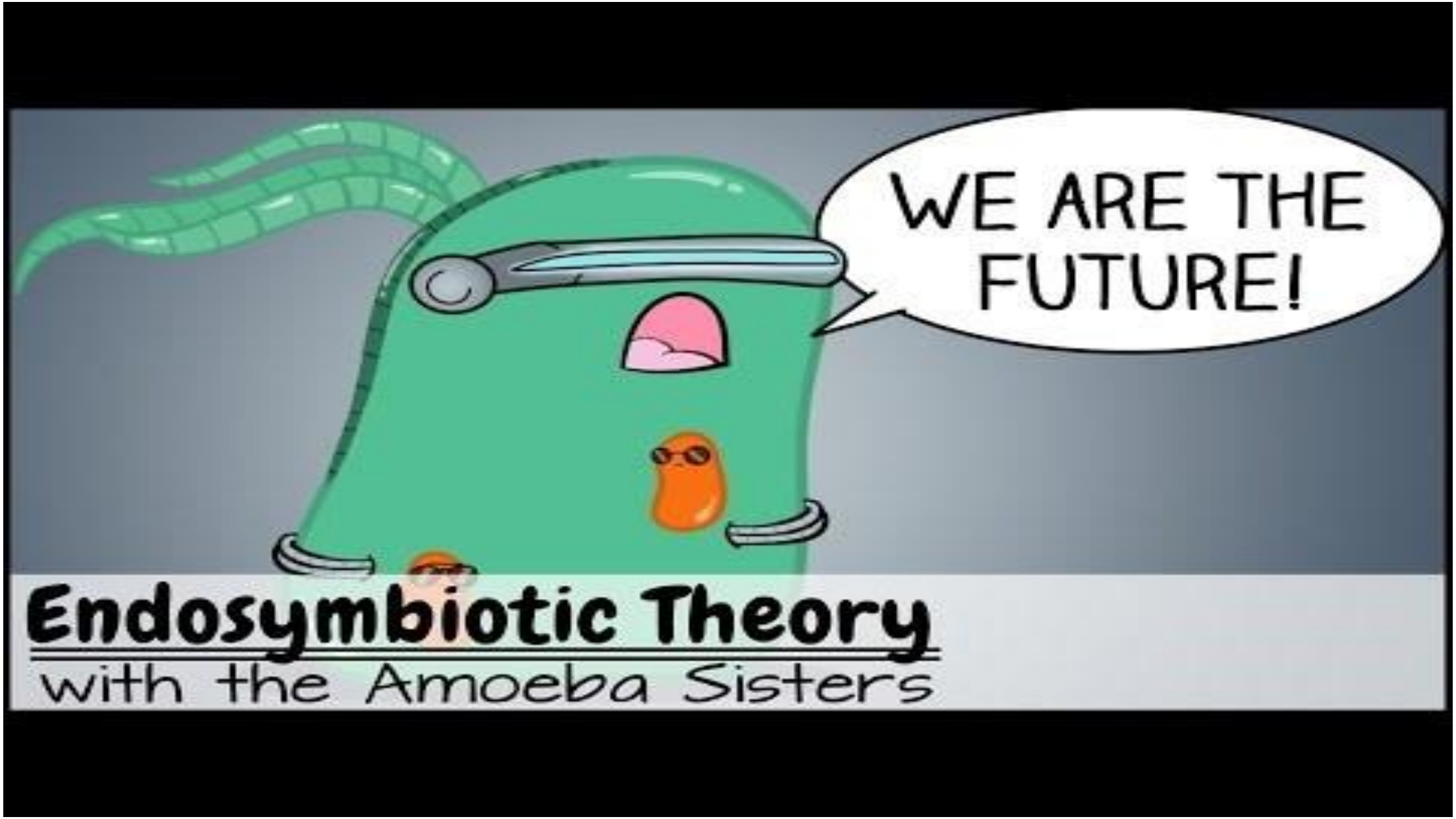
DNA of Prokaryotic cells

Prokaryotic cells have smaller, circular DNA. DNA for prokaryotic cells is held in a nucleoid.





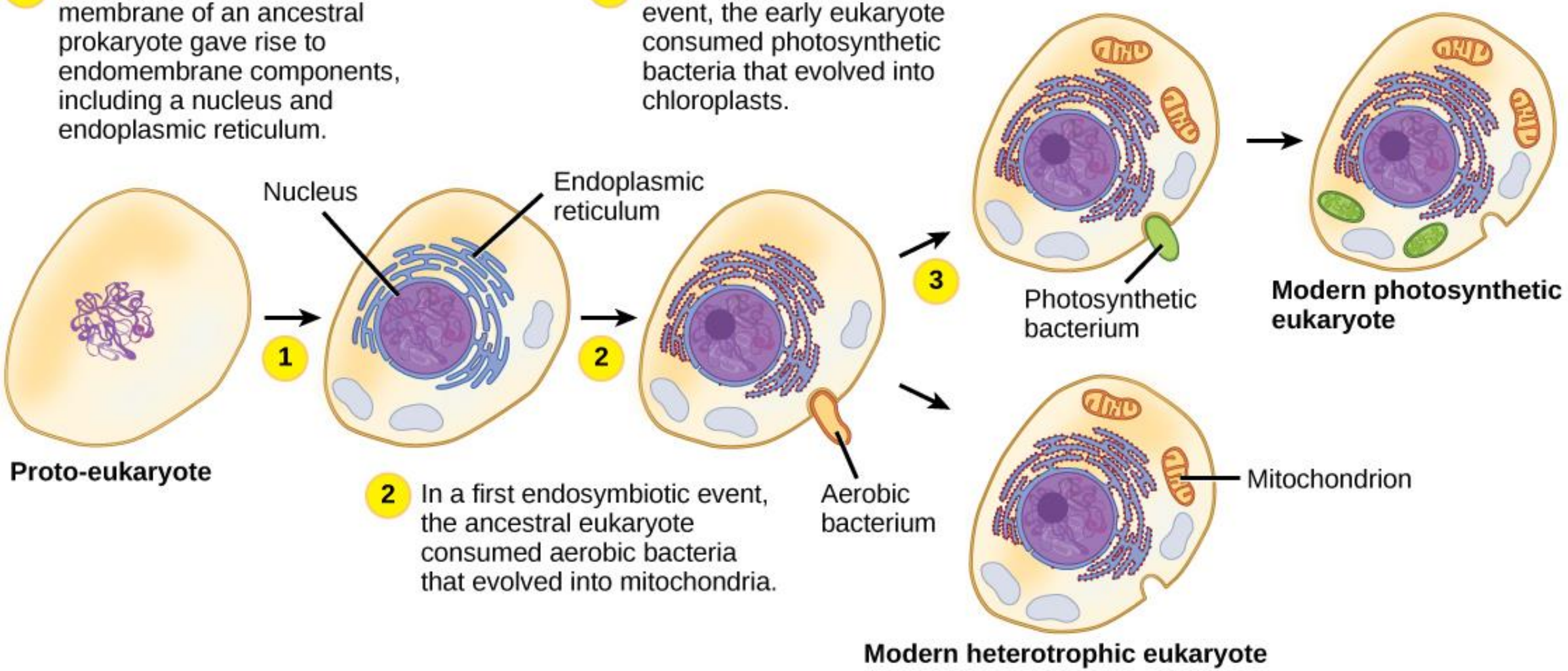
"Eukaryotic and Prokaryotic Cells: Similarities and Differences." Study.com. N.p., n.d. Web. 05 Jan. 2017.


WE ARE THE FUTURE!
Endosymbiotic Theory
with the Amoeba Sisters

The ENDOSYMBIOTIC THEORY

1 Infoldings in the plasma membrane of an ancestral prokaryote gave rise to endomembrane components, including a nucleus and endoplasmic reticulum.

3 In a second endosymbiotic event, the early eukaryote consumed photosynthetic bacteria that evolved into chloroplasts.



2 In a first endosymbiotic event, the ancestral eukaryote consumed aerobic bacteria that evolved into mitochondria.

EVIDENCE FOR ENDOSYMBIOTIC THEORY

1. Similarity of the membranes around mitochondria and chloroplasts to the cell membranes of prokaryotes
2. Similarity of the DNA in mitochondria and chloroplasts to bacterial DNA
3. Similarity of ribosomes in mitochondria and chloroplasts to bacterial ribosomes
4. Mitochondria and chloroplasts reproduce by binary fission, as do bacteria

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