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

Guiding question: What happened during Earth's early history?

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

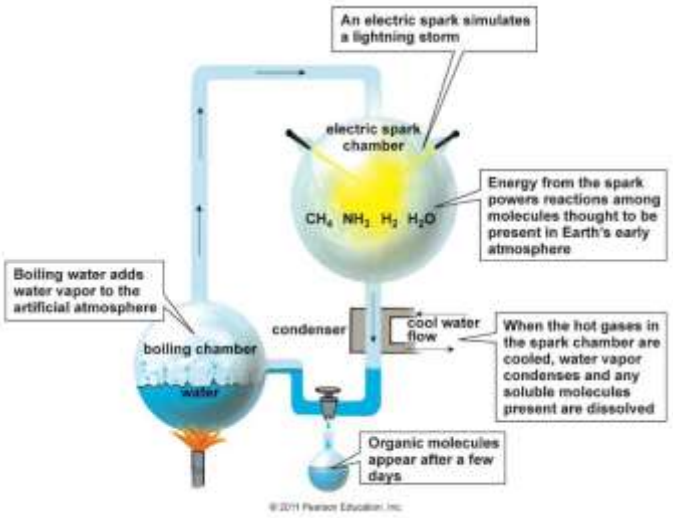
- In 1953, Miller and Urey's experiment suggested how mixtures of the organic compounds necessary for life could have arisen from simpler compounds on a primitive earth.
- They produced amino acids, which are needed to make proteins, by passing sparks through a mixture of hydrogen, methane, ammonia, 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

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.

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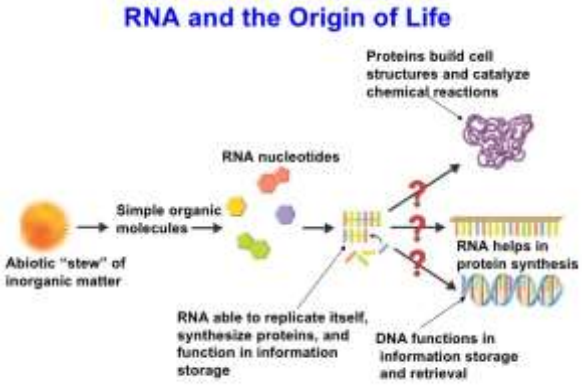
Under the right conditions

- 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.

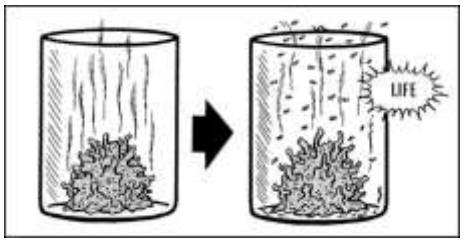


How would RNA have stored genetic information?

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

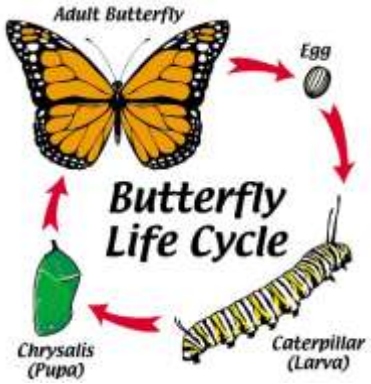


The church approved this belief and people trusted the church.

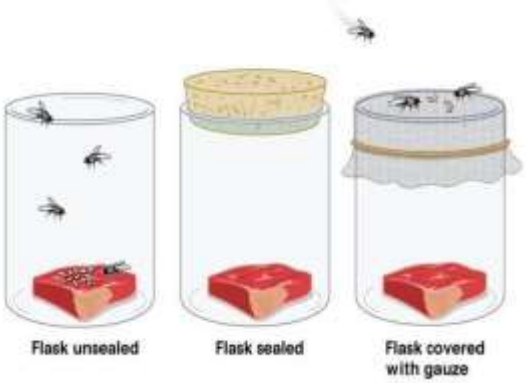
However, it wasn't until the man, Francesco Redi, conducted an experiment in 1668 that evidence was found for biogenesis.

Biogenesis

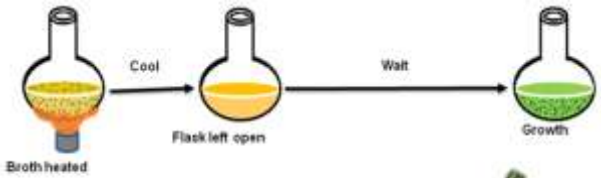
All life comes from life.



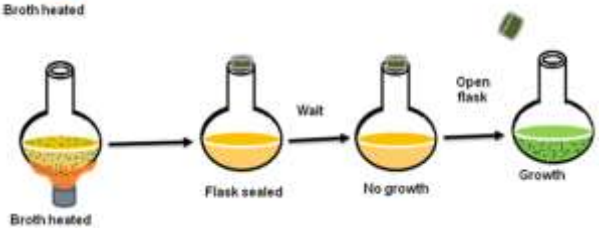
Redi's Experiment



John Needham (1748) supported spontaneous generation with experiment.



Lazzaro Spallanzani (1770) supported biogenesis with similar experiment.



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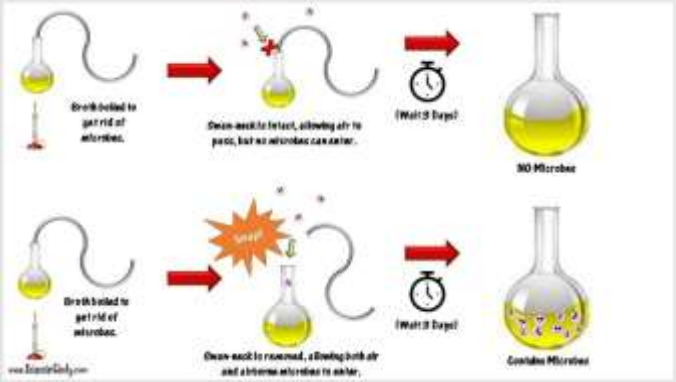
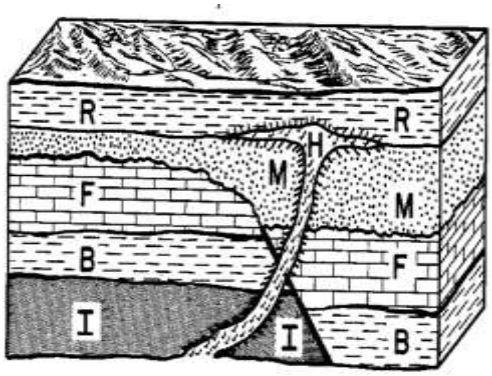
Pasteur's Experiment
Louis Pasteur (1862-1864) supported biogenesis with his own experiment.



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.

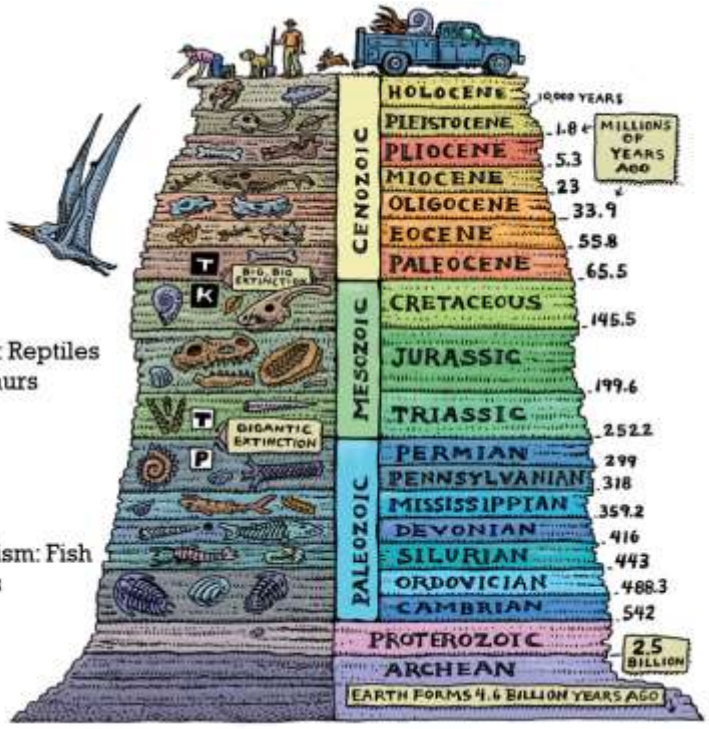
Geologic Time Scale

- 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



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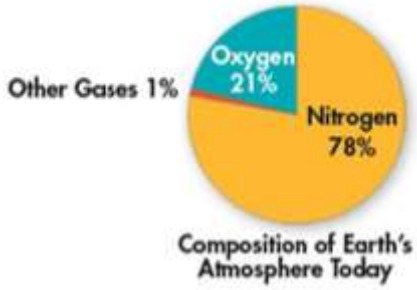
Earth's Early History

- 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 floor, 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.
- Oxygen gas began to accumulate in the atmosphere causing the ozone layer to form and the skies to turn to their present shade of blue.

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

Analyzing data

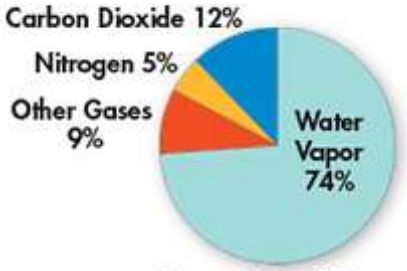
Many scientists think that Earth's early atmosphere may have been similar to the gases released by a volcano today. The graphs show the composition of the atmosphere today and the composition of gases released by a volcano.



Composition of Earth's Atmosphere Today

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

Which gas was probably most abundant in the early atmosphere?



Composition of Gases From Volcanoes

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