

Origins of Life

Name: _____

1. Early Earth

- a. About _____ the planets of our solar system formed by the condensing of matter around our sun
- b. The Atmosphere
 - i. Formed by _____
 - ii. Different than atmosphere today:

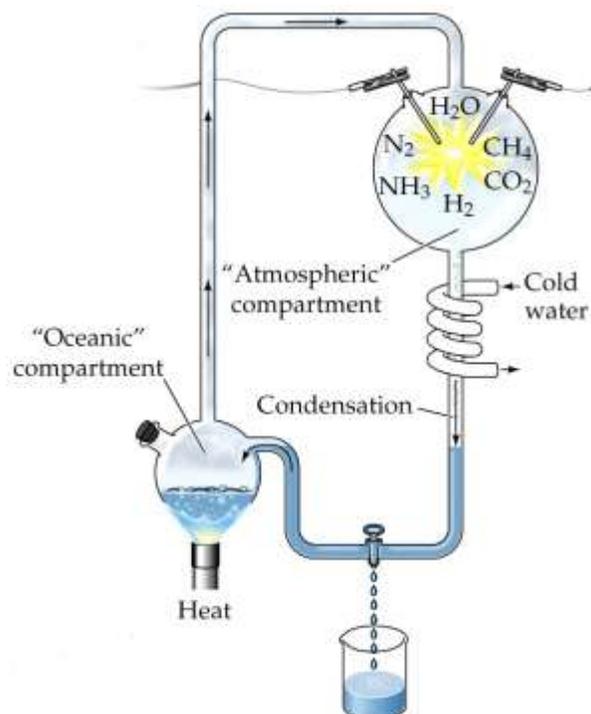
THEN	NOW
<ul style="list-style-type: none"> • _____ penetrated Earth's atmosphere • Consisted of methane, ammonia, water vapor, nitrogen, carbon dioxide, hydrogen and carbon monoxide • _____ atmosphere → lacks O₂ and allows formation of complex organic molecules 	<ul style="list-style-type: none"> • UV is absorbed by _____ in the atmosphere • Consisted primarily _____ and _____ • _____ atmosphere → free O₂ and inhibits formation of complex organic molecules

- c. The Surface
 - i. As earth cooled, water vapor condensed to liquid water, forming _____.
 - ii. Frequent _____ storms
 - iii. Many _____
 - iv. High _____ (little atmosphere to shield heat from the sun)

2. Four processes were needed for the spontaneous origin of life on Earth.

a. *Non-living synthesis of simple organic molecules*

- i. _____, or "**biochemical evolution**", is the study of how life on Earth could have arisen from inanimate matter.
- ii. _____ – common elements found in organic compounds
- iii. Two hypothesized mechanisms for the presence of simple organic molecules on Earth
 1. Organic molecules were created from inorganic matter on Earth
 - a. _____ (1953) duplicated early earth conditions in the lab:
 - b. Methods
 - i. In a glass refluxing system, they recreated a miniature _____



- ii. Included hydrogen, methane, ammonia and water into the system to model pre-biotic atmosphere
- iii. The mixture was _____ and circulated past an _____ (to model lightning) before allowing to _____
- c. Results: _____ were formed from the inorganic compounds
- d. Conclusion: molecules of life can arise from _____.
TOK: we may be able to show that organic compounds _____ arise under certain conditions, but we can't determine with certainty whether they _____ in the past
- e. Other scientists repeated their work, eventually producing other amino acids, ATP, glucose and other sugars, lipids and the bases which form RNA and DNA, and adenine (the key component of ATP)
- f. These molecules would accumulate over long time periods producing thick, warm " _____ "

2. Organic molecules were delivered to Earth from outer space

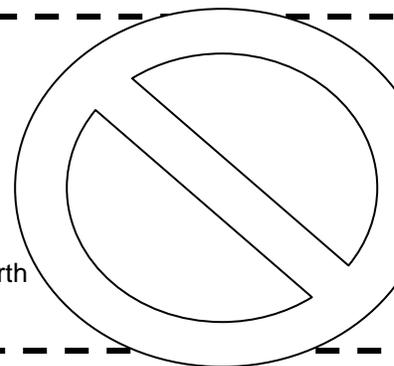
- a. Comets contain a variety of _____
- b. Heavy bombardment 4,000 million years ago may have delivered both organic compounds and water to the early Earth.
- c. Example: _____
- d. Rich with _____
- e. Demonstrates that _____

This is NOT that..



PANSPERMIA:

- Cellular life reached the Earth hiding inside a meteor
- The odds of an organism surviving inside a meteor for thousands of years are not high.
- It is even less likely that organisms would be able to withstand the high energy impacts of bolides into the Earth or other planetary objects.



b. **Assembly of these molecules into polymers.** Four hypotheses:

- i. _____ hypothesis:
 - 1. Early oceans carried organic molecules
 - 2. The porous surfaces of shoreline minerals helped organize such building blocks into polymers.
- ii. _____ hypothesis
 - 1. Some scientists calculate that at one point, the top 300 meters of the ocean were frozen over.
 - 2. Provided a protective shield from _____ (which destroys organic compounds)
 - 3. Organic compounds are _____ in colder temperatures and could combine in a lattice of ice.

iii. _____ hypothesis

1. Release hot gaseous substances
2. Today, they are surrounded by thriving ecosystems

iv. _____ hypothesis

1. Clay contains iron and zinc atoms which can serve as inorganic catalysts for polypeptide formation
2. Clay collects energy from radioactive decay and discharges it if temperature or humidity changes; could have been source of energy for polymerization to take place

c. ***Origin of self replicating molecules that made inheritance possible***

i. In living systems, information flows from _____ → _____ → _____

ii. This sequence developed in stages

iii. _____ hypothesis suggests that the first genes and enzymes were RNA molecules

iv. Why RNA? **RNA can act as a catalyst to:**

1. _____ to form polypeptides
2. _____ itself to create more RNA

v. _____ can be transcribed to _____ (using reverse transcriptase); this could have given rise to the first DNA

vi. DNA is more stable than RNA and eventually took over carrying the genetic information

d. ***Packaging of these molecules into membranes with an internal chemistry different from their surroundings***

i. _____ - cell-like structure with a lipid membrane

ii. Protocells could have developed from _____

1. Complex spherical units that spontaneously form when concentrated mixtures of macromolecules are held in the right temperature, ionic composition, and pH
2. Absorb and incorporate various substances from the surrounding solution

iii. How could a protocell develop?

1. _____ spontaneously form membranes
2. _____ enters the membrane
 - a. Creates proteins
 - b. Replicates itself
3. Structure divides into two when surface area is too large (animation)