

Early Earth, the Origin of Life, and Search for Extraterrestrial Life.

NOTE to STUDENTS and FACILITATORS: One of the main purposes of the Workshops is to allow free exchange of information by **having each member of a Learning Community in turn answer one part** of a discussion question. As each student explains a term or gives a definition in their own words, it should allow for free verbal EXCHANGE and promote learning by interaction. **Try to insure that everyone in your Learning Community does a question or two and they must EXPLAIN THEIR ANSWERS to the rest of the community.**

Conditions of Early Earth:

Lecture presented possible scenarios for the origin of the chemicals necessary for the evolution of early life on Earth. The 3 major hypotheses of the origins of life and cells are?

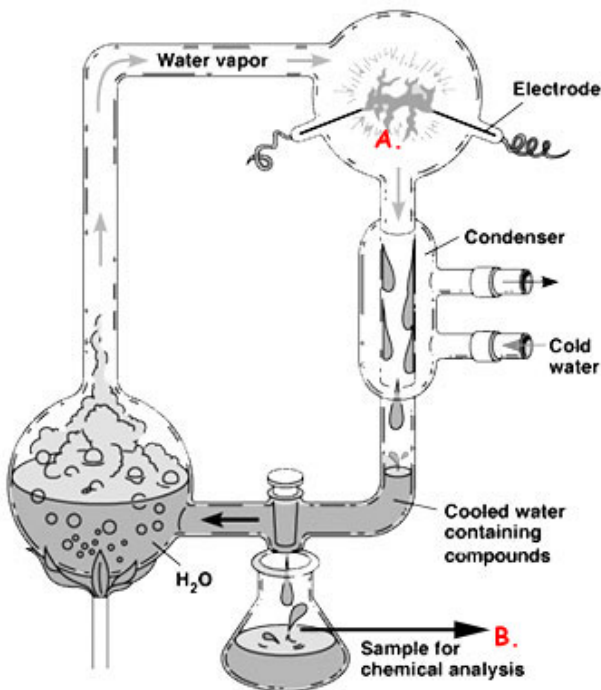
1. _____ 2. _____ & 3. _____

Radioisotope dating using ^{235}U decay indicates that the Earth is around _____ old and that life originated between _____?

Most biologists believe that life evolved on Earth from nonliving materials (chemicals) that became ordered into collections of molecules capable of self-replication and metabolism. Conditions on the primitive Earth are thought to have favored the spontaneous formation of organic monomers, the linking of these monomers into polymers, the development of self-replicating molecules, and the grouping of aggregates of organic molecules into droplets called _____?

Stanley Miller and Harold Urey, of the University of Chicago in 1953's were the first to experimentally test the idea that chemical evolution may have given rise to the precursor molecules of life. Below is a picture of their experimental apparatus. Each member of your group should answer a part of the question, in turn. Discuss the important points of each question and its answer.

A. Consider the Stanley Miller apparatus.



- A. What was it meant to simulate _____?
- B. What molecules were in the reaction vesicle that is labeled "A." _____?
- C. The atmosphere inside the vessel "A." is described as a chemically _____ atmosphere?
- D. In the sample vesicle which they tested for various types of chemicals made... What molecules did they find in "B." _____?
- E. In their experiment, what energy source(s) were provided, and what was it likely meant to simulate? _____?
- F. How might each of the molecules made in the Miller/Urey apparatus have contributed to the formation of early cells? _____?

?

Components of Life: Have one member, each in turn, define for the others in your Learning Community...

1. What is an abiotic molecule and mention some examples?
2. What is the definition of a biological macromolecule and what are some examples?
3. Have one member of your Learning Community, each in turn - Name two common examples of each of the following types of macromolecule:
 - a. nucleic acid a. _____ and b. _____
 - b. protein c. _____ and d. _____
 - c. carbohydrate e. _____ and f. _____
 - d. lipid g. _____ and h. _____

Where did the Chemicals of Life come from?

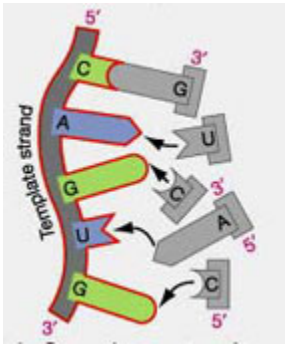
Have one member, in turn, of your group answer each question.

One hypothesis, popular in many scientific circles, suggests that Life originated as a result of the "seeds of life" having been carried here via extraterrestrial means.

1. This idea is often known as _____ ?
2. Pose an experimentally testable research question that might help to determine whether this idea might be correct. Have your Learning Community critique the experiment. Is the experiment really testable? And if not, why not?
3. Possible extraterrestrial sources of early organic molecules that may have lead to life include:
 - a) _____, b) _____, and c) _____.
4. Others believe that life is the result of divine creation over a very short period of time. Pose some experimentally testable questions which might help to determine whether this idea could be correct. Is this question really testable? And if not, why not?
5. What are the differences between a hypothesis that is scientifically verifiable and one that is not?
6. Besides an extraterrestrial possible source for early cells and life, or its molecules, there is another terrestrial (Earth origin) source of primitive organic molecules for the chemical evolution of life. These sources are found in the deep sea in areas referred to as _____ ?
7. The currently accepted paradigm suggests that there were at least 4-steps or stages that contributed to the chemical evolution of life:
 - a) the abiotic synthesis of _____ ?
 - b) the joining of small organic monomers into _____ ?
 - c) the origin of heredity via _____ ? molecules.
 - d) and the packaging of these molecules into membrane-like enclosed bodies called _____ ?

8. In 1998 Robert Hazen's lab showed that minerals such as feldspar, magnetite, clay, and calcite may be able to play roles in allowing primitive organic molecules to react with each other, chemically forming more complex molecules. This is primarily because these minerals provide
- _____?
 - feldspars contain small pits that can protect molecules from _____?
 - _____? triggers a combination of _____? & _____? into ammonia.
 - layers of _____ allow molecules to be held in close proximity to form more complex molecules.
 - calcite can attract different _____? to different crystal faces.

9. The autocatalytic assembly of polymers is catalyzed by a chemical reaction known as a _____?



- The chemical reverse of this type of reaction is a reaction referred to as _____?
- The figure to the right is of an RNA molecule that is exhibiting _____?

10. In 1989 Sid Altman and Tom Cech demonstrated that small RNA molecules have catalytic activity, i.e., the ability to break and/or form new covalent bonds. Such RNA molecules are known as _____?

Life: One member, each, of your group should answer 1 question below & explain your answer to everyone.

- The idea of the origin of life via Spontaneous Generation was rejected in 1862 with who's experiments _____?
- What is Spontaneous Generation? _____?
- "All life arises from _____? life..." is often referred to as the Principle of Biogenesis.
- There are 3 primary mechanisms by which cells can transform energy. They are:
1) _____, 2) _____, and 3) _____?
- The natural elements of the human body show that these 4 elements occur in the greatest amounts?
1) _____, 2) _____, 3) _____, and 4) _____
- The evolution of the Eukarya may have been the single most important step in evolution of multi-cellular life forms and was a key step that lead from a primordial cell to plant & animal life. Name 4 likely steps that would have occurred in the evolution of eukaryotes from a primordial cell?
1)
2)
3)
4)
- one member should define... metabolism and then another member should distinguish between an autotroph and a heterotroph?
- We spent a lot of time in class describing life in terms of a cell. Have one member of your group define, in relatively formal terms, tell what a cell is and then ask your group to add to it or change the definition presented.