

# (Introduction to the Origins of Life)

## Chapter 26: Origins of Life

### OBJECTIVES:

#### Introduction to the History of Life

- \_\_1. Describe the major events in Earth's history from its origin up to about 2 billion years ago. In particular, note when Earth first formed, when life first evolved, and what forms of life existed up until about 2 billion years ago.
- \_\_2. Describe the timing and significance of the evolution of photosynthesis.
- \_\_3. Describe the timing of key events in the evolution of the first eukaryotes.

#### The Origin of Life

- \_\_4. Contrast the concept of **spontaneous generation** and the principle of **biogenesis**.
- \_\_5. Describe the four stages of the hypothesis for the origin of life on Earth.
- \_\_6. Describe the contributions that **A. I. Oparin**, **J. B. S. Haldane**, and **Stanley Miller** made toward developing a model for the abiotic synthesis of organic molecules. Describe the conditions and locations where most of these early organic reactions probably occurred on Earth.
- \_\_7. Describe the evidence that suggests that RNA was the first genetic material. Explain the significance of the discovery of **ribozymes**.
- \_\_8. Describe how natural selection would have worked in an early RNA world.
- \_\_9. Describe the key properties of **protobionts** in the evolution of the first cells.
- \_\_10. Describe the evidence that suggests that life first evolved on the sea floor near deep-sea vents.
- \_\_11. Describe the **endosymbiosis theory** as it pertains to the origins of Eukaryotic cells. (*pp.* 548-552)

#### The Major Lineages of Life

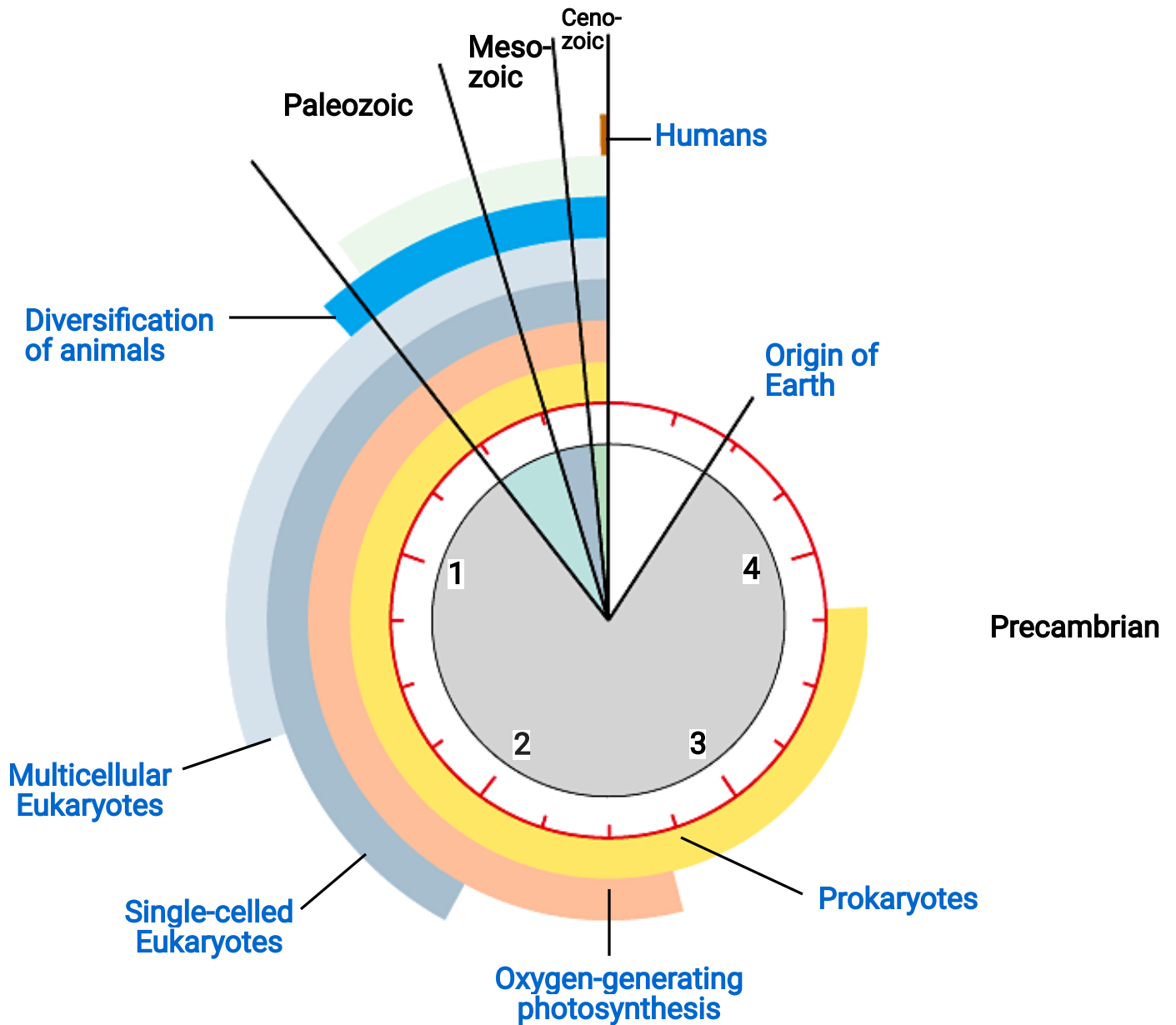
- \_\_12. Describe the basis for R. H. Whittaker's five-kingdom system.
- \_\_13. List, distinguish among, and describe examples from each of the five kingdoms.
- \_\_14. Compare the **three-domain** system and R. H. Whittaker's five-kingdom system of classification.



**Stanley Lloyd Miller**  
(March 7, 1930 – May 20, 2007)

## Guided Reading: Chapter 26

- (p.512) 1. How old is the planet? 4.5 Billion Years
- (p.512) 2. How old is the earliest evidence of life on Earth? 3.5 Billion Years
3. How long ago did the human lineage diverge from other primates.? \_\_\_\_\_
- (p.512) 4. Use the clock model to note the following events in the life of the planet: *origin of the Earth, appearance of prokaryotes, evolution of atmospheric oxygen, occurrence of eukaryotic cells, multicellularity, and life moves onto land.* For each event, also label the number of years ago it occurred.

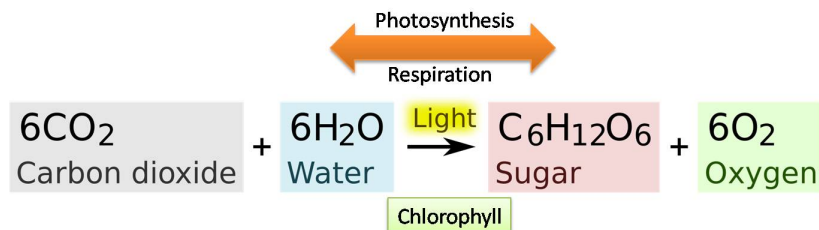


- (p.516) 5. One current hypothesis on the origin of life suggests a sequence of four main stages. Summarize them in the table below. **(Origins of Life on Earth)**

Stage	Description
1	The abiotic (nonliving) synthesis of small organic molecules, such as amino acids and nucleotides.
2	The joining of these monomers into polymers including proteins and nucleic acids. <b>(Dehydration Synthesis)</b>
3	The origins of self-replicating molecules that eventually made inheritance possible.
4	The packaging of all these molecules into "protobionts" droplets with membranes that maintained an internal chemistry different from its surroundings ( <i>compartmentalization</i> ).

- (p.516) 6. In your table above, the first stage is the synthesis of organic molecules. Consider the early planet, probably thick with water vapor and stinky with methane, ammonia, and hydrogen sulfide. What gas was missing from this early mix? Why?

Oxygen was missing from the atmosphere of the early planet because photosynthetic organisms has yet to evolve.



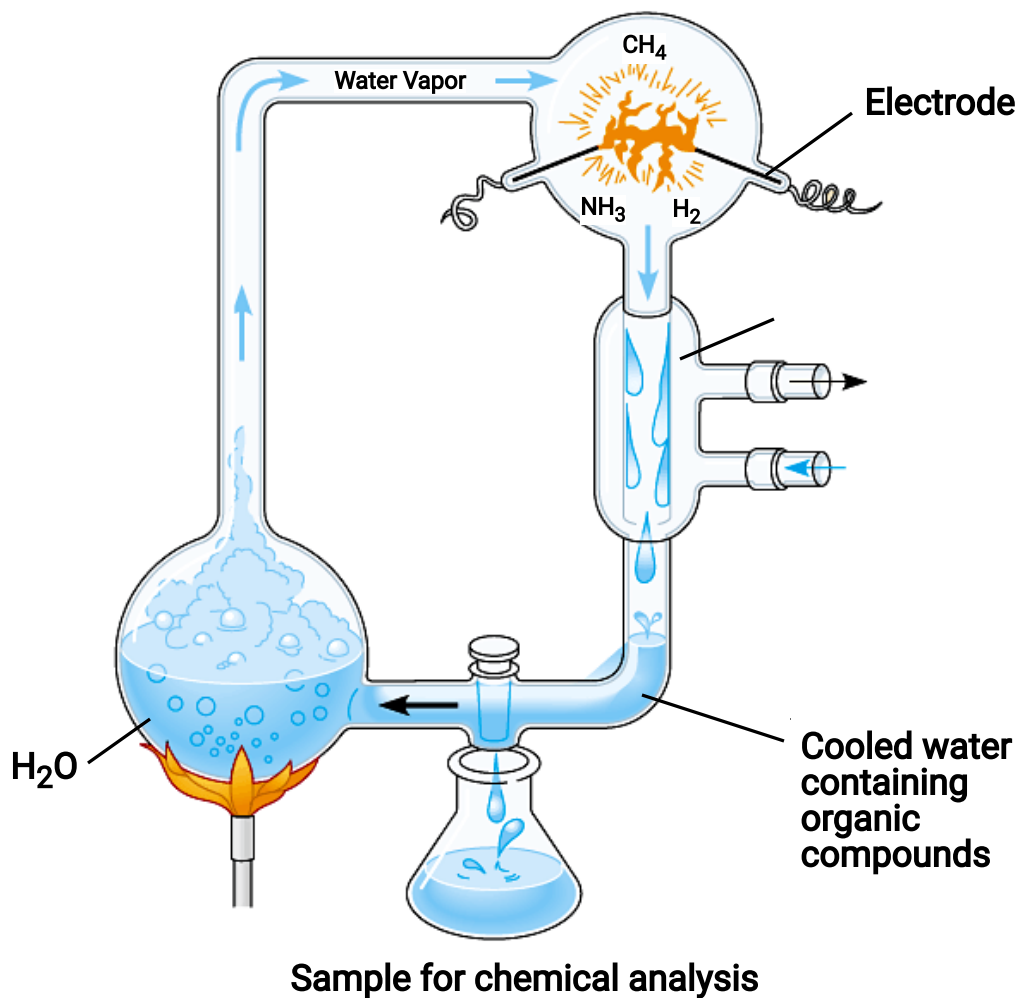
- (p.516) 7. A. I. Oparin and J. B. S. Haldane hypothesized that the early atmosphere was a *reducing environment*. What did they suggest was the source of energy for the early organic synthesis?

The source of energy for the early organic synthesis of biomolecules was provided by lightning and the intense UV radiation from the sun that penetrated the primitive atmosphere due to a very thin ozone layer

(p.518)8. In 1953 at the University of Chicago, *Stanly Miller* and *Harold Urey* tested the *Oparin- Haldane hypothesis* with the apparatus shown to the right. Label the diagram and use it to explain the elements of this experiment, using arrows to indicate what occurs in various parts of the apparatus.

[\(Animation I\)](#)

[\(Animation II\)](#)



(p.518)9. What was collected in the sample for chemical analysis?

**A variety of organic molecules including amino acids were collected in the sample for chemical analysis.**

(p.518)10. What was concluded from the results of this experiment?

**The successful abiotic synthesis of organic molecules was concluded in this experiment.**

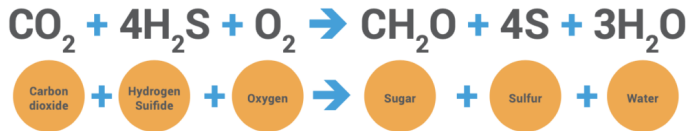
**(Greatest Discoveries)(Greatest Discoveries)**

(p.518) 11. List and briefly describe some of the other plausible explanations for the origins of the organic ingredients necessary for life.

Some of the other plausible explanations for the origins of the organic ingredients necessary for life include:

(1) the synthesis of organic molecules using the chemicals (H<sub>2</sub>S) and energy from submerged volcanoes and deep-sea vents.

(2) some organic molecules reaching earth from outer space.



(p.519) 12. What did *Thomas Cech* propose was the first genetic material, DNA or RNA? RNA

(p.519) 13. What are *ribozymes*?

Ribozymes are catalysts that help catalyze the synthesis of new RNA, notably rRNA, mRNA and tRNA.

(p.516) 14. Explain the evidence for an early “RNA world.”

Evidence for an early “RNA world” include

(p.520) 15. What are *protobionts* and what properties of life do they demonstrate?

Protobionts are aggregates of abiotically produced molecules that are capable of maintaining an internal chemical environment different from their surrounding and exhibit some of the properties associated with life including metabolism and excitability.

**(p.523)16.** Taxonomy is in flux! When Mr. Collea was in high school, he was taught there were two kingdoms: plants and animals. Then in his college courses, he was introduced to five kingdoms: Monera, Protista, Plantae, Fungi, and Animalia. Now biologists have adopted a three-domain system, which consists of the domains Bacteria, Archaea, and Eukarya. This system arose from the finding that there are two distinct lineages of prokaryotes

Use the diagrams below to help you explain the differences between the Five-Kingdom and Three-Domain system of classifying life on Earth.



**(a) The five-kingdom system**



**(b) The three-domain system** ([Ricochet Science: Three Domains of Life](#))

**Differences:**

Five-Kingdom System	Three-Domain System

**([Ricochet Science: Classification](#))**

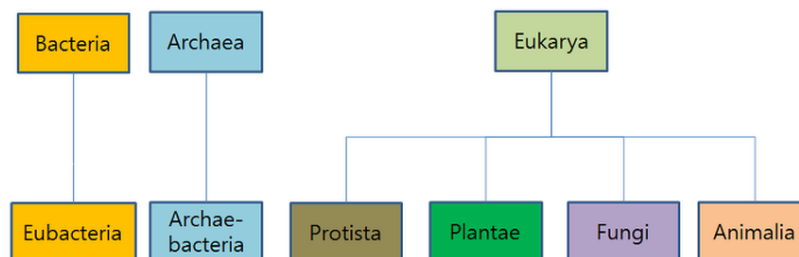
**(p.523) 17.** What two domains include all prokaryotes?

**The two domains that include all prokaryotes are Bacteria and Archaea.**

**(p.523)18.** Which kingdom is made obsolete by the three-domain system? Why?

**The Monera Kingdom was made obsolete by the three-domain system because molecular analysis revealed that there were two distinct lineages of prokaryotes.**

3 Domains



6 Kingdoms

(p.549) 19. The first *eukaryotes* did not appear until approximately 2.1 billion years ago. Complete the diagram below which is found on page 549 and use it to explain the evolution of eukaryotes by *endosymbiosis*.

(Animation)

(Animation)

