

## **MILLER/UREY EXPERIMENTS**

### **Name of the "Proof"**

Miller/Urey Experiments and the Origins of Life

### **Background information on the claim**

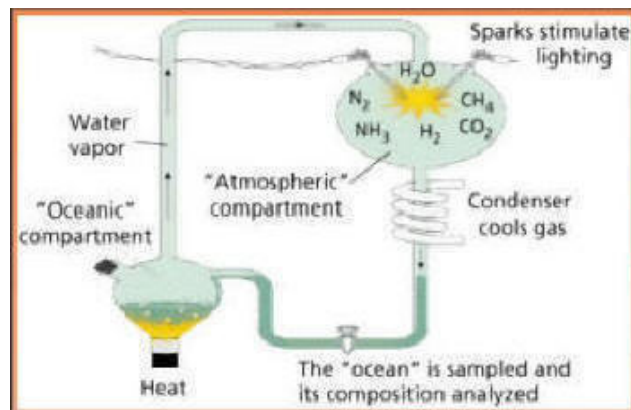
A great boundary to the completely naturalistic, random development of biological life on the planet as proposed by Darwinian evolution and widely accepted by many scientists since Darwin's time is the origin of life itself.

As the textbook authors indicate, some of the first work to show how existing life came about began with the work of Francesco Redi in the 1600s. Redi disproved the theory of spontaneous generation of maggots in decaying meat by conducting simple experiments with meat in covered vessels and meat in uncovered vessels. However, scientists still believed that very small organisms were spontaneously generated in the air. This was later disproved by Louis Pasteur's famous Swan-necked flask experiments with broth in the mid-1800's. Pasteur's principle became known as biogenesis, which stated that "life comes only from life." This principle is one of the bedrocks of biology and has been widely accepted (and verified repeatedly through experiment) over the last 150 years.

During the mid 1800's, before the advent of microbiology, Darwin and his contemporaries like Ernst Haeckel described cells as "homogeneous globules of plasm." It was only later, when scientists began to view deeper into cell structure through more powerful microscopes, that this notion of simplicity at the foundation of life was rejected.

Scientists who were committed to the study of biology and the naturalistic philosophy of origins proposed by Darwin began to argue that life must have evolved from non-life on the early Earth. A Russian scientist working in the 1930s, Alexander Oparin, proposed the idea that life had first begun in the oceans on early Earth by converting heat energy from the sun, lightning, or the heat of the Earth and producing favorable chemical reactions to produce small organic molecules from the elements present in the atmosphere.

In the 1950s, American scientists Stanley Miller and Harold Urey conducted experiments which attempted to simulate conditions thought to have existed on early Earth, with particular gases, including ammonia and water vapor, and striking the gases with a high voltage electric charge to simulate lightning. The results of the experiment were that several simple amino acids were collected from the apparatus. Since amino acids are key components of proteins, and proteins are the building blocks of DNA, the Miller/Urey experiments generated much excitement that a solution to the first step in the evolutionary process from chemical 'soup' to living organism had been found. Scientists began to postulate that this would lead to a better understanding of how the first living organism could have come together by chance from non-living chemicals.



Miller-Urey Experiment

### **Claim from the Textbook**

1. Earth's early atmosphere probably contained little free oxygen and was probably composed of water vapor, carbon dioxide, nitrogen, perhaps methane and ammonia.
2. Stanley Miller and Harold Urey were pioneers whose experiments showed that small molecules can form complex organic materials under conditions that may have existed on early Earth.

### **Quotes from Textbook regarding the claim**

(Glencoe Biology (North Carolina Edition)- The Dynamics of Life, Copyright 2000, McGraw-Hill)

Page 388-390: "Remember that Earth's early atmosphere probably contained little free oxygen. Instead, the atmosphere was probably composed of water vapor, carbon dioxide, nitrogen, and perhaps methane and ammonia. Many scientists have tried to explain how these substances could have joined together and formed the simple organic molecules that are found in all organisms today.

In the 1930s, a Russian scientist, Alexander Oparin, hypothesized that life began in the oceans that formed on early Earth. He suggested that energy from the sun, lightning, and Earth's heat triggered chemical reactions to produce small organic molecules from the substances present in the atmosphere. Then, rain probably washed the molecules into the oceans to form what is often called a primordial soup.

In 1953, two American scientists, Stanley Miller and Harold Urey, tested Oparin's hypothesis by simulating the conditions of early Earth in the laboratory. In an experiment similar to the one shown in Figure 14.12, Miller and Urey mixed water vapor (steam) with ammonia, methane, and hydrogen gases. They then sent an electrical current through the mixture. Then, they cooled the mixture of gases, produced a liquid that simulated rain, and collected the liquid in a flask. After a week, they analyzed the chemicals in the flask and found several kinds of amino acids, sugars, and other small (p.391) organic molecules, providing evidence that supported Oparin's hypothesis."

An insert on p.481 listed under 'Focus on History' with subheading 'Pioneers' is the following language about Miller/Urey:

*"Two scientists, Stanley Miller and Harold Urey, pioneered work about the origin of Earth's life. Their experiments showed that small molecules can form complex organic materials under conditions that may have existed on early Earth."*

### **The Reality of the Scientific Study**

Despite the favorable presentation of the Miller/Urey experiments in the biology text above and the scientific experimentation that this work inspired beginning in the mid-1950's, it is now evident and has been for some time, that there are serious difficulties in trying to apply the results to the notion of the evolution of life on the early Earth. None of these difficulties are presented in the biology text, so they will be briefly explained below.

#### **1. Intelligent intervention was necessary to prevent the natural destruction of the amino acids that were produced.**

The amino acids that were formed during the Miller/Urey experiments were removed from the apparatus by Miller from the trap in order to prevent them from being subjected to side reactions that normally occur in such chemical environments. Such reactions would have served to degrade the amino acids into compounds that were not biologically significant. The question then becomes, how could the first such amino acids formed in the 'pre-biotic soup' have been saved from destruction in this manner?

#### **2. The Miller/Urey experiments did not simulate atmospheric conditions present on the early Earth, according to most modern scientific evidence.**

One receives a very slight hint from the textbook authors to this effect when they state, "*the atmosphere was probably composed of water vapor, carbon dioxide, nitrogen, and perhaps methane and ammonia*" as given above. When one looks at the atmospheric conditions in the Miller/Urey experiments, also from the text as "*Miller and Urey mixed water vapor(steam) with ammonia,*

*methane, and hydrogen gases*”, some key differences stand out. Miller/Urey suggested a strongly reducing atmosphere, with abundant hydrogen, while scientists now believe that the early atmosphere contained very little free hydrogen. Secondly, while methane and ammonia were key ingredients in the Miller/Urey experiments, scientists now believe that they were not likely to have been present in significant amounts (thus the authors’ use of the word ‘perhaps’). The reality is that the atmospheric conditions in Miller/Urey are very unlikely to have been consistent to those on the early Earth.

### **3. The assumption of the strongly reducing atmosphere.**

Biologists have long known that a strongly reducing atmosphere, with little or no free oxygen present, would be necessary (required) for the chemical evolution of life. This is a primary reason for the atmospheric conditions that Miller and Urey chose to use in their experiment. If any significant levels of free oxygen were present, the production of biological building blocks would have been halted and those present would be quickly degraded. Many geochemical studies have shown that it is likely that a significant amount of oxygen was present in the atmosphere of early Earth, probably from volcanic out-gassing and photodissociation of water vapor. In short, scientists commonly view a strongly reducing atmosphere on the early Earth as improbable.

### **4. The amino acids produced by Miller/Urey (or any other such ‘early Earth atmosphere’ experiment) are very different from those present in functioning proteins in living organisms.**

Scientists now know that amino acids found in all functioning proteins are strictly left-handed (L-form), while those that occur in nature are equally right (D-form) and left-handed. Miller/Urey produced the latter and there is no known natural mechanism to either eliminate only the right-handed amino acids or preserve only the left-handed ones. This ‘left-handedness’ in the amino acids of all functioning proteins is required because of linkage requirements in building protein molecules. Just as pieces of a jigsaw puzzle interlock to form a picture, amino acids interlock in a particular way to form a particular protein.

### **What's Wrong with the Textbook Claim?**

1. The textbook never mentions that scientists have long believed, beginning shortly after the Miller/Urey Experiments were conducted, that the Miller/Urey Experiment did not reasonably simulate the conditions present on the early Earth. The textbook authors, for example, don’t include hydrogen in the discussion of probable early earth gases, but a hydrogen-rich atmosphere was what Miller/Urey used.

2. The textbook authors give no basis for the statement that “*Earth’s early atmosphere probably contained little free oxygen*” and never mention that such conditions would be necessary in order for chemical evolution to take place. In other words, the assumption that life first came from non-living chemicals on the early Earth makes a strongly reducing atmosphere necessary. There is much scientific evidence to suggest that the statement is not just misleading, but completely wrong.

3. The textbook authors never mention the need for Miller/Urey to remove the amino acids produced in the experiment in order to keep them from degrading. This ‘rescue’ has no correlation to early Earth conditions and is a significant omission.

4. The textbook authors point to the production of amino acids, but never mention that there is no known process by which the amino acids produced (equally right and left-handed) could be used in any functioning protein.

### **Conclusion:**

The presentation of the Miller/Urey Experiments in the textbook is yet another example of ‘selective education’ in favor of Darwinian evolution. The textbook authors owe it to students to point out the false assumptions used by these men and discuss the problems with these experiments based on current scientific understanding. Without such discussions, students are being misled as to what Miller/Urey really contributes to the prospects of the origin of life from chemicals.