**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period\_\_\_\_\_\_\_\_**

**Understanding Abiogenesis**

In 1920, Oparin and Haldane proposed a reducing atmosphere hypothesis for early earth. In 1953, Miller and Urey devised a way to test this hypothesis by recreating the proposed reducing atmosphere as well as replicating the proposed lightning energy source. The products of this experiment were biomolecules essential to life or important precursors to those molecules. This experiment provided support for Abiogenesis or life arising from nonlife.

**Biomolecules (or Precursors) Produced by Abiogenesis Experiments**

C4H7NO4

Aspartic acid

C3H7NO2

Alanine

Propane

C3H8

Glycolaldehyde

C2H6O2

C3H7NO2S

Cysteine

C2H5NO2

Glycine

Adenine

C5H5N5

Formaldehyde

CH2O

C5H11NO2S

Methionine

Fatty Acid

CH3(CH2)10COOH

1) Examine the molecules produced in the Abiogenesis experiments. Categorize their importance to life into the chart below based on the structure of each. Be sure to draw and label the molecule in each appropriate column.

\*Hints have been inserted into each column to help you.

|  |  |  |  |
| --- | --- | --- | --- |
| **Carbohydrates****(CxH2Ox)** | **Lipids****(Hydrocarbons: C backbone bonded to many H’s)** | **Proteins****(Amino Acids: Central Carbon bonded to H, NH2, COOH and variable group)** | **Nucleic Acids****(Nitrogenous bases: purines- double C & N ring, Pyrimidines- single C & N ring)** |
|  |  |  |  |

2) Why were these molecules so important to the formation of life?

|  |  |
| --- | --- |
|  | Importance to Life  |
| Carbohydrates |  |
| Lipids |  |
| Proteins |  |
| Nucleic Acids |  |

The inorganic molecules present in the Miller-Urey laboratory atmosphere (H2O, H2, CH4, NH3), are shown below.



3) Examine the chart “Biomolecules Produced by Abiogenesis Experiments” and determine for each molecule listed which molecules in Miller’s laboratory atmosphere would have come together to create these biomolecules.

|  |  |
| --- | --- |
| Biomolecule Produced | Possible Inorganic Molecules Needed to Build Biomolecule |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

Some evidence suggests that Earth's original atmosphere may have differed from the one proposed by the Urey Miller Experiment. There is abundant evidence of major volcanic eruptions 4 billion years ago, which would have released carbon dioxide (CO2), nitrogen (N), hydrogen sulfide (H2S), and sulfur dioxide (SO2) into the atmosphere.  Experiments using these gases in addition to the ones in the original Miller–Urey experiment have produced more diverse molecules.



4) Examine the molecules remaining on the “Biomolecules Produced by Abiogenesis Experiments” chart and determine if the molecules available in this revised atmosphere could have played a part in their formation.

Complete the chart for these molecules as before.

|  |  |
| --- | --- |
| Biomolecule Produced | Possible Inorganic Molecules Needed to Build Biomolecule |
|  |  |
|  |  |

5) The following are statements about the nature of science. For each, evaluate how the Miller-Urey Experiment as well as later experiments discussed supports these statements.

A) Scientific knowledge is based on empirical evidence, and is appropriate for understanding the natural world, but it provides only a limited understanding of the supernatural, aesthetic, or other ways of knowing, such as art, philosophy, or religion.

|  |
| --- |
|  |

B) Scientific knowledge is durable and robust, but open to change.

|  |
| --- |
|  |