CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

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Project Number

S0603

Project Title

The Abiotic Synthesis of Silicon-Based Life

Abstract

Objectives/Goals

This experiment was a physical simulation of a physical system. The purpose was to see if long polymers necessary in the creation of silicon-based life could be formed in conditions mimicking conditions on alien planets. It was hypothesized that if different degrees of heat are exerted on ammonium hydroxide and orthosilicic acid with 60,000 volt shocks of electricity mimicking lightning in a closed environment, then increasing temperatures will create large molecules. This experiment is inspired by the Miller-Urey experiment, but it searches for the origins of silicon-based life instead of carbon-based life.

Methods/Materials

An apparatus was created to simulate an alien atmosphere. The apparatus consisted of a 2,000 mL flat-bottom flask that was heated to three different temperatures with a hot plate, including 150°C, 250°C, and 300°C. A condenser tube to cool the top of the apparatus had cold water running through it. Every 10 minutes for 20 seconds, 60,000 volts of electricity from an induction coil ran through the apparatus, simulating lightning. Inside the apparatus were 4 mL of ammonium hydroxide and 1 mL of orthosilicic acid. The heating at the bottom and cooling at the top of the apparatus created the equivalent of a water cycle, but with ammonium hydroxide instead of water. The experiment ran for 8 hours at each temperature in a ventilation hood provided by the school's chemistry lab. Afterwards, samples were collected and put through light resistance, chromatography, and HPLC testing to determine their size.

Results

Based on three tests, it was concluded that longer molecules were formed under higher temperatures.

Conclusions/Discussion

It was found that the results supported the hypothesis that large silicon polymers would be created under higher temperatures. This experiment was a physical simulation of a physical system. Understanding that silicon polymers can be formed on conditions that may be present on alien planets answers a basic question of life in the universe: can life arise in different forms? Answering this question encourages organizations like NASA to search for other forms of life in our universe instead of just carbon-based life like ourselves. Should silicon-based life be found, it would expand our understanding of life in the universe, allow for new medicines, help create new technology using silicon, and help us understand the limits of our own carbon-based life.

Summary Statement

This experiment is a physical simulation of a physical system, the atmosphere of an alien planet, and strives to answer a basic question of life in the universe: can life arise in different forms?

Help Received

Mother and teachers helped edit the report, parent helped provide idea, Mr. Taylor provided a safe working environment and supervision, parents bought materials and provided testing sites, parent provided ammonium hydroxide