CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Kevin Zhang

Project Number
S1431

Project Title
RAF Sets and the Origin of Life

Abstract

Objectives/Goals
To determine the probability that life arises using randomized sets of "molecules", "reactions", and "catalysts". This further relies on the necessity of a RAF set (as defined in the 2010 study by Nan, Andersen and Kjaersgaard) for the arisal of life.

Methods/Materials
Computer, Java, BlueJ, Excel

Results
Sets with a larger number of molecules exhibited a smaller probability of containing a RAF set, and sets with larger numbers of reactions exhibited a larger probability of containing a RAF set.

Conclusions/Discussion
This experiment proved that smaller molecules such as amino acids and RNA are more likely to form from a set of random molecules and reactions than proteins and DNA, respectively. Most importantly, I was able to determine a mathematical basis for approaching the problem of the origin of life. My models allow me to determine the approximate probability that a certain molecule was formed given a basic set of parameters, which include the number of molecules involved, the number of reactions involved, the probability that an individual molecule catalyzes a specific reaction, and whether each reaction takes single or multiple reactants/products. Furthermore, when graphing these probabilities versus the number of reactions, I found that the slopes of each best-fit line (each line was for a given number of molecules and a given catalysis probability) satisfied a curve that almost seemed biological in nature: for small numbers of reactions, the initial growth in the slope of the graph was small, while there was a period of rapid growth near the middle of my graph, from 25-35 reactions. This rapid growth decreased sharply when approaching high numbers of reactions, approaching a limiting value (which, of course, theoretically should be 1).

Summary Statement
My project is to model the origin of life using a computer and a given set of parameters, further allowing me to approximate the probability that a specific molecule arises under these parameters.

Help Received
(none)