



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

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Project Title Environmental Changes and Species Diversity: A Numerical Simulation	
Abstract	
Objectives/Goals The objective is to understand the statistical forces that drive population diversity in the fossil record. Diversity falls during the KT extinction, but rapidly speeds up afterwards until it reaches its pre-extinction rate.	
Methods/Materials I wrote a numerical simulation program in C++ that studies the diversity of families in different environmental conditions. This simulation involves a population of animals with 1 gene that interacts with the local environment to determine the number of offspring. The program runs many generations and calculates the mean gene value and diversity in each generation. Abrupt changes in climate are modeled by changing the environmental variable. In this program, I defined Goobers, virtual, single-gene animals inhabiting a virtual landscape. The statistics of their population and gene distribution provide information on their interaction with the environment.	
Results I studied 4 different cases. 1) The 1st case has no environmental change. I ran the program for 1000 generations. I found that after 150 generations the Goobers found their optimal condition and no diversity change was detected. 2) The 2nd case has one environmental change. The environmental change was enforced after 500 generations, which caused 99% of the Goobers to die. 3) The 3rd case has four different environmental regions. The diversity steadily rises in this situation. 4) Case 4 was started with the same parameters as Case 3. After 300 generations, the environments were changed suddenly. The effect of the dramatic climate change is apparent. The number goes down then quickly recovers as new families evolve. The diversity also shows a rapid decline followed by a rapid increase to previous levels. This case most closely matched the fossil record.	
Conclusions/Discussion Many features of evolution are due to purely statistical effects, which can be modeled by simple simulations. My climate change simulation shows how to interpret the plot of diversity in the fossil record. Rising diversity indicates that the population is expanding into new niches. Sudden climate changes show decrease in diversity followed by a very rapid increase.	
Summary Statement Using computer modeling, my projects shows that punctuated evolution is a statistical process and closely related to environmental changes.	
Help Received Father taught me basic computer programming; Mother proof-read report; Mrs. Edgar-Lee supported me in entering the Regional Fair	