CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)

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Project Number

J1726

Project Title

The Race Against Resistance: How Fast Do Bacteria Become Antibiotic Resistant?

Abstract

Objectives/Goals

The purpose of this experiment is to investigate the relationship between antibiotic doses and bacteria colony longevity using a computer model programmed in a language called Python. We wanted to find out how fast bacteria become antibiotic resistant. We also wanted to know if the number of doses, and the timing of the doses affect the longevity of the bacteria colony. Our hypothesis was that the longer a bacterial infection goes untreated, the harder it is to destroy the colony.

Methods/Materials

We used Python programming software and an iMac computer running OS X. We developed a simple computer model of a bacteria colony, including random mutations that make some bacteria resistant to antibiotics. We also modeled doses of antibiotics that kill most of the bacteria. In our first program we gave antibiotic treatment every five generations after the treatment started, and tried starting the treatment at different generations. We measured the size of the bacteria colony and ratio of antibiotic resistant-bacteria to non-resistant bacteria, and saw how that ratio changed when we tried different patterns of doses. At first all our model colonies became very large, so we tried a pattern of doses that would be more likely to kill the bacteria colony, giving a dose every generation after the treatment starts.

Results

Looking at our graphs, we could tell one thing for sure: every time, the percentage of resistant bacteria and the colony size rose with every generation. When a dose of antibiotics was given every five generations, the colony almost always grew faster than it died. When we provided antibiotics every generation, it became slightly more frequent that the colony size dipped or declined all the way to zero.

Conclusions/Discussion

Our hypothesis was correct because the longer time the bacterial infection goes untreated the faster the colony grows, but the frequency of the dosage matters as well. The percentage of resistant bacteria increases very quickly from zero percent to ninety-nine percent. Our results show that bacteria colonies can quickly become resistant to antibiotics. Because of this, our project could help scientists use computers to discover new, better antibiotics that kill bacteria quickly and could, with more research and experimentation, develop a frequency that is very successful.

Summary Statement

We made a model of bacteria growth and mutation, and tested the effects of different antibiotic dosing strategies.

Help Received

Rachel Thorsett (Laura Thorsett's mom) helped us learn Python programming.