CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
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Project Number
31373

Project Title
Collapsing Cancer Cells: Exploiting the Elasticity and Natural Frequency of a Cancer Cell's Cytoskeleton

Abstract

Objectives/Goals
For many years, scientists have used biochemical and genetic based methods to analyze cancer cells. This project utilizes civil engineering principles to manipulate the elasticity and natural frequency of the tensegrity model of a cancer cell's cytoskeleton. The project takes a new approach to cancer, and uses biophysics to try and collapse the cancer cell's cytoskeleton without harming the healthy cells. The main goal is to find if applying a load equivalent to that of the cell's natural frequency to the tensegrity structure of the cancer cell cytoskeleton can make the cytoskeleton collapse.

Methods/Materials
This project utilized to modeling programs in order to model the tensegrity structures and find the natural frequency. MATLAB was utilized to model the cancer cell's and normal cell's cytoskeleton. Frame 3DD was used to conduct a modal analysis on the cells' cytoskeletons and to find the natural frequency of the cells. The same three nodes of each cells' cytoskeleton were allowed to move while undergoing modal analysis and experiencing natural frequency; that is the control. The natural frequency of the cancer cell and normal cell's cytoskeleton was found, and applied to the models.

Results
The natural frequency of the cancer cell's cytoskeleton is 131 megahertz. The natural frequency of the normal cells' cytoskeleton is 414.8 megahertz. Both cells collapsed under a load equivalent to their respective natural frequencies.

Conclusions/Discussion
Since the natural frequencies of the cancer cell and normal cell were different, if one applies the cancer cell's natural frequency to a pool of cancer and normal cells, only the cancer cell's cytoskeleton would vibrate intensively and break apart. This is important because it can enable doctors to detect cancer much more easily than by using the current methods of looking at the shapes of the cells. If applied on real cancer cells, this approach could be very significant in the path to cure cancer. This project was general because it used a general model for cancer cells, but in the future, the plan is to conduct the same experiment on specific cancer cells, such as leukemia, lung, and pancreatic cancer cells.

Summary Statement
The project is about finding the natural frequency of a cancer cell's cytoskeleton, then making the cancer cell's cytoskeleton oscillate at its natural frequency in order to make the cytoskeleton collapse, thus killing the cancer cell.

Help Received
Bought modeling programs using grant from COSMOS summer program; father helped connect civil engineering program Frame 3DD and MATLAB program together ; learned MATLAB using online teaching guides of Dr. Ellen Kuhl from Stanford University