

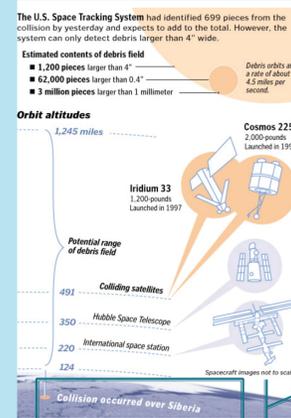
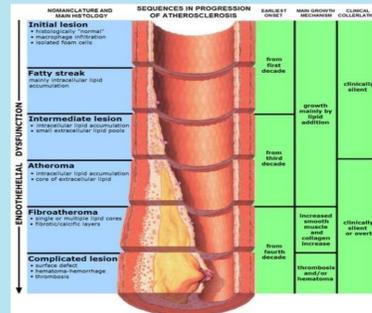
Introduction

We are aware of the pollution that we can taste, see, smell, hear and touch, but what about the pollution that we can't immediately experience with our five senses?

The focus of our research is to create and compare mathematical models in order to investigate the proliferation of space debris orbiting our planet and plaque in the arteries of the human body. We will accomplish this by using simplified models, graphing calculators, computer graphing utilities and spreadsheets.

Recognizing both the power and the limitations of mathematical models, we attempt to answer a critical question: "What would happen if the trend continues?". An equally important question: "Can we reverse the damage?"

Right: Atherosclerosis is a condition where pollution, medically termed fatty material, has collected in the arteries of the human body. Much like the act of polluting rivers and streams, this condition takes time to become a noticeable issue.



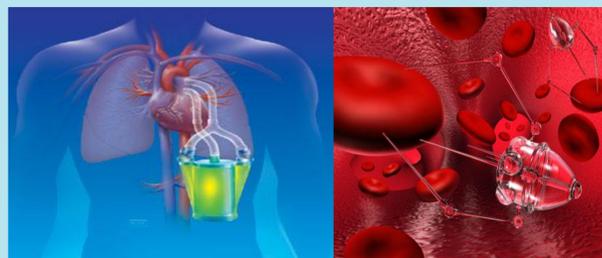
Left: Tracking orbital debris is of great importance to countries. Once the debris enters the tropospheric layer, scientists must scramble to calculate where the space junk could land, as it now takes the qualities of a meteor and can cause great damage to those below.



Method

By examining data collected from previous studies, we are able to draw conclusions about future cases mathematically. For example, the **Navier-Stokes Equation** is the primary equation for computational fluid dynamics relating pressure and external forces acting on a fluid to the response of the fluid flow. This equation is used to compute blood flow and what it should be. Thus, if abnormal it can show that the bloodstream is being slowed down by plaque in the arteries.

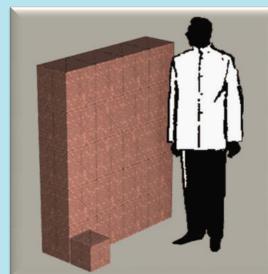
$$\frac{\partial \vec{u}}{\partial t} + (\vec{u} \cdot \nabla) \vec{u} = -\frac{1}{\rho} \nabla p + \gamma \nabla^2 \vec{u} + \frac{1}{\rho} \vec{F}$$



Above right: The nanobots being inserted into the heart. Above left: The nanobots swimming through blood stream inspecting abnormalities.

Calculating the weight of debris orbiting the earth was dependent on data samples collected by NASA during actual space exploration missions.

Right: To explain the weight of debris orbiting our earth we compare the weight of the debris to the weight of pennies. There is approximately 51 million pounds of debris orbiting Earth; that is approximately ten billion pennies. We would need to multiply these stacks 84 thousand times!



Left: Actual photo of debris orbiting Earth; NASA 2008

Results

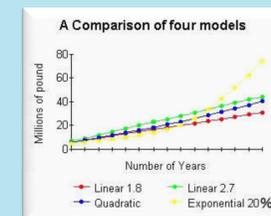
Nanotechnology gives hope for those of us whose arteries are riddled with plaque. Nanotechnology is the study of devices that are between 1 and 100 nanometers. Such devices, also known as nanobots, can enter the body through the blood stream with reported therapeutic efficacy and minimal side effects for the purpose of administration of the targeted area or precise patterning of surfaces. Two examples of nanobots are: (1) liposomes, nanotherapeutics used for treating breast cancer and unclogging arteries, and (2) the nanoscale MRI contrasts agents used to create 3-D nanoscale pictures.

Nanotechnology and nano circuits are key factors in the advancement of medicine. Using these devices could aid in early detection, diagnostics, prognostics, and the selection of therapeutic strategies to prevent cancer by detecting a broad variety of molecular signals and biomarkers in real time.



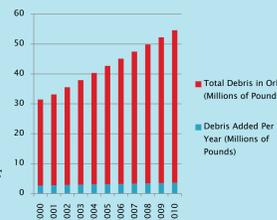
Left: A nanobot removing junk that is clogging an artery.

Space junk poses a different problem. It's accumulation will affect future space travel so scientists and various governments are trying to develop and implement a system of accountability. Without accountability, the junk orbiting our planet will undoubtedly increase and force the direction of future space explorations and permeate discussions about **man-made meteor events**.



Left: This chart compares the rates of increase using linear, quadratic and exponential growth models.

Right: Debris orbiting our planet is on the rise. For a number of years explorers have ventured beyond our local atmosphere in search of the undiscovered. However, with each trip they leave behind mission related debris that has accumulated into what is known as "space junk."



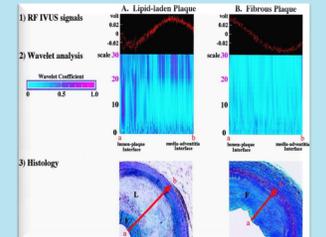
Conclusion

In building our mathematical models, we have completed these tasks:

1. We identified the problem, defined the terms in our problem and created flow charts in order to analyze the steps needed to model our respective ideas.
2. We began with a simple model in order to state our assumptions. Later we focused on particular aspects of the phenomenon of junk.
3. We utilized equations that helped us express the relationships between the variables and constants involved in our project.

Our research is ongoing; there is more to be discovered.

Right: This chart demonstrates the difference between lipid laden plaque and fibrous plaque. Using wavelet analysis we can find the difference between a healthy and unhealthy person. Notice the wavelet coefficient is significantly higher on the lipid laden plaque



Left: Physicists Albert Einstein, Hideki Yukawa and John Wheeler (l-r). "The black hole" phenomenon in space was named by Dr. Wheeler. Contributions by these and other great scientists have provided the mathematical models for predicting the behavior of junk in Earth's orbit.

Right: Syringe filled with nanobots. Thanks to nanotechnology, doctors are able to help people not only live longer but live healthier lives. What does the future hold for humans using this novel technology?



Acknowledgements

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