What does size have to do with it?

Problem: Why are cells so small?

Abstract:

Cells in our body are limited in size due to the rate of diffusion. Students will discover how surface area and volume are related to diffusion rates and how this is one of the deciding factor that makes our cells small. Students will create a GSP model based on a science lab activity "Why cells aren't big". Students will use GSP to model how surface area is related to volume, then take the data collected in GSP and create graph representations using Excel.

Students will discover that math calculations such as surface volume, volume and shrinking and stretching concepts have a lot to do with how biological systems function. Students will participate in a lab that models the diffusion of molecules through cubes of different shapes. They will take measurements to see how far a substance diffuses into different sizes of cubes (ie cell). Students will then use GSP to manipulate sizes of different objects and be able to relate how size changes surface area & volume (shrinking & stretching). Using GSP student will collect data and use Excel to create graphs. Using these graphs students will be able to relate that diffusion rates work best in biological systems and are more energy efficient in small cells in relation to bigger objects.

NYS Standards

Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

Standard 2: Students will access, generate, process, and transfer information, using appropriate technologies.

Standard 3:

Key Idea 4: Students use mathematical modeling/multiple representation to provide a means of presenting, interpreting,, communicating, and connecting mathematical information and realationships.

Standard 6

Key idea 5: Identifying patterns of change is necessary for making predictions about future behavior and conditions.

Standard 7

Key idea 1: Solving interdisciplinary problems involves a variety of skills and strategies, including effective work habits: gathering and processing information: generating and analyzing ideas: realizing ideas: making connections among the common themes of mathematics, science, and technology; and presenting results.

Standard 4

Key Idea 1

1.1a: Living things are composed of cells. Cells provide structure and carry on major functions to sustain life. Cells are usually microscopic in size.

Why use GSP?

Geometer Sketch pad was chosen because students would be able to manipulate the size of an object and see the direct relationship of the numbers as they change the size of an object. It is also a helpful tool in collecting data of several object sizes in large numbers that we could not do accurately in a lab setting. Thus using this software we could get accurate measurements of multiple sizes to get a larger sample size that would allow more accurate data and a clear set of numbers that would be easy for the students to see the relationships.

The group plan was determined and organized using the out line below.

Date	Activities	Materials Needed	Notes
Monday February 28, 2005	☺ Intro GSP ☺ Guided GSP Project ☺ Intro-what are we doing here? ☺ Game Plan ☺ Email Exchange ☺ What do you know about cells? ☺ Internet activity "what are cells, how big are they, what is their function?" ☺ What is diffusion?	☺ Tutorial on GSP ☺ Self guided activity GSP ☺ Project folders	
Thursday March 3, 2005	☺ Inro to Excel ☺ Graphing on Excel ☺ Reading Graphs	☺ Excel M&M exercise ☺ Need M&M	
Monday March 7, 2005	☺ Cell Lab	☺ Cell lab stuff	
Monday March 14, 2005	☺ GSP model of volume vs surface area ☺ Collect Data into Excel and create graphs		No meeting several students out sick
Monday March 21, 2005	☺ The Results ☺ Making Poster	☺ Poster Board	
Monday March 28, 2005	"D-Day"		

Each student worked with all teachers on each of the projects outlined. We discussed problems and concepts with all students as they arose. Each day we had an activity planned that we did with the students and discussed results as a group. Everyone did all of the work and nothing was divided up between the students to do at home. All of the work was constructed and executed after school from 2:15pm to 3:30pm.

We encountered several problems during our project, the most difficult was the lack of computer skills that our students had and time. All of our students lacked knowledge in how to use Excel and GSP. The only skills that they had were how to get on the Internet and play games. They were slow in entering data into the computer and formatting the Excel program to make charts and graphs. We had to spend a whole day on an activity where they practiced how to use Excel to chart data. We ran into several behavior problems also. One student had to be kicked out of the program for showing up late and causing chaos in the hallways on several occasions.