Challenge Project
Motion In Two Directions

Bioscience School @ Franklin
Physics Class (Mrs. Java/ Ms. Pennella)

Problem Statement:

Mrs. Java's Physic class is exploring Newton's Laws of Motion. Students must analyze two-dimensional motion. How do you calculate where an object will land based on its initial velocity? The students determine the magnitude of the displacement and decide which geometric formula to apply in order to solve their individual situations.

The students were able to choose any object: a football; bird; parachutes or volleyball to display the two-dimensional motion of an object. Working with a partner and developing the model in Interactive Physics, they had to show the coordinate starting point of the object and the initial velocity of the projectile. The students were then required to use kinematics, (branch of mechanics that deals with motion in the abstract without reference to force or mass) equations to answer the concluding questions and evaluate the results. The students use a technique of resolving vectors into components. They then apply one-dimensional form of the equations for each component. The students then combined the components to determine the resultant. By applying the Pythagorean Theorem and trigonometry functions to calculate the magnitude and direction of a resulting vector, the students would then solve problems involving relative velocity, predict the direction and magnitude of the acceleration caused by a known net force.

Then, students had to use the data from their models along with mathematical reasoning to explain the results of their project. In future classes, Mrs. Java plans on having the students manipulate data form the models to create other mathematical variations.

Justification of Software

Interactive Physics was the application chosen for this project. With the use of the coordinate plane, the display of force and two-directional motion through vectors, Interactive Physics is able to replicate real-life situations. A student is also able to utilize the data collected from the model to display the evidence of their findings and make predictions of results for variations of the model.

Definition of Problem

How do you calculate where and object will land based on its initial velocity? You must determine the magnitude of the displacement of the object traveling at a known velocity, describe the motion in terms of changing velocity and calculate the time or velocity under constant acceleration.

There were several problems to overcome in completing this Challenge Project. School related issues had to be resolved such as schedule changes for the students and teachers. Ms. Pennella had to volunteer her class preparatory time to attend Mrs. Java's physics class. Since each group of students chose their own real-life situation to create a model, they progressed at different paces having various equations to calculate.

The beginning of the project was timely. We presented a rubric for students to refer to while creating their posters and set a time frame for each aspect of the project to be completed. I would approach the project in a more structured manner by giving frequent feedback to the students for each step of the project and include a lab report to be written from each group. Although the results were recorded in the poster format, lab reports would have made the students evaluate their situations more closely and perhaps come up with various predictions.

Lack of attendance had a negative effect on their academic progress. Often one or more students were missing form a group, which impacted the productivity for that class period.

Evaluation of Results

The results of some student groups were not as successful as I had hoped for. Out of the six groups, four came up with a mathematical result to their particular model. The other two groups worked and had somewhat completed their computer models but did not have time to work the formulas nor analyze the data. Often, their group members were missing from class.

The "Perfect Serve" students asked, "What is the angle and velocity a volleyball needs to be launched in order to create a perfect serve fifteen feet from the net? Fatima and Ashley used trigonometry formula to find that the angle of elevation for the volleyball serve has to be 60 degrees. With the Vy of 9.95 m/s and a Vx of 5.75 m/s. the volleyball would move 11.5 m/s. to land in the center of the opponent's court, fifteen feet from the net.

In the "Flight of the Hummingbird" Megan, Maurice and Chrishonda asked, "If a humming bird travels at a typical rate of flight speed, what is the distance and time the bird would land on the ground?" Using velocity equals distance over time the students had to research the usual flight pattern of a humming bird. They calculated it would take the bird 4782 second or 79.7 minutes to fly a distance of 45.6 km before it landed.

The model of "War and Peace" by Raymound and Jonathon, two planes are flying towards each other. One plane is carrying food to be dropped and land on the designated target. The second plane is a fighter plane that will drop a bomb on the same target area.

Summary of Experience

This was the first time I worked with a whole class. Even though it was a small class, the groups of two to four students varied in skill and difficulty of their models. The students were not creating the same model. Because of these variables, I found it more necessary to be as structured as possible while keeping the expectations high. Both Mrs. Java and I gave more support during different points of the projects. At times, more guidance was needed to help the students' progress through the projects, and work productively in their groups. The poster rubric set the expectations and grading standards

for the posters. After the posters were made, the computer models were generated. Some students had difficulty calculating and using the formulas to answer their proposed questions. Overall, I believe that the students enjoyed learning to use Interactive Phyics to demonstrate real life situations.

This Challenge Project addressed at least six New York State math, science and technology standards. Standard 1- Analysis, Inquiry, and Design requires students to use mathematical analysis, scientific inquiry, and engineering design, to pose questions, seek answers, and develop solutions. Standard 2- Information Systems: students will access, generate, process and transfer information using appropriate technologies. Standard 3- Mathematics: students will understand mathematics and become mathematically confident by communicating and reasoning mathematically, by applying math in real-world settings, and by solving problems through the integrated study of number systems, geometry, algebra, data analysis, probability and trigonometry. Standard 4- Science: requires that students understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science. Standard 5- Technology: Students will apply technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs. Standard 6- Interconnectedness: Common Themes: students will understand the relationships and common theme that connect mathematics, science, and technology and apply the themes to these and other areas of learning. All of these standards were addressed while using Interactive Physics in the classroom.