Topic:
Process Skills- Predicting, Identifying Variables, Making Hypotheses, Measuring, Communicating, Experimenting

Grade: 4-5

Subject: Science

Objective:
 Students will be able to determine how incline affects speed and communicate results graphically.

Standards:
South Carolina State Standards
- Prediction- Use prior knowledge and observation to identify and explain in advance what will happen.
- Measure- Use standard (U.S. customary and metric) units to estimate and measure length.
- Communicate- Use drawings, tables, graphs, written, and oral language to describe objects and explain ideas and actions.

Materials:
The materials needed are for each group
- Cardboard tubes
- Stack of 10 books (textbooks preferable)
- Small marbles
- Large marble
- Meter stick
- Basic function calculator
- TI-73 Explorer
- TI Graph Link cable
- Connectivity Software
- Stopwatch
- Open space

Introduction:
Take students out to the playground and ask for four volunteers to sit on the swings. Then ask for four volunteers to push them. Have the four volunteers who are pushing the students to pull the students back at various lengths (for example, 1 foot, 2 feet, 3 feet, 4 feet). Ask the rest of the class to determine which student goes faster and swings the longest and how long it takes that student to stop. Ask students to think about why this happens as they go back into the classroom.

Content:

1.) This lesson can actually be extended to 2- 60 minute class periods. Divide students into 4-5 groups (depending on how many students are in the class).

2.) Explain that we are going to measure how incline affects speed. We are going to do this by measuring how far and how long it takes for a small marble to travel down various inclines. Each group will complete each trial 3 times (triangulation) and take the mean **time** and **distance.**

3.) Tell students that they will be measuring the distance and time at the incline of 2, 4, 7, and 10 books. One person in the group should measure the distance; one should keep time; one should roll the marble; two should do calculations. Roles should rotate with each increase in incline.

4.) Instruct students to make a prediction with their group about which height the marble will go the fastest and at which height will it go the slowest. *****It would be interesting to place the groups on space with different textures (carpet, hardwood, concrete, combination) because this would affect their predictions*****

5) Experiment and conduct trials!!! *****Teacher observes each group and walks around to monitor progress and problems.*****

6) After students have finished all trials and have calculated average time (seconds) and distance (cm), have them sit in their groups and explain what communication is (communicating results using graphs or tables to make it easier to determine results). Hand each person graph paper and explain that students can make either a bar graph or line graph. They need to make a rough draft so that when they do a computerized graph they will have an idea of what it should look like. Give out TI-73 to each group after the rough draft is completed and show them how to hook it up and use it.

7.) Allow each group to work at a computer and print out their graphs. After printing them out, allow students to explain their results, tell what problems they encountered, and how the various texture(s) of their surface affected the speed of the marble.

Conclusion:

Students should conclude that higher inclines increase speed. Relate this conclusion back to the playground activity. The student who was pulled back the farthest was the one who swung higher and longer.

Assessment:

Students will make graphs. One axis should be the incline (number of books) and the other should be distance (cm). At each point (if doing a line graph) or each bar (if doing a bar graph), the average time in seconds should be written. The height of the bars or positioning of the points on the graphs should increase steadily.

Extensions:

This activity can be applied to math in variety of ways. Students use graphs and have to learn how to communicate results effectively. Students should be familiar

with mean, median, range, and mode and should be reminded that they used mean when they calculated the average distance and time. In math, everything does not always work out the first time and sometimes it takes multiple trials to get the correct answer. Remind them that estimation was used especially when calculating the mean and transferring that number to the graph. Sometimes students will come out with numbers like 2.67 and students can round that to the nearest tenth or to the nearest whole number.