Integrating Computing Across the Curriculum

Title:	Effect of Friction	
Grade(s):	4	
Subject(s):	Science	
Author:	ICAC Team	
Overview:	During this lesson, students will investigate **friction** by measuring the distance a ball will roll on various surfaces. Using a computer, students will type a hypothesis regarding which surface has the most friction and which has the least. Then, students will measure and record their findings to determine if their hypothesis is correct.	
Content Standards:	SC (4)	4. Describe effects of friction on moving objects.
	MA (4)	14. Measure length, width, weight, and capacity, using metric and customary units, and temperature in degrees Fahrenheit and degrees Celsius.
	TC (3-5)	1. Use input and output devices of technology systems.
	TC (3-5)	2. Use various technology applications, including word processing and multimedia software.
	TC (3-5)	9. Use technology tools to organize, interpret, and display data.
	TC (3-5)	10. Use digital environments to collaborate and communicate.
Local/National Standards:		
Primary Learning Objectives:	Students will: • accurately compare relative friction levels using a tennis ball and various surfaces; • use a tape measure to accurately determine the distance between starting and ending points of the ball roll; • use Microsoft Word create a table that clearly displays the ball rolling data and includes a description of the results; • describe experimental design including a **hypothesis**, **fair test**, and **repetition**.	
Additional Learning Objectives:	Students will work cooperatively in their groups to complete the task.	
Approximate Duration of Lesson:	60 minutes	

Materials and Equipment: 5 tennis balls; 5 stations (long, flat surfaces with different textures (for example: concrete floor; carpeted floor or rug; large piece of cardboard; large poster board; cloth sheet on floor); 5 ramps (one per station, may be constructed by stacking 2 textbooks with the top book open so that its cover forms a ramp; ramps at each station must be identical); measuring tape (1 per station); round glass jar; 1 large paperclip; masking tape to mark starting line at each station; (optional: 2 small pieces of sandpaper, 2 small pieces of wax paper)

Technology Resources Needed: Computer with Microsoft Word

Background/ Preparation: Prepare the friction example by taping a large paperclip onto the side of a round glass jar, as pictured below.

Set up surface areas before beginning lesson. These surface areas may serve as "stations" for each group to rotate through. Place a strip of masking tape at one end of each station to serve as a starting point. The stations should be long, flat areas on the floor that a ball could be rolled across. These areas could be: concrete floor area; carpeted area or rug; large piece of cardboard; large poster board; cloth sheet on the ground. Identical ramps should be placed at each station. These may be constructed by stacking two textbooks with the cover of the top book opened to form a ramp.

Procedures/ Activities:

Step 1 *Introduction to Friction*

Begin by asking students if they have ever been down a water slide; then ask if they have been down a plastic slide in the summer when it's sticky outside. Which was easier to slide down? Which do you think has more friction? Which has less?

Continue introducing **friction** by asking for other examples (these may include brakes on a bicycle or rubber on the bottom of tennis shoes).

Explain that friction is a **force** that causes the motion between two surfaces to be reduced. Illustrate this by asking, would it be easier to rub two pieces of sandpaper together or two pieces of wax paper?

Step 2 *Example of Friction*

As an introduction to the activity, further illustrate the effect of friction with this example (or use other objects in the classroom to illustrate friction):

Tape a paper clip to the outside of a jar. Roll the jar along an uncarpeted floor. What do you hear? (The clicking sound of the clip will get slower and slower until the bottle stops.) What do you see? (The bottle slows down and finally stops.) What do you think would happen if we rolled this jar on a carpeted surface?

Inform the class that they will be comparing the friction of different floor surfaces by rolling a tennis ball. But first, they will prepare by creating their **hypothesis** and data table, as described below.

Step 3 *Prepare for Group Activity*

Divide the class into groups of 3-5 students each, with at least one computer for each group.

Describe to the class each surface that will be used in the activity; explain that they will be rolling a tennis ball across each surface and measuring the distance that the ball rolls each time. Ask each group to talk about which surface they think will have the most friction and which might have the least. They will be using their ideas to write two hypotheses (one for greatest amount of friction, one for least amount of friction).

Have each group open Microsoft Word and type their hypotheses. (Example:
"Hypothesis 1: The ball will roll furthest on the concrete floor. Hypothesis 2: The ball will roll the least distance on the carpeted floor.")

Step 4 *Friction Activity*

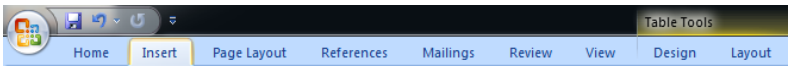
Explain to groups that they will rotate from station to station and that group members will take turns rolling the ball, taking measurements, and typing in data.
Discuss the idea of a **fair test**. How can we make sure that the ball is rolled the same way each time?

Discussions should include making sure that the front edge of the ramp is on the tape each time and that the ball is released the same way each time. Demonstrate how to roll the ball by placing it at the top of the ramp with half of the ball overhanging the edge. Hold the ball in place with one finger, and then remove your finger to release the ball (this prevents extra force from being placed on the ball).

Next, ask students how to control for differences in the roll of the ball (ball sticks at top, rolls at angle down ramp, gust of wind from open door hits ball, etc.) Students should suggest that they repeat the roll at each station several times. Discuss the importance of **repetition** in any scientific experiment. Students will need to construct a table with columns for each repetition.

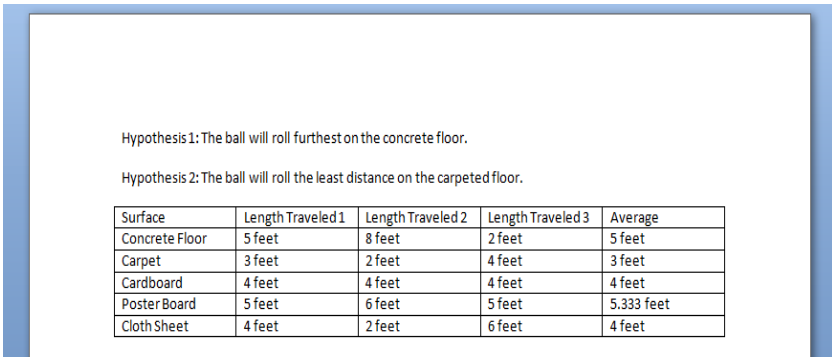
Step 5 *Creating a Table*

Before collecting data, each group needs to create a table in their **Word** document. Students should add the table below their hypotheses. To do this, first click on the "Insert" tab:



Next, click on the table matrix icon:

A dropdown menu will appear. Select the correct matrix, in this case 5x6. Now type in the labels for the different surface areas, as shown below (type headings only, not sample data).



Hypothesis 1: The ball will roll furthest on the concrete floor.

Hypothesis 2: The ball will roll the least distance on the carpeted floor.

Surface	Length Traveled 1	Length Traveled 2	Length Traveled 3	Average
Concrete Floor	5 feet	8 feet	2 feet	5 feet
Carpet	3 feet	2 feet	4 feet	3 feet
Cardboard	4 feet	4 feet	4 feet	4 feet
Poster Board	5 feet	6 feet	5 feet	5.333 feet
Cloth Sheet	4 feet	2 feet	6 feet	4 feet

Next, demonstrate how to use the tape measure to determine the distance between the starting point and the ending point. Discuss which units to use (inches, centimeters, etc.) Students will type their measurements in the appropriate box in the table. Groups may begin the activity at their assigned station and continue rotating until each group has tried every station.

Step 6 *Writing Conclusions*

When Step 5 is complete, instruct groups to look at their table and compare distances. On which surface did the ball travel the furthest? On which surface did it travel the least distance?

Have students use their data to write a conclusion. For example, "Hypothesis one is supported because the ball rolled furthest on the concrete floor. Hypothesis two is not supported because the ball rolled the least distance on the cloth sheet (not the carpeted floor). Our conclusion is that the concrete floor has the least friction and the cloth sheet has the most friction."

Students may include any other interesting data, for example, if two surfaces had the same distances recorded.

Step 7 *Wrap-up*

When all groups are finished typing their conclusion, wrap-up the lesson by having each group report on their findings. Were there any differences among groups? Why might that be? What is another way we could measure friction?

Attachments: Checklist

Assessment Strategies: See Checklist

Extension: After collecting all the information, students may combine the measurements from all groups and find the average distance for each surface. Explain that this is a good practice because more repetitions help even out skewed data (for example, if one group used a slightly different technique than other groups).

Remediation: If students struggle with measurement taking, it may be essential to have a class review (have student volunteers help demonstrate). Be sure to explain these points:
-Choose your unit of measure (i.e., feet and inches, centimeters).
-Place the "0" end of your tape at the starting point; have someone hold it in place so that it does not move.
-If using feet and inches, count the number of feet first, and then count the remaining inches (always begin counting the largest unit of measure first).

Observation Checklist

The student:	Always	Mostly	Sometimes	Never
• used the tennis ball and surfaces as instructed				
• used the measuring tape to accurately determine distance				
• worked cooperatively and positively with group				
The written assignment:	Yes	Mostly	Somewhat	Not at all
• includes a table with correct titles				
• includes a table with all data entered accurately				
• has a complete hypothesis				
• has an accurate conclusion based on data				