Name ____________________

Date ____________________

EXPLORATIONS

ACTIVITY 8

Bouncing Ball

When you drop a ball on the floor, its *rebound height* decreases from one bounce to the next. Mathematically speaking, most balls bounce in a very regular pattern. You can use percentages to determine how high a ball will rebound on each bounce and make predictions about its motion.

Objectives

In this activity you will:

♦ Create a Height-Time plot for a bouncing ball.

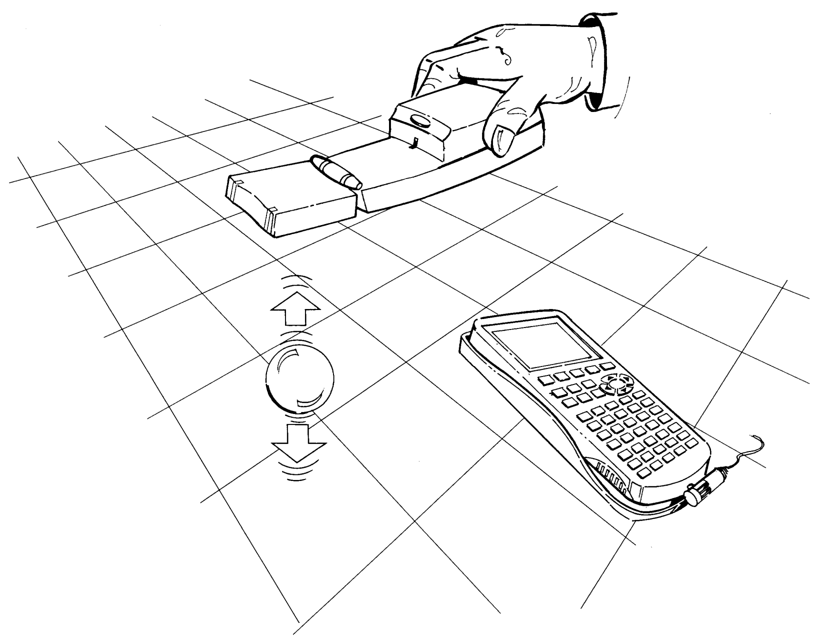
♦ Explain how the ball's height changes mathematically from one bounce to the next.

You'll Need

♦ CBR unit

♦ TI-82 or TI-83 and calculator-to-CBR cable

♦ A variety of balls to bounce (Racquetballs and basketballs work well.)



CBR Setup

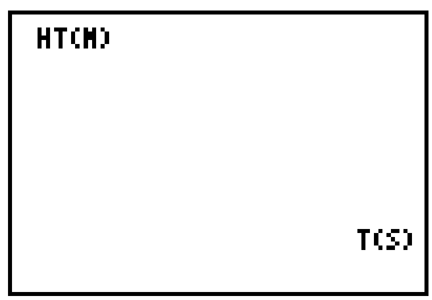
1. Connect the CBR to the calculator using the link cable.
2. Turn on your calculator. If you have not already loaded the **RANGER** program into your calculator, follow these steps:
   - **a.** Press [2nd] [LINK] [▸] [ENTER]. The calculator displays **Waiting** …
   - **b.** Press the (82/83) transfer button on the CBR.
3. Run the **RANGER** program on your calculator:
   - **a.** Press [PRGM].
   - **b.** Choose **RANGER**.
   - **c.** Press [ENTER].
4. From the **MAIN MENU**, select **3: APPLICATIONS**.
5. From the **UNITS?** menu, choose **1: METERS**.
6. From the **APPLICATIONS** menu select **3: BALL BOUNCE**.

Collecting the Data

1. Position the CBR at shoulder-height and hold the ball 0.5 meters below it, as shown in the setup diagram. Press [ENTER].
2. The person holding the ball must release it at the same time that the person holding the CBR presses (TRIGGER). When you are ready to start collecting data, press (TRIGGER). Be sure to move your hands out of the way after the ball is released.

   Your plot should show at least four complete bounces.

3. If you are satisfied with your plot, sketch your plot to the right, and then go to the next section. If not, press [ENTER], select **3: REPEAT SAMPLE** from the **PLOT MENU**, and try again.



Looking at the Results

1. Use [▶] and [◀] to move along the *ball bounce* plot you created. Record the first 4 complete bounce heights (peak y-values) in the table below. Round to 2 decimal places.

Bounce Number	Rebound Height (meters)
1	
2	
3	
4	

When you've finished tracing the data, press [ENTER]. From the **PLOT MENU**, select **5: QUIT**. Press [CLEAR].

2. How does one bounce compare to the next? To find out, look at bounce ratios. Write the ratio of the second rebound height to the first rebound height (in fraction form) in the second column of the table below. Repeat for the ratio of the third bounce to the second bounce and the fourth bounce to the third bounce.

	Bounce Ratio	Rebound Percent
$\frac{\text{Bounce 2}}{\text{Bounce 1}}$		
$\frac{\text{Bounce 3}}{\text{Bounce 2}}$		
$\frac{\text{Bounce 4}}{\text{Bounce 3}}$		

3 Express each bounce *ratio* as a *percent*. To convert a ratio to a percent, divide the top number by the bottom number on your calculator, then multiply by 100. Round your answers to the nearest whole percent. Write your results in the third column of the table above.

4. How do the rebound percents compare? Your results should be in close agreement. Use the average percent rebound to complete the following statement.

Each time the ball rebounded, its new height was ________ percent of its previous height.

5. How would the rebound percents change for a different starting height? To find out, repeat the experiment, exactly as described above. This time, use a different starting height. Summarize your results in the tables below.

Bounce Number	Rebound Height (meters)
1	
2	
3	
4	

	Bounce Ratio	Rebound Percent
$\frac{\text{Bounce 2}}{\text{Bounce 1}}$		
$\frac{\text{Bounce 3}}{\text{Bounce 2}}$		
$\frac{\text{Bounce 4}}{\text{Bounce 3}}$		

Did a different starting height significantly affect the rebound percentage? ________________________

6. Suppose that you repeated this activity using a ball that was not quite as bouncy as the first one you used. For example, if you used a basketball, imagine that some air has been let out of it. Do you predict that the rebound percent would be smaller, larger, or remain the same? Explain your reasoning.

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Test your hypothesis by comparing your group's results with the results of other groups that used different types of balls. Find one group that used a ball that was more bouncy and one group that used a ball that was less bouncy. Record their results below.

	Rebound Percent
More bouncy	
Less bouncy	

Do these results support your hypothesis? ______________________

Going Further

Answer these questions on a separate piece of paper. Show all work.

1. If the heights in this activity were measured in feet rather than meters, do you think the rebound percent would be higher, lower, or the same? Explain your reasoning.
2. If you dropped the ball you used in the activity from a height of 12 meters, to what height would it rebound on the first bounce? On the second bounce?
3. A certain ball rebounds 85 percent on each bounce. The first bounce height was 1.5 meters. Find the next three bounce heights.
4. For the ball described in question 3, how many times would it have to bounce before the rebound height would be under 50 centimeters?