BOUNCING BASKETBALLS

Introduction to the Experiment

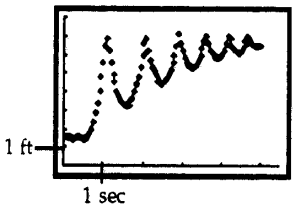
Do you know how high a basketball is supposed to bounce? Sports are big business and nothing is left to chance. In the NBA and NCAA the officials even test the basketballs to make sure that their bounce falls within regulation guidelines. The following regulation is from the NBA web page. "It shall be inflated to an air pressure such that when it is dropped onto the playing surface from a height of about 1.80 m [5.9 ft] measured from the bottom of the ball, it will rebound to a height, measured to the top of the ball, of not less than about 1.20 m [3.9 ft] nor more than about 1.40 m [4.6 ft]." In this experiment, you'll use the motion detector to investigate exactly how high a basketball bounces.

The motion detector is positioned near the ceiling (or 8-9 feet high), *above* the basketball. The ball is held above the floor, directly underneath the motion detector, then dropped. Let the ball bounce for the duration of the experiment.

Before You Start

Looking at Sample Data

The data you will collect may look like the points shown on the screen at the right. Remember that the y-value is the distance of the ball to the motion detector and that the motion detector is above the ball.



Interpreting the Sample Data

Refer to the sample graph above. If you want to generate the graph on your calculator, you will need to download and run the program BOUNDATA.

1. Circle the points that correspond to the ball coming up to the motion detector for the first time.
2. Explain how you could determine the distance between the motion detector and the floor.
3. What is the distance between the motion detector and the floor for the sample data?
4. At what time did the ball hit the floor for the first time?

[Source: Transforming Functions to Fit Data, Key Curriculum Press, 1150 65th Street, Emeryville, CA 94608, 1-800-995-MATH; http://www.keypress.com/catalog/products/supplementals/Prod_TransFunc.html]

Collecting Your Data

What You Need

Electronic data-collection device, motion detector, yardstick or measuring tape, calculator with the program BOUNCE, link cable

What You Do

Step 1 Be sure to measure any distances that might affect the experiment results.

Step 2 Attach the motion detector to the sonic port on the electronic data collection device.

Step 3 Position the motion detector about 8 feet above the floor, aimed downward.

Step 4 Connect the calculator to the electronic data-collection device; turn on the electronic data-collection device; turn on the calculator.

Step 5 Select the program BOUNCE and press ENTER to start the program. The screen should look like the one at the right.

Step 6 Say "Go" and then drop the ball. This experiment lasts for about 5 seconds.

prgmBOUNCE
GET READY
PRESS ENTER KEY
SAY GO, THEN
DROP BALL
RUNS FOR 5 SEC

When the experiment is finished, and your group is satisfied with the data, use the link cable to send lists L1 and L2, as well as Xmax and Ymax, to all the calculators in your group. To ensure that the screen on each calculator will display the same graph, set Xmin = 0 and Ymin = 0. Graph (L1, L2) using a scatter plot.

Interpreting Your Findings

1. Copy the graph on the calculator display to the screen diagram below, and record the window data. (You may use a printed copy if you have access to a computer, printer, and the appropriate like software.)

Window Values
Xmin _____
Xmax _____
Ymin _____
Ymax _____

2. There may be some points in your data plot that you think don't belong to the experiment. Circle these points.

[Source: Transforming Functions to Fit Data, Key Curriculum Press, 1150 65th Street, Emeryville, CA 94608, 1-800-995-MATH; http://www.keypress.com/catalog/products/supplementals/Prod_TransFunc.html]

3. Using your graph or data, when did the basketball reach its first peak?
4. At the first peak, how far from the floor was the basketball?
5. What was the initial drop height of the basketball?
6. What was the height of the first bounce?
7. Record the height of each bounce in the table below.

Initial height	
First bounce	
Second bounce	
Third bounce	
Fourth bounce	
Fifth bounce	

8. Find the ratio of each bounce height to the previous height, and record your results in the table below.

	Ratio
First: Initial	
Second: First	
Third: Second	
Fourth: Third	
Fifth: Fourth	

9. What can you conclude about the ratios in Question 8?
10. The data plots have peaks and valleys. Estimate the time (x-value) for each valley on the sample plot and on your plot. (For your plot, the calculator TRACE function might help.) Record these values in the first columns in the tables below.

Sample data	**Time (x-value)**	**Elapsed Time**
First valley		
Second valley		
Third valley		
Fourth valley		
Fifth valley		

Your data	**Time (x-value)**	**Elapsed Time**
First valley		
Second valley		
Third valley		
Fourth valley		
Fifth valley		

[Source: Transforming Functions to Fit Data, Key Curriculum Press, 1150 65th Street, Emeryville, CA 94608, 1-800-995-MATH; http://www.keypress.com/catalog/products/supplementals/Prod_TransFunc.html]

11. Calculate the number of seconds between successive valleys, and record your results in the appropriate columns in the tables above.
12. Determine the distance from the basketball to the floor at the first valley for the sample data and for your data.

Exploring Further

1. Make a sketch showing what you think the graph would look like if you used a basketball with less bounce.
2. Let some air out of the basketball, and try the experiment in Question 1 to see how close your prediction came to the actual results.

[Source: Transforming Functions to Fit Data, Key Curriculum Press, 1150 65th Street, Emeryville, CA 94608, 1-800-995-MATH; http://www.keypress.com/catalog/products/supplementals/Prod_TransFunc.html]