

## How High Does the Ball Bounce?

Math / Physics / General Science  
 Middle / High  
 Regressions / Data Collection / Energy

**Introduction:** This activity does not use the CASIO EA-100 Data Collector. This activity is to familiarize you with the operation of the CFX-9850G or CFX-9850Ga Plus graphing calculator. The activities that follow will use the EA-100 in the completion of the activities.

This activity will enable you to collect ball bounce data by using the CASIO CFX-9850G Color Graphing Calculator, or the FX-7400G Mini Graphing Calculator. It will also detail how to expand this activity to include a group activity in which a comparison of the data collected can be made and graphed.

The relation to the physical sciences is in the conservation of potential energy to kinetic energy and back again. Students should understand the differences and relationship between these two energies, and understand that no system is perfect, that some energy is always lost to the environment. This activity is a good way to introduce the Law of the Conservation of Energy.

**Objectives:** Students will be able to...

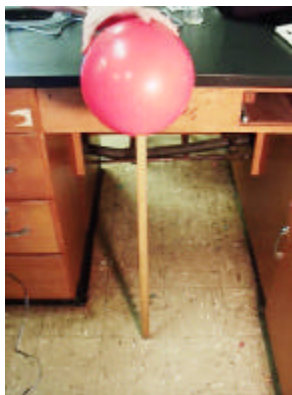
1. Collect data by following an experimental procedure.
2. Input data in a graphing calculator.
3. Compare results.
4. Draw conclusions.
5. Make predictions.
6. Discuss the relationship between potential and kinetic energy.

**Related Key Words:** kinetic energy                      potential energy                      thermal energy  
 elasticity    friction    conservation of energy

**Materials:** CASIO CFX-9850G Color Graphing Calculator  
 One tennis ball  
 One Ping Pong Ball  
 One Super Ball  
 One Meter Stick, or tape measure

**Procedures:** To collect and record the bounce height of three different types of balls dropped from various heights, follow the steps outlined below.

**STEP 1—** One person in the group should hold the meter stick straight. One person should stand in front of the meter stick so that he/she can see the ball bounce up in front of the meter stick. One person should stand to the side of the meter so that he/she will be able to drop the balls at the designated heights. The fourth person should act as the recorder



**STEP 2--**

Fill in the chart below with the data obtained from the activity. (HINT: Try a few practice drops with each ball before you record the height you want to record.)

DROP HEIGHT	TENNIS BALL BOUNCE HEIGHT	PING PONG BALL BOUNCE HEIGHT	SUPER BALL BOUNCE HEIGHT
20 cm			
40 cm			
60 cm			
80 cm			
100 cm			

**STEP 3--**

Once the data is recorded into the table, you must now enter the data into the lists in the **STAT Mode** of your calculator. Place the DROP HEIGHT into LIST 1, the TENNIS BALL BOUNCE HEIGHT into LIST 2, the PING-PONG BALL BOUNCE HEIGHT into LIST 3, and the SUPER BALL BOUNCE HEIGHT into LIST 4.

**STEP 4--**

Now that the data is entered into the lists, you must set up the graph option so that you can graph the type of graph you want. To do this press the F1 [GRPH] key. Now press F6 [SET] to set up the graphs.

**STEP 5--**

The first line on the screen reads **StatGraph1** and is highlighted. Using the down arrow, go to the next line, Graph Type, and make sure it says SCATTER. (NOTE: To change the type, use the F6 key to view additional choices and make your selection by pressing the appropriate F key.) The next line down, X-LIST should read LIST 1. The next line, Y-list, should read LIST 2. Frequency should read 1. Mark TYPE can be your choice. Graph COLOR should be BLUE. You have now set up the calculator to draw a scatter plot for the data in LISTS 1 and 2, a graph of the bounce height of the Tennis Ball.

**STEP 6--**

Use the up arrow key to return to the top of the screen. Now we must set up the next Stat-graph. Press F2 [GRPH2] to graph the second STAT GRAPH, arrow down leaving the graph type and the X-List the same. Change the Y-List to LIST 3. Leave the Frequency and the Mark Type the same. Change the Graph Color to Orange.

**STEP 7--**

Use the up arrow key to return to the top of the screen. Press F3 [GRPH 3] to graph the third STAT GRAPH, arrow down leaving the graph type and the X-List the same. Change the Y-List to LIST 4. Leave the Frequency and the Mark Type the same. Change the Graph Color to Green

**STEP 8--**

Press the [EXIT] key. In order to graph one of the STAT GRAPHS at a time simply press the corresponding F key. (F1; Graph 1, F2; Graph 2, F3; Graph 3). If you would like to graph more than one of the graphs at once, press the F4 [SEL] key. This allows you to turn on any, or all, of the STAT GRAPHS to graph at once. Do this by highlighting the Stat-Graph and press the F1 [ON] or F2 [OFF] key. The press the F6 [DRAW] key to draw all of the graphs you selected.

**STEP 9--**

To draw the line of best fit for any, or all, of the Stat Graphs pick the appropriate regression model you want to use. In this case, it would be linear [X]. Since there is more than one graph on the screen now you must pick on which graph you would like to draw the line of best fit. To do this, use the up and down arrow keys to change the selection as it appears in the upper right hand corner of the screen. Once the Stat Graph you want appears, press the [EXE] key. Now to draw the line press [F6] DRAW, or to copy the equation into the GRAPH FUNCTION menu press F5 [COPY].

**STEP 10--**

Now that we have copied the equation into the graph function menu, you can now use it do predictions of different values. Example: What is the bounce height of the Tennis Ball if it were dropped from a height of 950cm? (HINT: Use the TABLE MENU to solve this problem easier.)

The same activity can be done using the FX-7400G instead of the CFX-9850G. Some of the keystrokes differ slightly, but the calculator works in the same way.

Dave Barron of Casio, Inc. developed this activity.

Questions and Problems:

Level 1: Answer the following questions in complete, well-structured sentences.

1. How high do the balls bounce compared to the height from which they are dropped. Do any of them come back to the original height?
2. Which ball bounced the best?
3. Why do some balls bounce better than others do?
4. Predict how high the Ping-Pong ball will bounce from a height of 950cm?
5. Explain how potential and kinetic energy are related in this experiment?

Level 2:

1. Why don't the balls bounce back to the original height?
2. Explain what happens to the original potential energy from the time that it is dropped until its highest point after it bounces.
3. By what percent does the best ball bounce over the other two?
4. What would have to been done to get a ball to bounce higher than the height from which it is dropped?
5. Where does the ball have it's greatest potential energy? Kinetic energy?
6. Identify two other types of energy that can be observed when a ball is dropped?

Extension:

Drop a tennis ball and basketball side by side from the same height at the same time. What do you observe about the height of each ball?

Drop the tennis ball and basketball at the same time with the tennis ball on top of the basketball. What do you observe about the height of the bounce of each ball? Explain your observations.