

**Data Collection: Start to Finish**  
**The “Ball Drop” using TI -89, CBL2, motion detector, and DataMate**  
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**PREPARE THE EQUIPMENT**

Motion Probe → CBL-2 → TI-89



**PREPARE THE CALCULATOR**

1. Make a CBL2 folder on the calculator
  - a. Press VAR-LINK
  - b. Press **[F1]** and choose 5: Create Folder
  - c. Type the folder name CBL2
  - d. Press **[ENTER]** *twice* to create the folder
  
2. Switch to your CBL2 folder on the calculator
  - a. Press **[MODE]**
  - b. Press **[↓]** to get to “Current Folder”
  - c. Press **[↓]** to see the list of folders available
  - d. Press **[↓]** or **[↑]** to locate the CBL2 folder
  - e. Press **[ENTER]** *twice* to save the mode setting
  
3. Download the DataMate program from the CBL2 to the calculator
  - a. With the CBL2 connected to the TI-89 and the TI-89 on the HOME screen (press **[HOME]**), press the TRANSFER button on the CBL2
  - b. Wait.
  
4. Run the DataMate program on the TI-89
  - a. Either TYPE the command datamate()  
or
  - b. Press VAR-LINK (**[2nd][=]**) and choose **datamate** from the menu and remember to *type the closing parenthesis* at the end of the command
  - c. Press **[ENTER]** to execute the command.


## DataMate

The **DataMate** “Main Screen” consists of 6 menu choices:

- |          |            |
|----------|------------|
| 1: SETUP | 4: ANALYZE |
| 2: START | 5: TOOLS   |
| 3: GRAPH | 6: QUIT    |

To set up an experiment, press 1: SETUP.

Set up the sensor (if it is not an Auto-ID sensor or you want to change the units):

Press  so that the arrow pointer points to DIG:

Press .

Choose 2: MOTION (FT) by pressing the 2 key.

Set up the time for data collection:

Back on the SETUP screen, choose MODE: and press .

Press 2: TIME GRAPH to get to the TIME GRAPH SETTINGS menu.

The screen shows the current time setup.

Press 2: CHANGE TIME SETTINGS

Enter the time between samples as **0.1**

Enter the number of samples as **20**

The experiment length is therefore 1 second.

Press 1: OK on the TIME GRAPH SETTINGS screen.

Press 1: OK on the SETUP screen to return to the MAIN SCREEN.

*Warning: check, in the TIME GRAPH SETTINGS, that you are not using a ‘live’ display:  
Press 3: ADVANCED, and make sure that LIVE GRAPH is set to NONE. If it is not, press  
2: CHANGE GRAPH SETTINGS, and choose 2: NONE.*

## COLLECT THE DATA

Prepare the apparatus...

Put the motion detector 18” above the ball and the ball as far from the floor as you can *safely* reach.

Collect the data...

Press the 2: START key as the ball is dropped. At the end of 2 seconds, the GRAPH menu appears.

Graph the data...


Three items can be graphed (note the indicator on the left):

DIG-DISTANCE

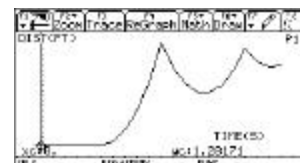
DIG-VELOCITY

DIG-ACCELERATION

Press  to see the graph of distance vs. time (in TRACE mode).

Press  to return to the GRAPH menu.

Press  or  and the  key to see the other plots.



*At this point you may want to repeat the experiment. Press 1: MAIN SCREEN to repeat the experiment by pressing 2: START on the MAIN SCREEN.*

## EDIT THE DATA

To 'crop' the data so that you have only a 'good' parabolic set of data, on the GRAPH menu, press 2: SELECT REGION.

Use  $\leftarrow$  and  $\rightarrow$  to place the cursor at the left end of the region you want.

Press  $\boxed{\text{ENTER}}$  to lock it in.

Use  $\leftarrow$  and  $\rightarrow$  to place the cursor at the right end of the region you want.

Press  $\boxed{\text{ENTER}}$ . Wait for the data to be analyzed and a new graph to appear.

## ANALYZE THE DATA

The DataMate program has analysis built into the program, so that you can perform regression analysis (curve-fit) and enter your own custom coefficients without quitting the program.

To ANALYZE the data, on the MAIN SCREEN, press 4: ANALYZE.

To fit a curve to the data, press 2: CURVE FIT and choose from the large list of choices.

For this experiment, use QUAD (DIST vs. TIME) on the second screen of choices.

## "BY-HAND" GRAPHING

Quitting the DataMate program (6: QUIT on the MAIN SCREEN) tells you where the data is stored. In addition to **L1** and **L6**, the data is also in the current Data/Matrix editor file, called **cbldata**, in the CBL2 folder you created.

To set up a stat plot of distance vs. time by hand, press  $Y=$  ( $\boxed{2\text{nd}}\boxed{F1}$ ). Press  $\uparrow$  to go up to the Plots.

Press  $\boxed{\text{ENTER}}$  to edit one of them.

For the X-list (time), enter either **L1** or **c1**. For the y-list (distance), enter either **L6** or **c6**.

*The L\* variables are lists (like the TI-83) the c\* variables are columns in the 'current' data file.*

Press  $\boxed{\text{ENTER}}$  to save the plot setup.

Press  $\boxed{F2}$  (Zoom) **9** (ZoomData) to see the graph of the data

## "BY-HAND" REGRESSION

Stat Calc tools (regressions) are built into the Data/Matrix Editor. Press  $\boxed{\text{APPS}}$  and choose the Data/Matrix Editor. Once in the editor, press  $\boxed{F5}$  (Calc).

On Calculation Type:, press  $\rightarrow$  to select the type of analysis. For this problem, choose 9: QuadReg.

Press  $\uparrow$  to move to the x..... field and enter either **L1** or **c1**. Press  $\boxed{\text{ENTER}}$

Press  $\uparrow$  to move to the y..... field and enter either **L6** or **c6**. Press  $\boxed{\text{ENTER}}$ .

Press  $\uparrow$  to move to the Store RegEq to... list. Press  $\rightarrow$  and choose a y-function to hold the equation.

Press  $\boxed{\text{ENTER}}$  to perform the regression.

At the end of the regression routine, the values of *a*, *b*, and *c* are displayed. Press Enter.

Finally, press GRAPH ( $\boxed{2\text{nd}}\boxed{F3}$ ) to see the graph of the data and the graph of the regression equation or press  $Y=$  ( $\boxed{2\text{nd}}\boxed{F1}$ ) to see the equation.

## SHARE THE DATA

To transfer the collected data to other TI-89's in the room, use the calculator-to-calculator link cable. Transfer the file **cbldata** that is in the CBL2 folder or transfer the lists **L1, L6, L7, and L8**. Remember that L1 contains time, L6: distance, L7: velocity, and L8: acceleration.

Details of linking:

1. Connect calculators.
2. Be sure that the receiving calculator has the correct 'Current Folder': CBL2 (check **MODE**)
3. Press VAR-LINK (**2nd** **[-]**) on both calculators
4. On the receiving calculator, press **F3** 2: Receive
5. On the sending calculator:
  - a. Select the file(s) you want to send by scrolling (**⬇** and **⬆**) and pressing **F4** on each file so that a check mark appears in the left edge of the screen next to the filename.
  - b. Press **F3** 1: Send to TI-89/TI-92 Plus
6. Wait.

## PRESERVE THE DATA

To save the data for a long time (DataMate always overwrites the file **cbldata**), there are two methods:

I. Use the Data/Matrix Editor:

Press **APPS** 6: Data/Matrix Editor and choose 1: Current

If the **cbldata** file is not the current file, then press **F1** and choose 1: Open and use the Open dialog box to open the CBL2 **cbldata** file.

Press **F1** 2: Save copy as... and enter a foldername and a *different* filename.

II. Use VAR-LINK to copy the file to another folder:

Press VAR-LINK (**2nd** **[-]**).

Locate the file **cbldata** in the CBL2 folder (use **⬆** and **⬇**).

Press **F1** 2: Copy

Select another folder.

Press **ENTER**

or...

Use VAR-LINK to rename the **cbldata** file:

Press VAR-LINK (**2nd** **[-]**).

Locate the file **cbldata** in the CBL2 folder (use **⬆** and **⬇**).

Press **F1** 3: Rename

Enter a new name for the file and press **ENTER**

## VIEW THE DATA

Use **APPS** **Data/Matrix Editor** to see the file **cbldata**.

Use **♦** **APPS** **Stats/List Editor** (if installed) to see the lists **L1, L6, L7, and L8**.