

Data Collection: Start to Finish
The “Ball Drop” using TI -89, CBL2, motion detector, and DataMate
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T³ . Teachers Teaching with Technology

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

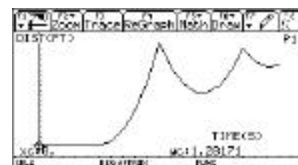
DIG-VELOCITY

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**.