

TI-73 Explorer Activity Cards

Activity 1: TI Temps - Using the TI Temperature Probe as a Thermometer

In this investigation you will set up the calculator with the temperature probe and the CBL2 to collect temperatures.

1. Turn on the TI-73 Explorer and press the **9** key to get the APPLICATIONS menu. Use the down arrow **#** to help find and highlight the *CBL/CBR APP*. When you have the APP highlighted press **b** to run it. Press any key to get past the splash screen that tells which version of the APP you have on the calculator. [Periodically check with TI Connect or the TI web page for newer versions of APPS.] From the CBL/CBR APP menu select 1:GAUGE. Either press **b** or **Y** to run the GAUGE program.
2. Set up the GAUGE program to do the experiment with the temperature probe. Do this by moving to each line with the directional arrows [**# \$ " !**], highlighting the choice for each item and pressing **b** to select it. In this investigation we want the following:
PROBE: Temp
TYPE: Bar
MIN: 0
MAX: 40
UNITS: °C
DIRECTNS: Off

The screenshot shows the GAUGE setup menu with the following settings:
PROBE: Temp Light
TYPE: Bar Meter
MIN: 0
MAX: 40
UNITS: °C °F
DIRECTNS: On Off
GO...
3. Now connect the calculator to the CBL2 and place the temperature probe into CH 1 on the left side of the CBL2. Make sure the I/O cable is pushed in snugly into both the bottom of the calculator and the CBL2 with no metal showing. When you are ready highlight the GO... option and press **b**. If you get a link error check the I/O cable, look at the connections and make sure the CBL2 has batteries or power.
4. You will now see the temperature of the tip of the probe shown on a bar. The default is to show the temperature to the hundredths place. You can control this by adjusting the MODE on the calculator before you start the *CBL/CBR APP*. Move the probe to different locations and collect the temperatures. Make sure you give the temperature probe enough time to adjust to the new surroundings.
5. Collect seven temperatures of things in the room. Place them in a table as shown below:

Item	Temperature (°C)
Milk	
Hand	
...	

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6. To stop the data collection press : **b** to stop the GAUGE program, and then press **-** **|** to return to the CBL/CBR APP menu. Press **Q** to select 4:QUIT to quit the APP and return to the Home Screen. Press : **b** a few times to remove any debris left from earlier interactions and leave you with a clean screen.
7. When you have all seven items measured and recorded, consider the nature of the items measured (solid, liquid, or gas); the room temperature (which items were hotter, which cooler); and the mean, median, mode, and range of your values.

Activity 3: Ray-Bans or Ban Rays? – Using the Light Probe

In this investigation you will set up the calculator, the light probe and the CBL2 to compare different sunglasses for their ability to block out light.

1. Turn on the TI-73 Explorer and press the **9** key to get the APPLICATIONS menu. Use the down arrow **#** to help find and highlight the *CBL/CBR APP*. When you have the APP highlighted press **[ENTER]** to run it. Press any key to get past the splash screen that tells which version of the APP you have on the calculator. [Periodically check with TI Connect or the TI web page for newer versions of APPS.] From the CBL/CBR APP menu select 1:GAUGE. Either press **b** or **Y** to run the GAUGE program.
2. Set up the GAUGE program to do the experiment with the light probe. Do this by moving to each line with the directional arrows [**# \$ " !**], highlighting the choice for each item and pressing **b** to select it. In this investigation we want the following:

PROBE: Light
TYPE: Meter
MIN: 0
MAX: 1
UNITS: mW/cm²
DIRECTNS: Off

PROBE: Temp **Light**
 Volt Sonic
TYPE: Bar **Meter**
MIN: 0
MAX: 1
UNITS: **mW/cm²**
DIRECTNS: On **Off**
GO...

- We set the GAUGE this way since we want to collect light intensities that range from 0 to 1 milliwatts per square centimeter displaying the values on a Meter to simulate a light meter. We leave the directions off, but some will want them on the first time they set up the investigation.
3. Collect about 7 different pairs of sunglasses for this experiment. We also will need a DC light source. A flashlight will do, but we need to set it up so that the position and direction of the light won't change over the different trials. When you have all of the equipment at hand, highlight the GO.... Option and press **|** to start the data collection.

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4. For the experiment position the end of the light probe so that it points at the light source. Move it toward or away from the light until you get a reading of around 0.8. Secure the light probe so that it won't move or change direction over the different trials. Place the center of one of the lenses of the first pair of sunglasses over the end of the light probe. Hold things steady until the level stabilizes and then press **f** to record a Comment. We will just code the glasses with numbers [1, 2, 3...] so quickly (right after you press **f**, press **Y** for the 1st pair of glasses). Record this reading in a table like the one below and continue on. If you take too long to enter the comment you may lock up and have to start over. Repeat this process for each pair of sunglasses.

Glasses	Code	Light Level
Green Ray-Bans	1	
SAM's House of Dark	2	
The Red Glass	3	

5. When you have collected all the data (with no more than 7 pairs of glasses), press **:** to stop the GAUGE program, and then press **-** **I** to return to the CBL/CBR APP menu. Press **Q** to select 4:QUIT to quit the APP and return to the Home Screen. Press **:** a few times to remove any debris left from earlier interactions and leave you with a clean screen.
6. Now to help determine which pair of glasses does the best job, we will set up a plot. Press **-** **e** to get the STAT PLOTS screen. Select Plot 1 with your cursor and press **b**.
7. Press **b** to highlight On. This turns the plot on.
8. Press **#"** to move to the bar graph and press **b** to select it.
9. For *CategList*, choose the LCMNT list. Press **-** **v** and use the arrow to move down to LCMNT and press **b** to select it. Do the same for *Datalist1* but this time select the list named LIGHT. Select *Hor* to get horizontal bars and *1* since we have just data set of light intensities.
10. Press ***** to get the graph and then **)**. To move over the different pairs of glasses use the **\$** and **#** keys. Which pairs is best and how much better is it?

Activity 5: A Battery of Batteries – Using the Voltage Probe

In this investigation you will set up the calculator, the voltage probe and the CBL2 to look at the effect of the number of batteries in a line on the total voltage. You will need several (3 or 4) of the same kind of batteries (AA, AAA, C, D) and a way to line them up, like in the groove of a ruler or in the fold of a book.

1. Turn on the TI-73 Explorer and press the **9** key to get the APPLICATIONS menu. Use the down arrow **#** to help find and highlight the *CBL/CBR APP*. When you have the APP highlighted press **b** to run it. Press any key to get past the splash screen that tells which version of the APP you have on the calculator. [Periodically check with TI Connect or the TI web page for newer

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versions of APPS.] From the CBL/CBR APP menu select 1:GAUGE. Either press **b** or **Y** to run the GAUGE program.

- Set up the GAUGE program to do the experiment with the voltage probe. Do this by moving to each line with the directional arrows [**# \$ " !**], highlighting the choice for each item and pressing **b** to select it. In this investigation we want the following:

PROBE: Volt
TYPE: Meter
MIN: -7
MAX: 7
UNITS: Volt
DIRECTNS: Off

PROBE: Temp Light
Volt Sonic
TYPE: Bar Meter
MIN: -7
MAX: 7
UNITS: Volt
DIRECTNS: On **Off**
GO...

We set the GAUGE this way since we want to collect voltages that range from -7 to 7 volts displaying the values on a Meter to simulate a voltmeter. We leave the directions off, but some will want them on the first time they set up the investigation.

- Place one battery in the holding area and press one end of the exposed metal of the voltage probe on one end of the battery and the other lead on the other end of the battery. With constant pressure on the battery, press **b** to select the GO... option to start the GAUGE. If you get a Link Error, check your connections and the CBL2 for batteries.
- When the voltage level stabilizes, record this value in a table like the one below and quickly press **b** to add a Comment. In this case quickly press **Y** to represent one battery. Repeat this process for two batteries, lined up tip to tail. Note that the value you get might be negative, depending on which end of the battery got the red or black lead.

Number of Batteries	Voltage
1	
2	
3	
...	

- When you have all of the data you want press **:** to stop the GAUGE program, and then press **- |** to return to the CBL/CBR APP menu. Press **Q** to select 4:QUIT to quit the APP and return to the Home Screen. Press **:** a few times to remove any debris left from earlier interactions and leave you with a clean screen.
- Now to help determine what is happening to the voltage as we add batteries. Looking at the data table, what do you think is happening?
- Let's set up a plot to help better show the relationship. Press **- e** to get the STAT PLOTS screen. Select Plot 1 with your cursor and press **b**.
- Press **b** to highlight On. This turns the plot on.
- Press **# "** to move to the bar graph and press **b** to select it.

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10. For *CategList*, choose the VCMNT list, which is the number of batteries. Press **- v** and use the arrow to move down to VCMNT and press **b** to select it. Do the same for *Datalist1* but this time select the list named VOLT. Select *Vert* to get vertical bars and *I* since we have just data set of battery types. Press ***** to get the graph and then **)**. To move over the different number of batteries use the **"** and **!** keys. What can you say about the pattern? Does this support what you had thought before? You can add other types of batteries like AA, and D if you get the data in a list with a different name and use the same pattern in the VCMNT list.

Activity 7: Measuring Up - Using the CBR (Motion Probe) to get the length

In this investigation you will set up the calculator with the CBR to collect distances.

1. We want to set the CBR motion probe to collect lengths for us in meters. We will also measure these lengths in inches with a tape measure. From this data we will discover the relationship between the two units of measure.
2. Turn on the TI-73 Explorer and press the **9** key to get the APPLICATIONS menu. Use the down arrow **#** to help find and highlight the *CBL/CBR APP*. When you have the APP highlighted press **b** to run it. Press any key to get past the splash screen that tells which version of the APP you have on the calculator. [Periodically check with TI Connect or the TI web page for newer versions of APPS.] From the *CBL/CBR APP* menu select 1:GAUGE. Either press **b** or **Y** to run the GAUGE program.
3. Set up the GAUGE program to do the experiment with the CBR (Sonic) probe. Do this by moving to each line with the directional arrows [**# \$ " !**], highlighting the choice for each item and pressing **b** to select it. In this investigation we want the following:

PROBE: Sonic
TYPE: Bar
MIN: 0
MAX: 4
UNITS: m
DIRECTNS: Off

PROBE: Temp Light
Volt **Sonic**
TYPE: Bar Meter
MIN: 0
MAX: 4
UNITS: **Ft**
DIRECTNS: On **Off**
GO...

- We set the GAUGE this way since we want to collect distances in meters that range from 0 to 4 meters. Note that the CBR can't record distances less than 0.5 meters directly. We will display the values on a Bar to simulate a ruler. Leave the directions off, but note that some will want them on the first time they set up the investigation.
4. Now connect the calculator to the CBR with the I/O cable. Make sure the cable is pushed in snugly into both the bottom of the calculator and the side of the CBR with no metal showing. When you are ready highlight the GO... option and press

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- b** . If you get a link error check the I/O cable, look at the connections and make sure the CBR has good batteries.
5. You will now be seeing the distance from the “eye” of CBR to the closest object in the cone of sound it sends out. If the distance is less than 50 cm you might be getting spastic readings. To do this investigation you might want to use the CBR clamp to help hold the probe steady. We want 7 lengths that span the 0.5 to 4 meter lengths. Select an item to measure and hold the CBR so that it is measuring that distance. For example the length of a table could be reported by placing the CBR at one end of the table with its eye pointing toward the other end. At the edge of the other end of the table, place a book for the signal to bounce off of. Hold everything steady until you get a constant reading. The reading will vary a small amount if you have it set up correctly. If the reading jumps a major amount, you probably are picking up another item, like something on a table. Make sure the length that is reported makes sense to you (estimate).
 6. When you get a reading to use, make note of it in a table like the one below and press $\text{[} \text{}$ on the calculator to capture that reading. Add a Comment that is an abbreviation or short name for the item (maximum is 6 letters). To put in the comment press $- \text{ [t]}$ to get to the Text Editor. Move over the letters with your arrow keys [$\$ \# ! "]$ to find the needed letters and the press $\text{[} \text{}$ to select the letter. Move on to each letter and press $\text{[} \text{}$ to pick it. If you make a mistake press $\text{[} \text{}$ to cancel one letter at a time until you get back to the correct point in the word. When you are done record the name used for the comment on the table and then highlight the word Done and then press $\text{[} \text{}$ to return to the GAUGE screen. Then press $\text{[} \text{}$ again to return to the interactive data measuring mode. Before you move on to the next item, measure the same length with your tape measure in inches. Record this value in your table. Move on to a second item and repeat the process until you have all 7 measures. [Note: Be careful as you move from one location to the next, common problems are disconnecting the devices or accidentally pressing a button.]

Item Name	Comment	Meters	Inches
Table Width	TABLEW	2.57	100
...			

7. When you have all of the data you want press $:$ to stop the GAUGE program, and then press $- \text{ [I]}$ to return to the CBL/CBR APP menu. Press [Q] to select 4:QUIT to quit the APP and return to the Home Screen. Press $:$ a few times to remove any debris left from earlier interactions and leave you with a clean screen.
8. The data that the calculator collected is in the list DCMNT for the comments and DIST for the meter measures. You will need to add the list of measures in inches. Call this list INCH. To do this, press $- \text{ [I]}$ to get to the CATALOG. Move to the ‘S’ area by pressing $- \text{ [t]}$ to get to an abbreviated Text Editor. Move with the arrow keys to the ‘S’ and press $\text{[} \text{}$ to pick it. This jumps you to the

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'S' words in the catalog. Move down **#** to get to SetUpEditor and while pointing at it press **|** to pick it. Now get the list names you want to look at. Press

- **v** to get the list of lists and then move down **#** to get to the DCMNT list. Press **|** to pick it and then put in a comma [**i**]. Repeat the process to get the list named DIST and then add another comma. Then create the list INCH by accessing the Text Editor [- **t**] and then press **|** with the word Done highlighted. Press **|** to set up the List Editor. Press **3** to access the List Editor and look at the lists. Since the INCH list was just created, you will need to move over to that column and add the lengths in inches that you collected. Make sure your measures match up with the meters and the item names.

9. Your goal now is to determine a number that you could use as a multiplier of the METER list to get the INCH list. Once you have this number determined, place it in the place of the M in the equation $Y = MX$ and key it into the Function Editor by pressing **&**. Note that the Y will be Y1 and that you can access the letter X by pressing **|**. Move to the left of the Y1 symbol and press **|** until you get the Bubble Baby with tail. If you get excited when you achieve the Bubble Baby and press **|** again, just keep pressing **|** until you achieve the Bubble Baby again.
10. Set up a Scatter Plot of the data as shown below. Press - **e** **|** to set up Plot 1. Press **C** **J** to automatically set up the plot and see how close your line comes to the data. How did you do? Use the Convert Menu to see the Truth about the relationship between Meters and Inches.



Activity 8: Making Shapes - Using the CBR (Motion Probe) to create different shapes

In this investigation you will set up the calculator with the CBR to collect position as time goes by.

1. When the RANGER program controls the CBR we can move objects in front of it (moving toward and/or away) to make shapes. We would like to explore how the motion of an object in front of the motion detector relates to the distance vs. time plot produced.
2. Now connect the calculator to the CBR with the I/O cable. Make sure the cable is pushed in snugly into both the bottom of the calculator and the side of the CBR with no metal showing.

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3. Turn on the TI-73 Explorer and press the **9** key to get the APPLICATIONS menu. Use the down arrow **#** to help find and highlight the *CBL/CBR APP*. When you have the APP highlighted press **b** to run it. Press any key to get past the splash screen that tells which version of the APP you have on the calculator. [Periodically check with TI Connect or the TI web page for newer versions of APPS.] From the CBL/CBR APP menu select 3:RANGER. To do this either move down to the appropriate line and press **b** or press **C** to run the RANGER program. If you get a memory error, quit and clean up your calculator. Either delete files or go to the TI Connect software on a computer and back up files you need, and then delete them from the calculator. Press **- Y Z** to check your memory and manage your files on the calculator.
4. Press **f** to pass the splash screen and choose 2:SET DEFAULTS from the MAIN MENU by pressing **Z**. This puts the program in the default mode. As you experiment with shapes you may want to adjust the settings. If you want any time different than 15 seconds for data collection, you will need to change the REAL TIME option to NO. You adjust the setting by pressing **f** to get different opportunities when you are on a particular parameter.
5. We are now ready to get a graph. Place the CBR so that it points at the object that will move. You might want to use the clamp to make things steady. Make sure the pointer is pointing at START NOW and press **f** when ready. For the first graph try to make a letter from the alphabet. Plan the moves of the object before you press **f** again to start. When you hear the sounds and the lights start moving the object to make the letter. Note: if the object gets within 50 cm of the eye of the CBR you will get noise and a bad graph.
6. If you are happy with the results show it to your teacher and/or connect to the graph link with the computer and TI Connect to get a copy of the graph/letter. If you are not happy you can repeat the event after you press **f**. Either way, when ready you will press **f** to get to the next screen.
7. From the PLOT MENU select your option by pressing the number associated with it. For example you would press **C** to do the experiment again.
8. Can you make other letters? Can you make numbers? Why can you make some shapes and not others?
9. For the bold try making the profile of famous shapes like the Gateway Arch in St. Louis, or the White House in DC. How about the Washington Monument? Mt. Rushmore. Take your best shot!
10. When you are finished exit the program by selecting the Quit option when it appears. If you leave the program restart it as you did at the start using the *CBL/CBR APP*.