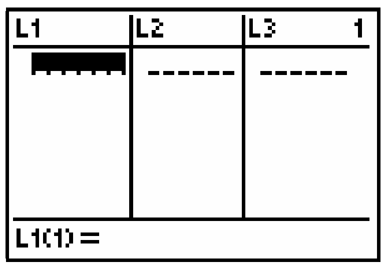
Introduction to the TI – 83+ Graphing Calculator

Lists:

Graphing calculators store data in **lists**. Pressing the ϖ button can access these lists. This will give you a screen that looks like this:

Once in this screen, use the arrow keys **(~ |)** to highlight the **EDIT** function and select **1:Edit**. This will bring you to the lists screen:

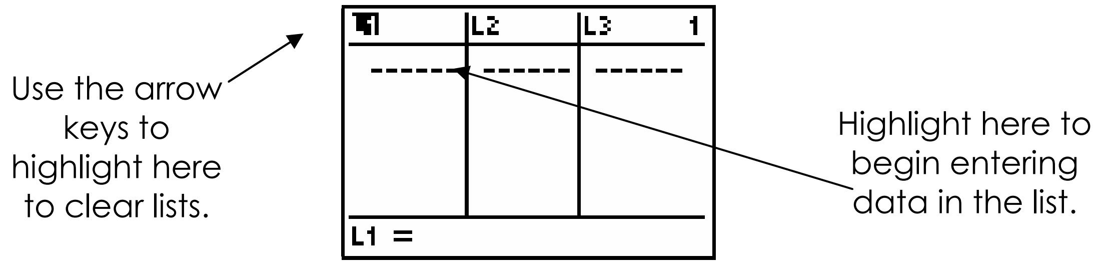


You can create up to 20 lists in the list editor.
Six lists are pre-named (L1 – L6). You can define more lists and name them with numbers or text. Each list can have up to 999 elements or data points.
You cannot rename lists 1 – 6. You can create a new list and name it anything you want. A list name can be 1 to 5 characters long. The first character must be a letter. Characters 2 – 5 can be any combination of letters or numbers
At the middle school level, the pre-named lists are usually sufficient.

To clear data from lists:

1. Press –
2. Press MEM (the ∴ key)
3. Press **4:ClrAllLists**. This clears all lists so you can start fresh with new data. Press β.

4. You can also clear the lists by using the arrow keys (~ |)to highlight the List you want to clear, and pressing ‘ , then β.



<u>To enter new data into lists:</u>

1. Traditionally, **L1** is used for the independent variable, and **L2** is used for the dependent variable. A LabPro™ will send data to the calculator this way.
2. Use the arrow keys (~ |) to highlight the first empty space in a list.
3. Enter the number into the list. Press enter after each number.

<u>To remove a number from the list:</u>

1. Highlight the number, Press / (Delete).

<u>DIM Error or DIM mismatch</u>:

1. When this message appears on the calculator screen, your lists do not have an equal amount of data in each,

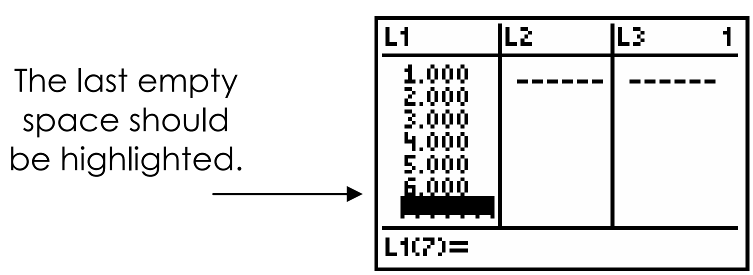
<u>Using Lists for arithmetic or statistical operations:</u>

There are two general methods

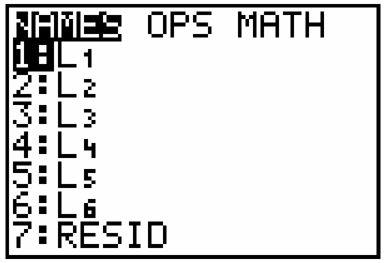
<u>General Instructions for Adding the Numbers in a List:</u>

Method 1:

1. Enter data into **List 1** (any empty list can be used)
2. Use arrow keys (~ |) to move to the bottom of the list.

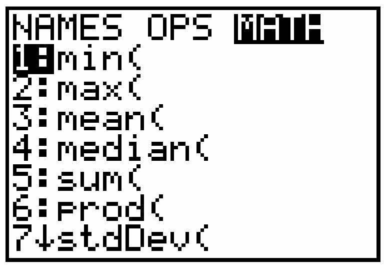


3. Press –, then [LIST] (the ϖ key). Your calculator screen will look like this:

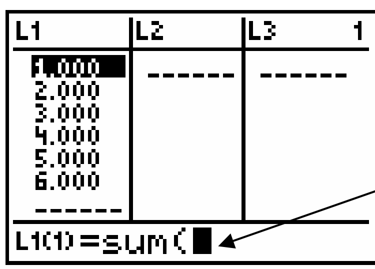


4. Use the arrow keys (~ |) to highlight **MATH**. You will see a selection of mathematical operations from which to choose:

The ↓ indicates that there are more choices. Use the # to see them.

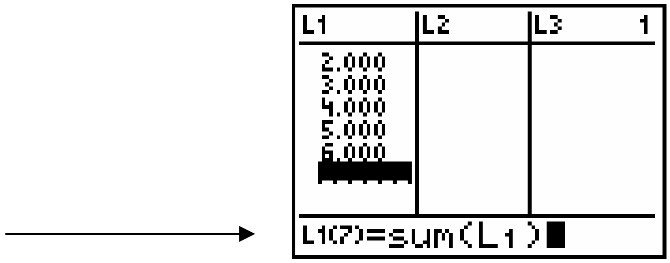


5. Select **5 : sum(** by using # to move to 5 and pressing β, or by simply pressing P on the calculator.
6. The calculator screen will show **sum(** followed by a flashing cursor:



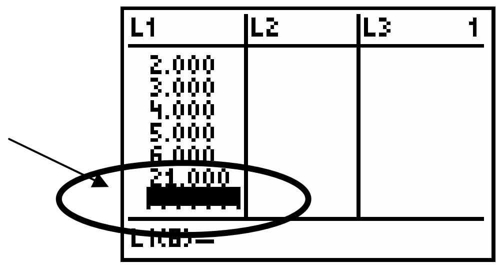
Flashing cursor appears here.

7. Enter List 1 by pressing – , then [L1] (the 1 button) Press E to close the parentheses.



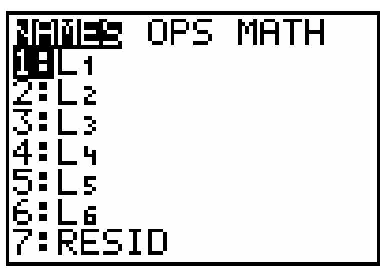
8. Press β. The sum of the list will appear on the screen in the last empty space in the list.

Sum of list displayed here.



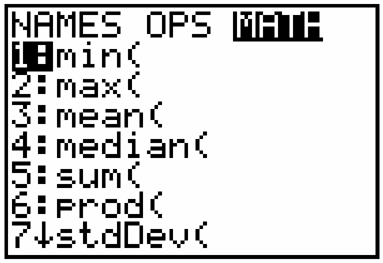
Method 2:

1. Enter data into **List 1** (any empty list can be used)
2. Use # to move to the bottom of the list.
3. Clear the home screen by pressing –, then [QUIT] (the z key)).
4. Press –, then [LIST] (the ϖ key). Your calculator screen will look like this:

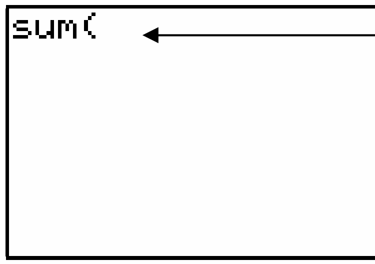


5. Use the arrow keys (~ |) to highlight **MATH**. You will see a selection of mathematical operations from which to choose:

The ↓ indicates that there are more choices. Use the # to see them.



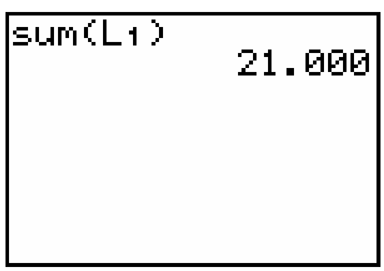
6. Select **5 : sum(** by using # to move to 5 and pressing β, or by simply pressing P on the calculator. Your calculator screen will look like this:



A flashing cursor will appear here.

7. Enter List 1 by pressing –, then [L1] (the 1 button) Press E to close the parentheses.

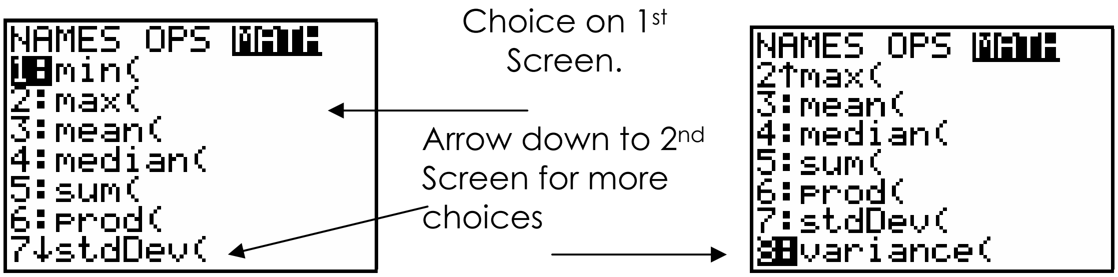
8. Press β for the answer.



The answer will display on the screen.

<u>To perform other arithmetic or statistical operations on numbers in a list:</u>

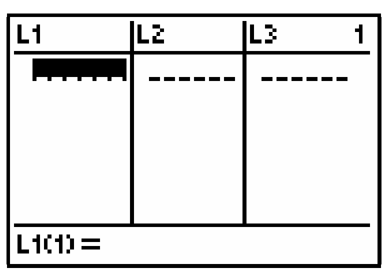
1. Repeat the steps in either method 1 or 2
2. Select appropriate operation from the **Math** menu



<u>Step – by – step example:</u>
Find the *average* of these data using method 1:

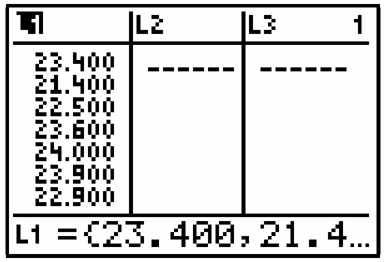
Group #	Distance in cm	Group #	Distance in cm
1	23.4	**6**	23.9
2	21.4	**7**	22.9
3	22.5	**8**	22.7
4	23.6	**9**	23.1
5	24.0	**10**	23.4

1. Clear all lists - Press – , Press MEM (the ∴ key). Press **4:ClrAllLists**. This clears all lists so you can start fresh with new data. Press β. Or, you can also clear the lists by using the arrow keys (~ |)to highlight the List you want to clear, and pressing ‘ , then β.
2. Press ϖ. Select **1:EDIT**. Use #to highlight the first space under **L1** (List 1).

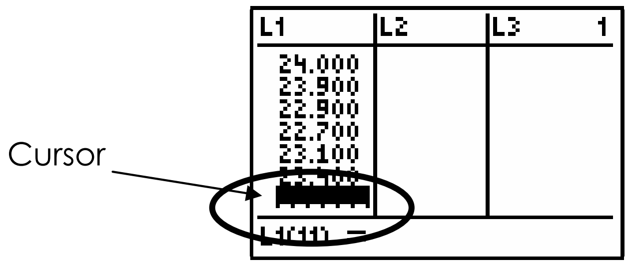


3. Enter 23.4. Press β.
4. Enter 21.4. Press β.

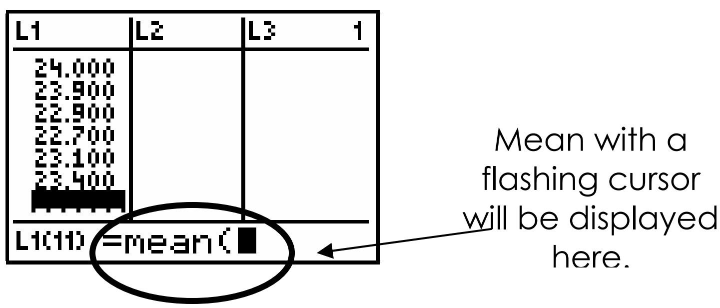
5. Continue until all data is entered



6. The cursor should be at the bottom of the list, if not, use #to move to the bottom

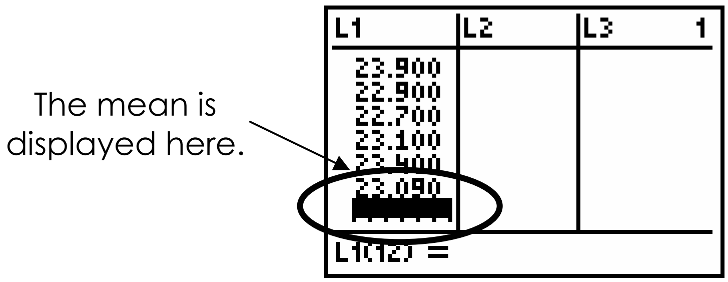


7. Press –, then [LIST] (the ϖ key).
8. Use the arrow keys (~ |) to highlight **MATH**.
9. Select **3: mean(** by using # to move to 3 and pressing β, or by simply pressing [on the calculator. Your calculator screen will look like this:



10. Enter List 1 by pressing – , then [L1] (the 1 button) Press E to close the parentheses.

11. Press β. The mean of the list will appear on the screen in the last empty space in the list.



12. Try it again using method 2 - Enter data into **List 1** Use # to move to the bottom of the list.
13. Clear the home screen by pressing –, then [QUIT] (the z key)).
14. Press –, then [LIST] (the ϖ key).
15. Use the arrow keys (~ |) to highlight **MATH**.
16. Select **3: mean(** by using # to move to 3 and pressing β, or by simply pressing [on the calculator.
17. Enter List 1 by pressing –, then **[L1]** (the 1 button) Press E to close the parentheses.
18. Press β for the answer.

Graphs:

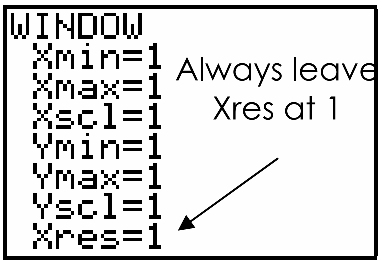
The TI – 83+ will make 5 different types of graphs or plots:

- Scatter plot
- XY line graph

- Box plot
- Modified box plot
- Histogram

General Instructions for Making a Graph:

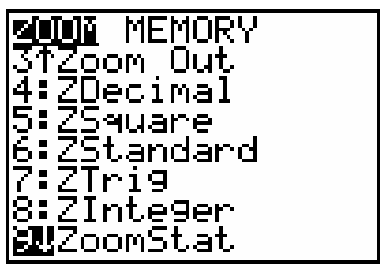
1. Enter data into the calculator
2. Establish the viewing area for the graph –
   - Press p to manually set the viewing area



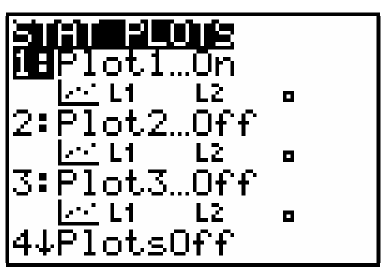
Xmin is the minimum number on the x - axis.
Xmax is the maximum number on the x - axis.
Xscl is the scale on the x - axis.
Ymin is the minimum number on the y - axis.
Ymax is the maximum number on the y - axis.
Yscl is the scale on the y - axis.

--- OR ---

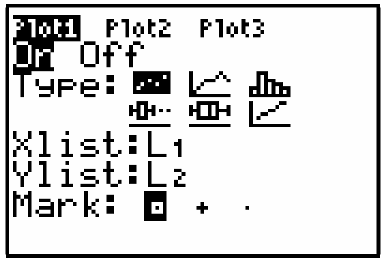
- Press q ; #to **9: ZoomStat** to automatically set the window (a good option for middle school)



3. Plotting the graph
   - Press –, Press [STAT PLOT] (the o button)
   - Select **1:Plot 1,** Highlight "**On**" to turn graph on.



- Press β. # to select **Type**:
- Press β



- Continue to arrow down to choose the features and select lists for the type of graph you have chosen.
- Use ~ | to choose your mark. Press β.
- Press s .

4. To trace your graph, press r and use the ~ | to move around the graph

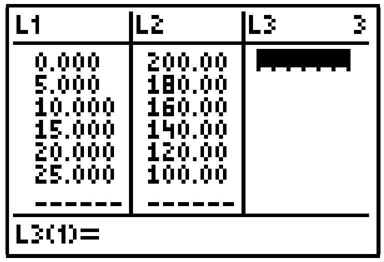
Step – by – step example:

Plot this data on an *x-y line graph*:

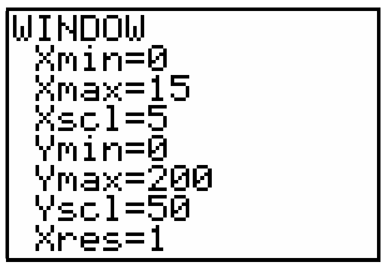
Time after exercise (min)	*Heart rate after exercise*
0	*200*
5	*180*
10	*160*
15	*140*
20	*120*
25	*100*

1. Enter the time data in List 1
   - Use ~ | to highlight **List 1**
   - Enter **0**, press β
   - Enter **5**, press β
   - Continue until all data is entered
2. Enter the heart rate data (responding variable) in List 2
   - Use ~ | to highlight **List 2**
   - Enter **200**, press β
   - Enter **180**, press β

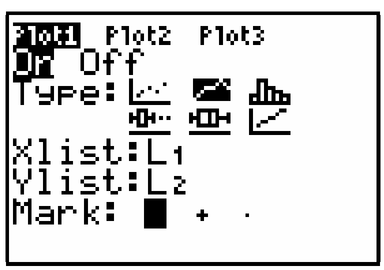
   - Continue until all data is entered



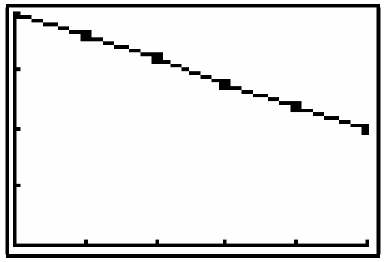
3. Establish a viewing area for the graph, Press **p**
   - The **Xmin** is 0, the lowest number on the X-Axis
   - The **Xmax** is 25, the highest number on the X-Axis
   - The **Xscl** is 5, or the scale you wish to use on the X-Axis
   - The **Ymin** is 0, the lowest number on the Y-Axis
   - The **Ymax** is 200, the highest number on the Y-Axis
   - The **Yscl** is 50, or the scale you wish to use on the Y-Axis
   - Leave the **Xres** at 1



4. Press –, Press [STAT PLOT] (the o button)
5. Select **1:Plot 1.** Highlight **On**. Press β
6. Use ~ | to choose x-y line graph (**2nd icon**). Press β
7. Choose the mark you want to use. Press β



8. Press s



9. Press r . Use ~ | to read the exact coordinates for each point on the graph.

To use ZoomStat to view the graph:

10. After the data is entered, Press –, Press [STAT PLOT] (the o button)
11. Highlight **ON**, press β
12. Use the ~ | to highlight the line graph icon (the second icon)
13. Use the ~ | to move to Xlist. If the calculator does not read **Xlist:L1**, press 2nd, L1 (the 1 key).
14. Use the ~ | to move to the Ylist. If the the calculator does not read **Ylist:L2**, press –, L2 (the Z key).
15. Use the ~ | to select the mark you wish to use for your graph.
16. Press q
17. Select **9:ZoomStat**

Name______________________________

Reaction Time I

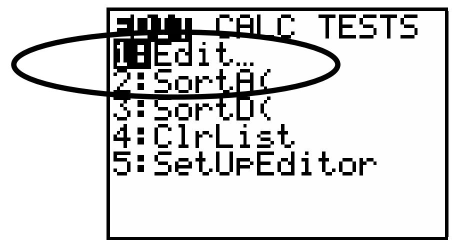
Materials:

30 cm metric ruler TI 83/83+ Graphing calculator

Procedure – Part 1:

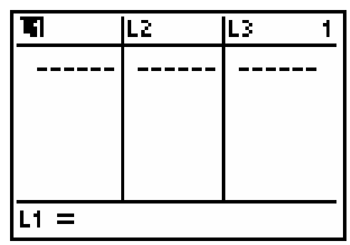
1. Work with a partner.
2. Set up your calculator to collect your data:
    a. Press ϖ.

Choose **1:Edit** →



    b. Select **1:Edit**

Clear the lists if needed. Use the arrow keys (~ |) to highlight the List you want to clear, and pressing ‘ , then β.



3. Hold the 30 cm end of the ruler with your thumb and forefinger (pointing finger) so that the 0 cm end of the ruler is pointing towards the ground.
4. Have your partner put their thumb and forefinger on either side of the ruler, ***without touching the ruler***, at the 0 cm end.
5. Drop the ruler and have your partner catch it as quickly as possible as it falls.
6. Enter the distance the ruler dropped in List 1.
7. Repeat 9 times for a total of 10 trials.
8. Delete the highest and lowest numbers in your list by using # ∃ to highlight the numbers and pressing /.
9. Find the mean (average) of your data:
    a. Press –, then [LIST] (the ϖ key).
    b. Use the arrow keys (~ |) to highlight **MATH.**
    c. Select **3: mean(** by using # to move to 3 and pressing β, or by simply pressing [on the calculator.
    d. Enter List 1 by pressing –, then [L1] (the 1 button) Press E to close the parentheses.
    e. Press β**.** The mean of the list will appear on the screen in the last empty space in the list.
10. Record your mean in the data chart.

11. Switch jobs with your partner and repeat the procedure.
12. Record the means of your classmates in the data chart.

Data Part 1:

Class Data			
Name	**Mean**	**Name**	**Mean**

Were all of the means the same? Why or why not? Explain your results:

____

____

____

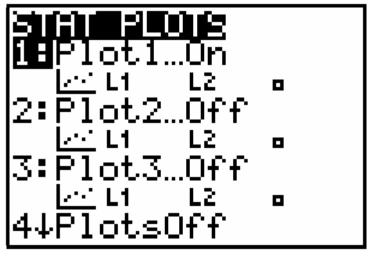
____

____

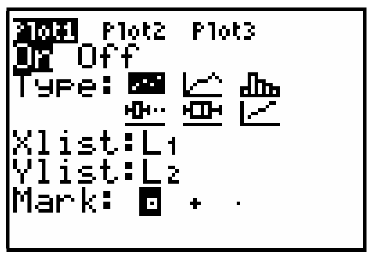
Procedure – Part 2:

1. Clear List 1 and enter the class means into it.

2. Use the Distance / Time data sheet to find out the time it took to grab the ruler, and enter that data into List 2.
3. Create a scatterplot of the data:
   a. Press –, Press [STAT PLOT] (the o button)
   b. Select **1:Plot 1,** Highlight “**On**” to turn graph on.



   c. Press β. # to select **Type**: Select scatterplot (the 1st icon). Press β.



4. Use # to move down the screen. Use ~ | to choose the mark you want to use on the graph. Press β.
5. Press q ; #to **9: ZoomStat**. Your scatterplot will be shown on the calculator screen.

Data – Part 2:

Distance / Time Data Sheet			
Distance (cm)	**Time (sec)**	**Distance (cm)**	**Time (sec)**

1	0.05	16	0.18
2	0.06	17	0.19
3	0.08	18	0.19
4	0.09	19	0.20
5	0.10	20	0.20
6	0.11	21	0.21
7	0.12	22	0.21
8	0.13	23	0.22
9	0.14	24	0.22
10	0.14	25	0.23
11	0.15	26	0.23
12	0.16	27	0.23
13	0.16	28	0.24
14	0.17	29	0.24
15	0.17	30	0.25

Sketch your scatterplot below:

What does the shape of the graph tell you about the data?

Reaction Time II

Background Information: Sensory neurons get information from the environment and send it to the brain or spinal cord. This information is called a stimulus. A stimulus is any change in the internal or external environment that causes a response. Sights, sounds, temperature, and smells are all stimuli. Motor neurons take messages away from the brain and spinal cord. They tell muscles to contract or relax. Motor neurons provide a response to stimuli. The speed that a person reacts to an external stimulus is called reaction time.

The Task:

Design an investigation to explore stimulus – response and reaction time.

Think About:

What do you already know?

What would you like to find out?

How will you find out what it is you want to know?

What To Do:

Decide what question you want to answer.

Develop a hypothesis for the question.

Design an investigation to test your hypothesis.

Record your results.

Draw a conclusion.

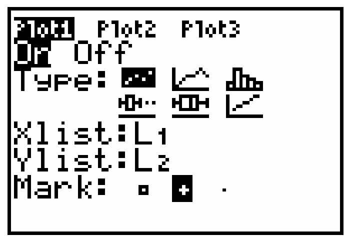
Share your investigation with the rest of the class.

Calculating a Mathematical Model:

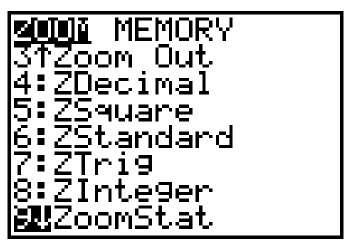
The graphing calculator can be used to compute a linear regression and draw a line of best fit.

General Instruction for drawing a line of best fit:

1. Enter all data for **X** in **L1**.
2. Enter all data for **Y** in **L2**.
3. Check your data to make sure your coordinates are paired.
4. Press –, Press [STAT PLOT] (the o button).
5. Select **1: Plot 1**. Select **On**. Press β.
6. # to the scatterplot (the first icon). Press β.
7. Check to make sure the **Xlist** is **L1** and the **Ylist** is **L2**.
8. Select the **mark** that will indicate the type of point you want for the graph.

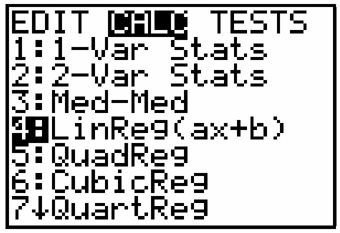


9. Although we can manually set the window to fit the graph, we will let the calculator do it for us:
   Press q , Select **9: ZoomStat**



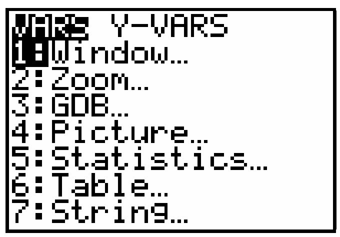
10. If the trend of the graph is linear, that is, looks like it should be a straight line, then:

11. Press ϖ . Arrow to **CALC**.

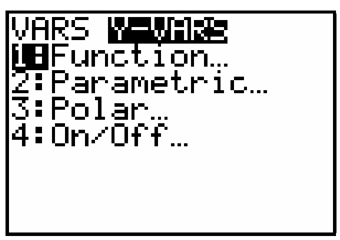


12. Select **4:LinReg (ax + b)** The calculator screen should read:

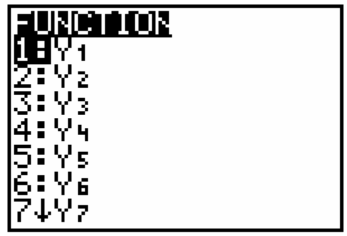
13. Press }.



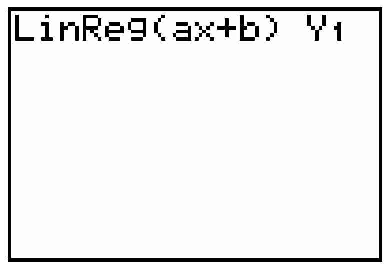
14. **Arrow** to **Y-Vars.** Select **1:Function.**



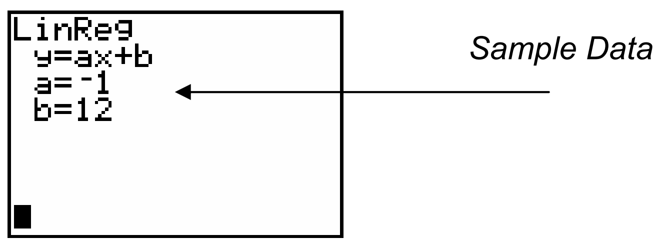
15. On the **FUNCTION** screen, select **1: Y1**,



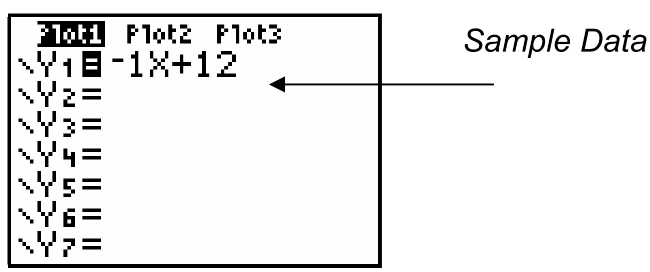
16. The calculator screen will display:



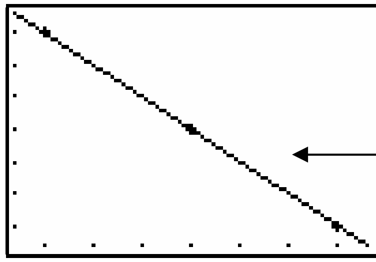
17. Press β. This will give you the values for a and b in your linear equation in the form of y = ax + b.



18. Press &. This will give you the equations with the a and b values in it.

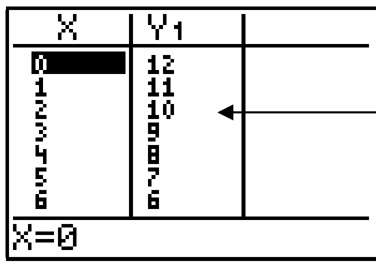


19. Press ∗. The calculator will show the data points and line.



Sample Data

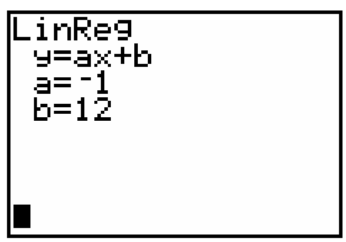
20. Press –. Press ι (the ∗ key).   You can arrow down to extend the graph or extrapolate *based on the linear equation, not the lists*.



Sample Data

The Line of Best fit can also be drawn without going through the algebra:

1. Follow steps 1 – 17, until you come this screen:



2. Press   q   , select **9:ZoomStat**, and the line will be drawn on the screen.

Introduction to the LabPro™ Data Collection Interface

The LabPro™ can be used several ways: with a Texas Instruments graphing calculator, with a computer, or as a stand-alone data logger.
The LabPro can be used with 4 AA batteries or an AC power adaptor.
When you use the AC adaptor, the LabPro runs through a self-test – you hear a series of beeps and see blinking lights at a successful start up.

Using the LabPro™ with a Graphing Calculator:

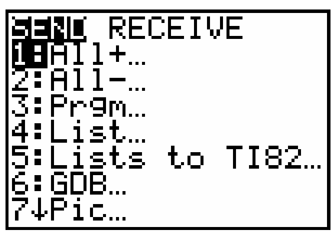
Set up the calculator and LabPro:

1. Slide the calculator cradle on to the LabPro until it snaps into place.
2. Put the upper end of the calculator into the cradle, press down on the lower end until the calculator snaps into place.
3. Plug the link cables into the bottoms of the LabPro and calculator.

Installing calculator programs or applications (apps):

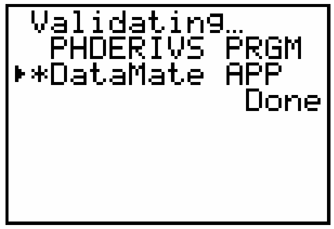
The LabPro comes with the DataMate program stored in it. The program is probably not on your calculator, so it will have to be transferred from the LabPro to the calculator:

1. Set up the calculator to receive the program:
   a. Press y , then [LINK].



   b. Use ~ to select **receive**.

   c. Press β. The calculator is now waiting to receive information.
2. Press the **Transfer** button on the LabPro. (Left button). The calculator screen will show the programs being loaded.
3. When the program is finished loading this screen will be displayed:



4. Double check that the programs have been loaded by pressing 8 on the TI – 73 and 83 and 9 on the TI – 83 +.

Other programs such as CHEMBIO, PHYSCI, and PHYSICS can be downloaded from the Vernier website (http://www.vernier.com/) using a TI GraphLink cable. These programs are very easy to use.
There are also programs written for specific lab activities that are available from several different websites and Texas Instruments resource CD's. Instructions for downloading and installing these programs can be found in the appendix.

Connecting probes & sensors:
There are two different types of sensors: analog and digital. Analog sensors include temperature probes, force sensors, and pH sensors. You can use up to 4 analog probes / sensors at one time with the LabPro. The 4 jacks for these sensors are labeled CH1, CH2, CH3, CH4.
Digital sensors include the motion detectors and photogates. You can use up to 2 digital probes / sensors at one time. The 2 jacks for these sensors are labeled DIG / SONIC 1, DIG / SONIC 2.

Always use the lowest numbered jack available.

Older probes, like those used with the original CBL's may need an adaptor to be used with the LabPro. These can be purchased for about $5.00 from Vernier.

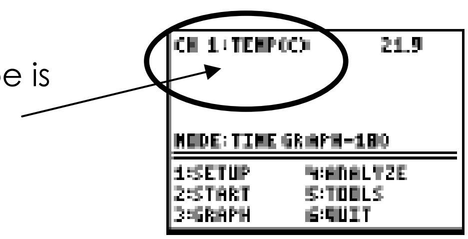
Collecting data:
General instructions for collecting data -

1. Plug the probe you wish to use into CH1 or DIG / SONIC1.
2. Press 8 (TI- 73, TI - 83) or 9 (TI – 83+)

3. Select **DataMate**. *It may not be 4*, the location will vary depending on what other programs are loaded in the calculator. The calculator will display this screen:

4. The calculator is able to automatically identify some sensors. If communication with the LabPro is successful you will see this screen:

Temperature probe is automatically detected.

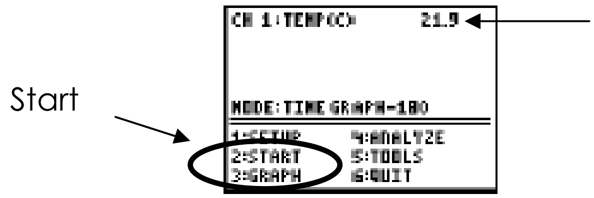


5. If any type of error messages appears, double check all connections.

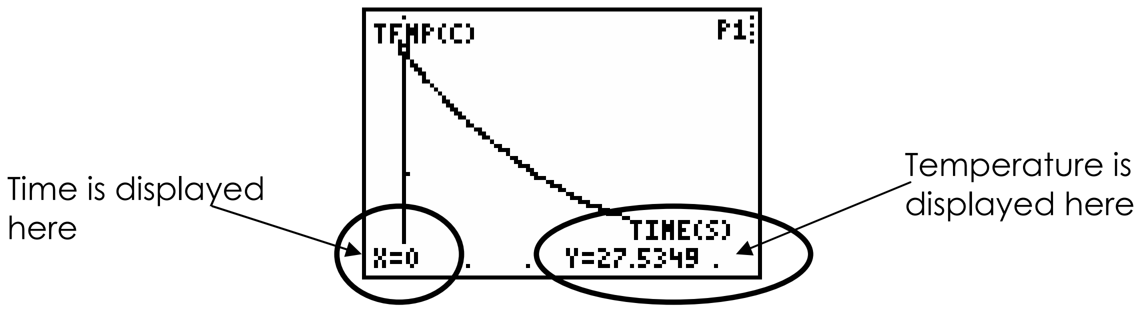
Step-by-step example:
Use the temperature probe to find the temperature of the air, your hand, and water.
1. Put a temperature probe into CH1 of the LabPro.
2. Press 8 (TI- 73, TI - 83) or 9 (TI – 83+)
3. Select **DataMate**
4. The program will set up the experiment for 180 seconds.

5. Select **2:Start** to begin.

Current temperature reading displayed here.



6. A graph will appear on the calculator screen as the data are collected.
7. Data collection can be stopped at anytime by pressing Ξ.
8. When the data collection is finished, a scaled graph will be displayed in the calculator screen:



9. Use ~ | to trace along the data points along the graph.

*Name*_______________________________

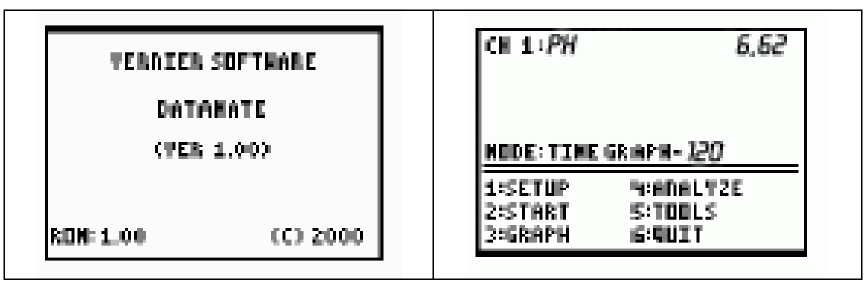
Cellular Respiration

Materials:

LabPro with pH sensor
Beaker
Straw
Graphing Calculator
Distilled water
Indicator Solution

Procedure:

1. Pour 100mL indicator solution into the beaker.
2. Use the straw to blow into the solution for 1 minute. Observe & record any changes.
3. Replace the used indicator solution with 100mL of fresh solution.
4. Jog IN PLACE for one minute.
5. Use the straw to blow into the solution for 1 minute. Observe & record any changes.
6. Pour 100mL of distilled water into the beaker.
7. Put the pH sensor in the water.
8. Set up the LabPro to collect pH data:
    a. Put the pH probe into CH1 of the LabPro.
    b. Turn the LabPro & calculator ⊥ .
    c. Press 9 Select DataMate.



9. Take the sensor out of the bottle, place it in the beaker of water. Select 2:Start on the calculator and use the straw to blow into the solution for 120 seconds. Observe the graph created on calculator.
10. Use ~ | to trace along the data points along the graph.
11. Replace the water with 100mL of fresh distilled water.
12. Jog IN PLACE for one minute.
13. Repeat the data collection.

Data:

Create a chart or table to record your observations:

Analysis:

Respiration and breathing are not the same thing. **Breathing** is the movement of the chest that brings air into the lungs and takes away waste gases. When we breathe in, or inhale, the air that comes into the lungs has oxygen. Oxygen goes from the lungs into the circulatory system because there is less oxygen in the blood than there is in the lungs. Remember osmosis? Osmosis happens when molecules move from an area of high concentration to an area of low concentration. Oxygen goes from the lungs in to the blood by osmosis. This is called **gas exchange**. Then the blood carries the oxygen to cells all over the body.

At the same time, the digestive system sends glucose from digested foods to the same cells. The oxygen and glucose combine in a chemical reaction to make energy. This chemical reaction is called **cellular respiration**.

This reaction cannot take place without oxygen.

Carbon dioxide and water molecules are waste products of cellular respiration.

Carbon dioxide & water are carried back to the lungs in the blood. Exhaling, or breathing out, takes the carbon dioxide and some water out of the body.

The chemical formula for respiration looks like this:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

1. Why does your body need oxygen?

   ____

   ____

2. Describe respiration in your own words.

   ____

   ____

3. How do waste products get into the blood?

   ____

   ____

4. Describe the basic function of the respiratory system.

   ____

   ____

5. Why would a single-celled organism not need a respiratory system?

   ____

   ____

6. Does exercise affect the amount of carbon dioxide (CO_2) our respiratory systems produces? Use evidence to support your answer.

   ____

   ____

   ____

   ____

7. What was the independent variable in both experiments?

   ____

8. What was the dependent variable in both experiments?

   ____

9. Which experiment produced the best data? Explain your answer.

   ____

   ____

Using the LabPro™ with a Computer:

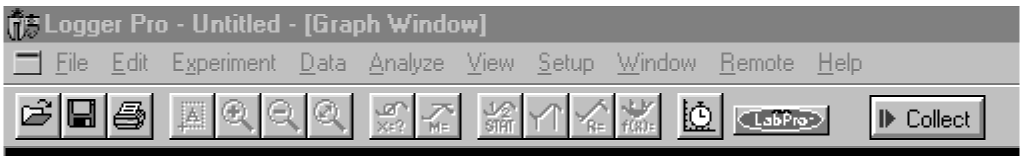
To use a LabPro with a computer, Logger *Pro* software must be installed on the computer.

Setting up to use Logger *Pro*:

1. Connect the LabPro to the computer.

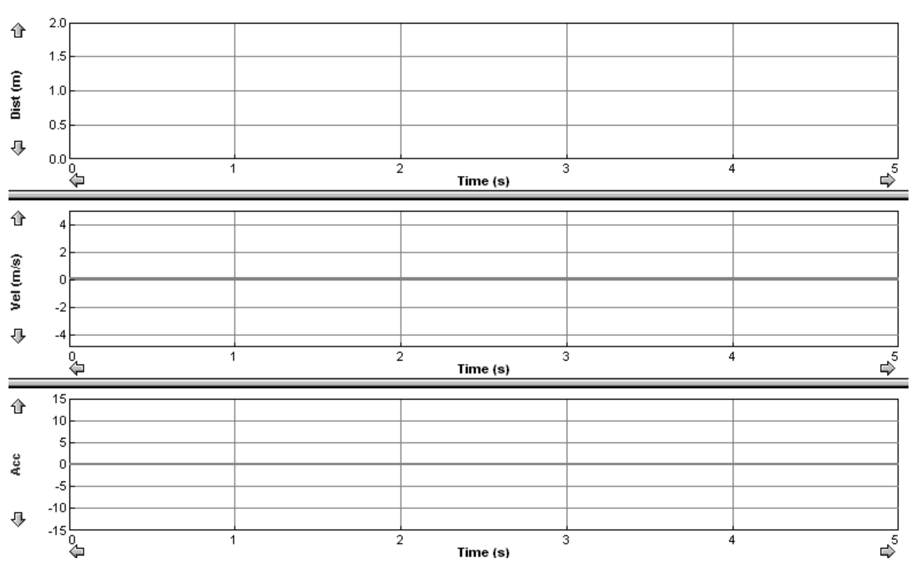
a. If you are using a serial port – connect the LabPro end of the serial cable to the **|o|o|** port on the LabPro and the other end to the computer.
b. If you are using a USB port – slide back the door to the USB port on the LabPro and connect the end of the USB cable to the LabPro and the other end to the computer.

2. Plug the probe you wish to use into **CH1** or **DIG / SONIC1**.
3. Open the Logger *Pro* program.
4. You will see this toolbar:



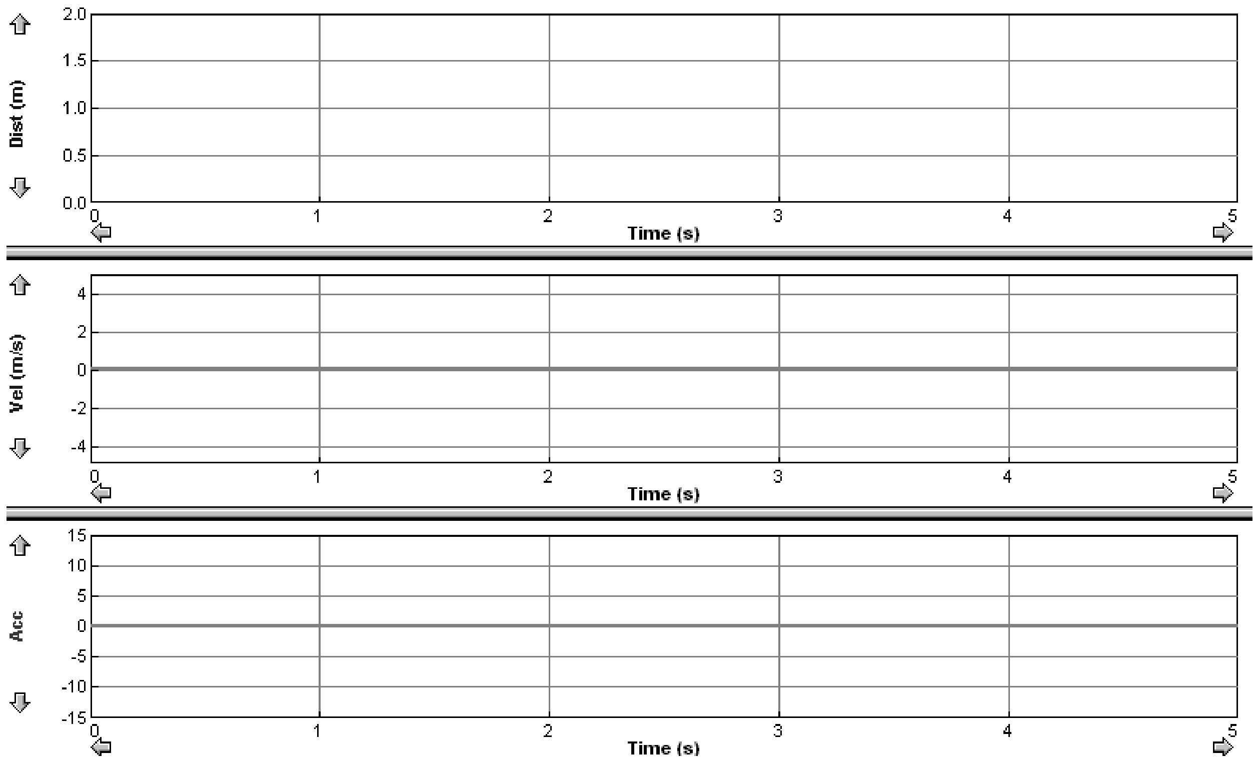
and an appropriate screen for the sensor / probe you are using, if an Auto-ID probe is connected to the LabPro.

This is the screen that will be displayed when the motion detector is connected to the LabPro.



<u>Step-by-step example:</u>

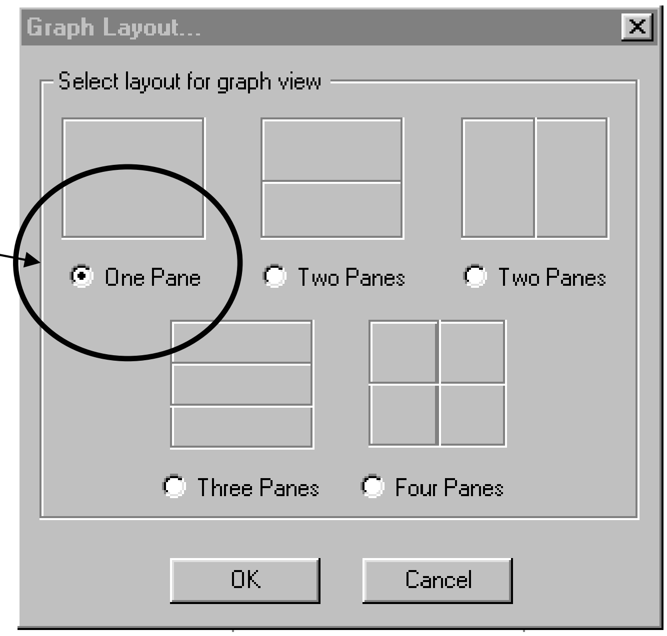
1. Connect the LabPro to the computer.
2. Connect a motion detector to the LabPro. Use the DIG / SONIC port.
3. Open the Logger Pro program. The program will Auto – ID the sensor and display this screen:



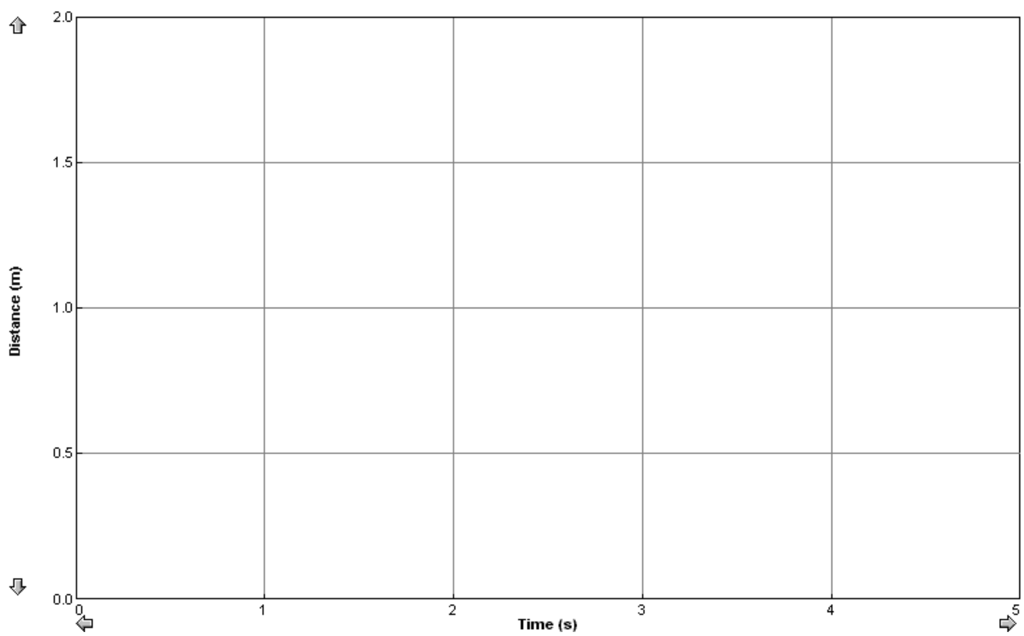
4. Go to **View**, then **Graph Layout**:

5. Choose the **One Pane** option, click OK

Choose this option



6. A distance / Time graph will be displayed:

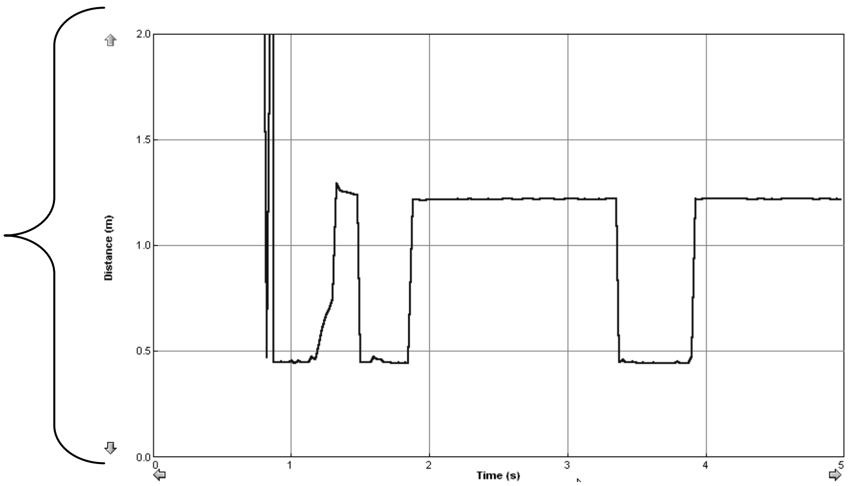


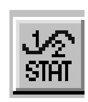
7. Place the motion detector on a level surface so that nothing is moving in front of it.

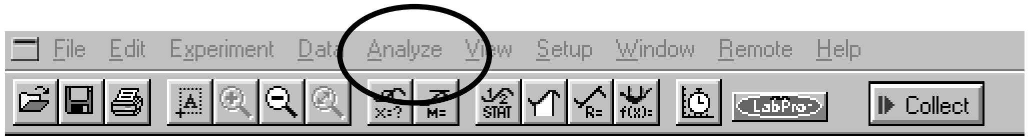
8. Click the **Collect** button to begin collecting data:

9. Move the motion detector around, a distance graph will be displayed on the screen.

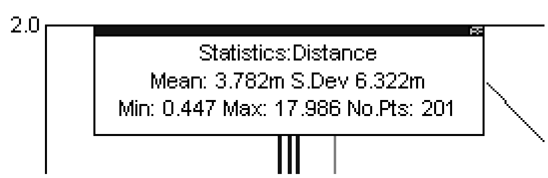
Sample Graph



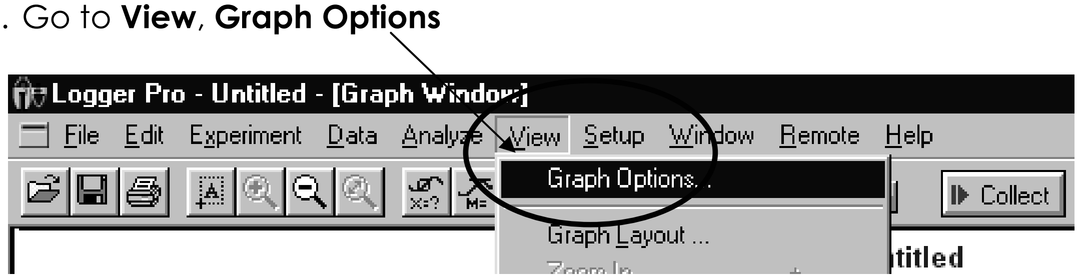
10. Click **Analyze**, then **Statistics** or click on 



11. The statistics for the data will be displayed at the top of the graph:

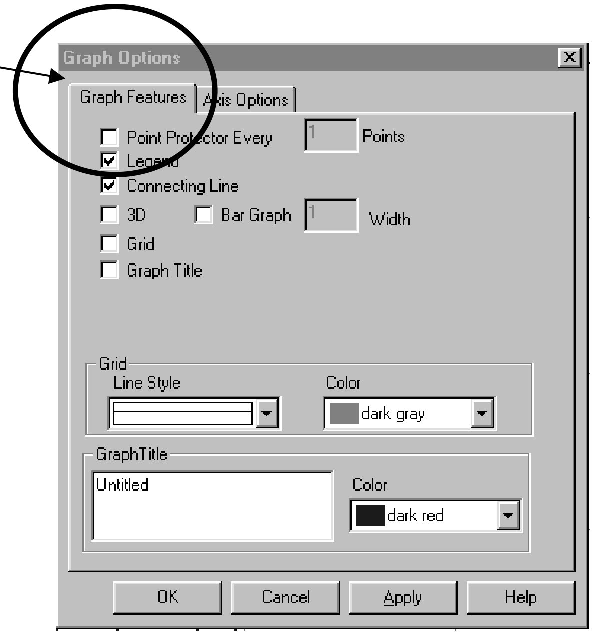


12. Go to **View**, **Graph Options**



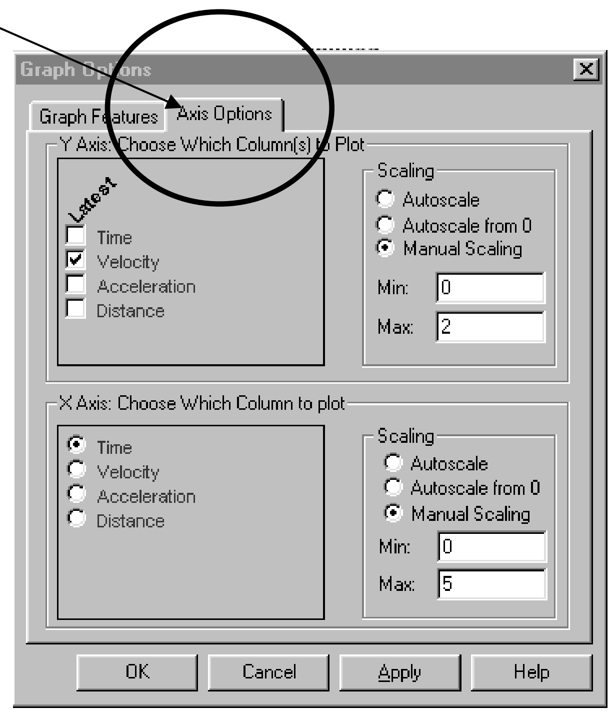
13. You will see a dialog box with options for your graph, make sure the Graph Features tab is selected:

Explore the Graph Features by checking and unchecking the different boxes.



14. Select the Axis Options tab:

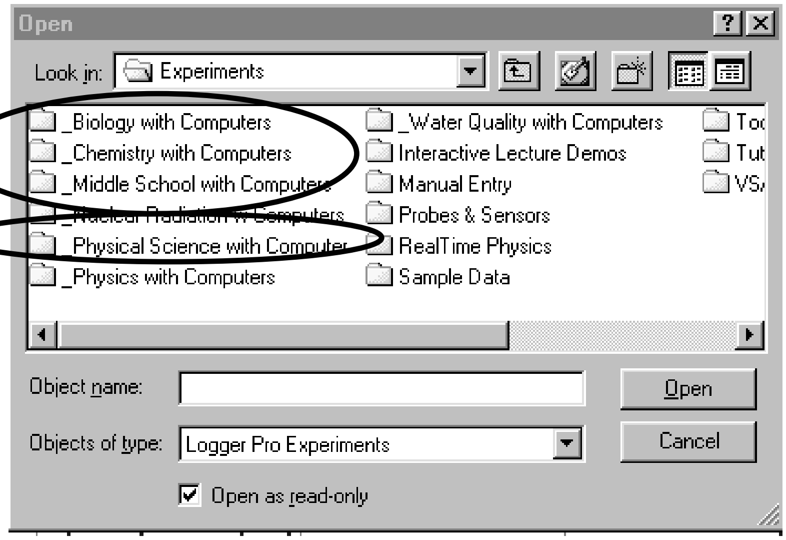
Explore the Axis Options by checking and unchecking the different boxes.



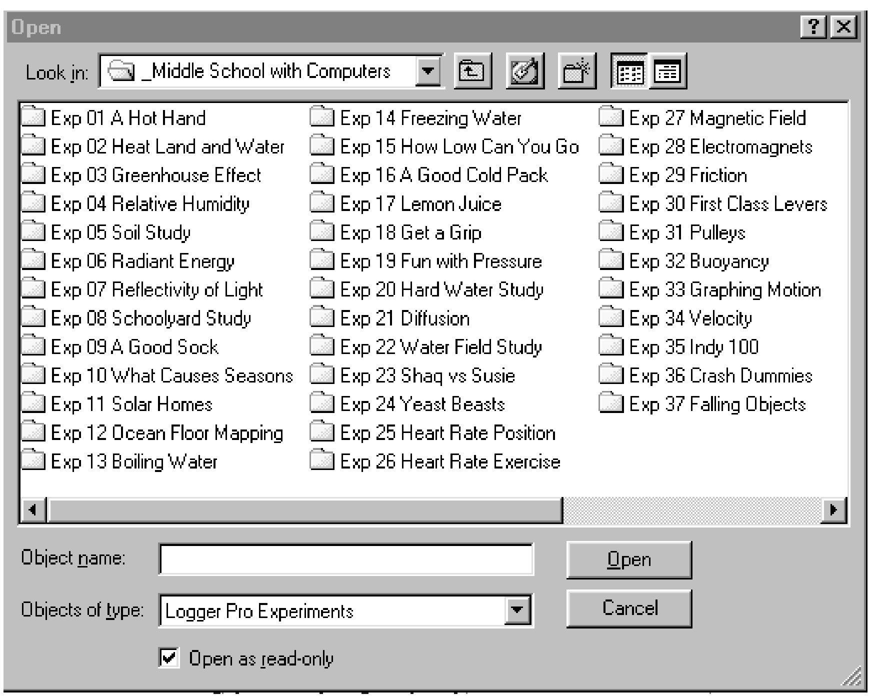
<u>Using Logger *Pro* Labs:</u>

1. Labs developed for Vernier sensors are included in the Logger *Pro* software. These same labs are in the *Middle School with Computers*, *Chemistry with Computers*, and etc activity books.
2. To use these labs, go to **File**, choose **Open**:

Most useful for middle school.



3. Double click on Middle School with Computers and you will see every experiment available to you:



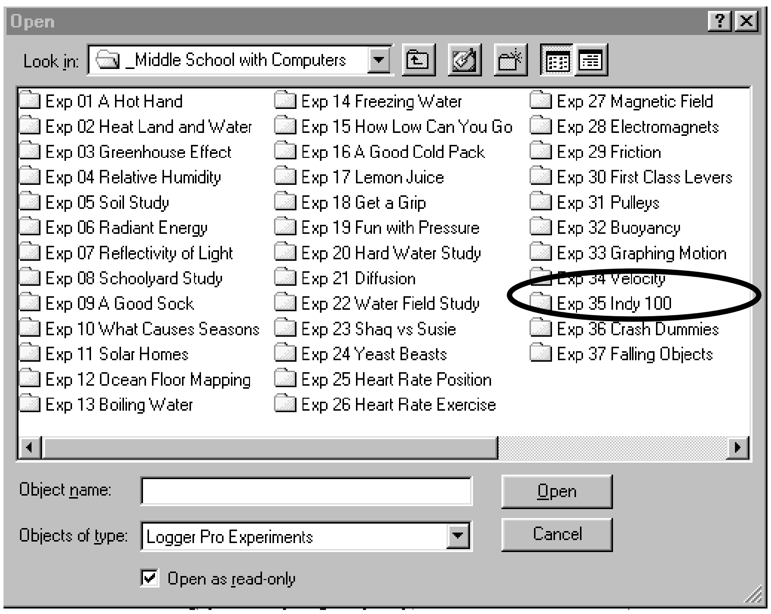
The Indy 100

Materials:

LabPro Interface
1.8m board
Meter stick
Toy car
Motion Detector
Several books
Masking tape

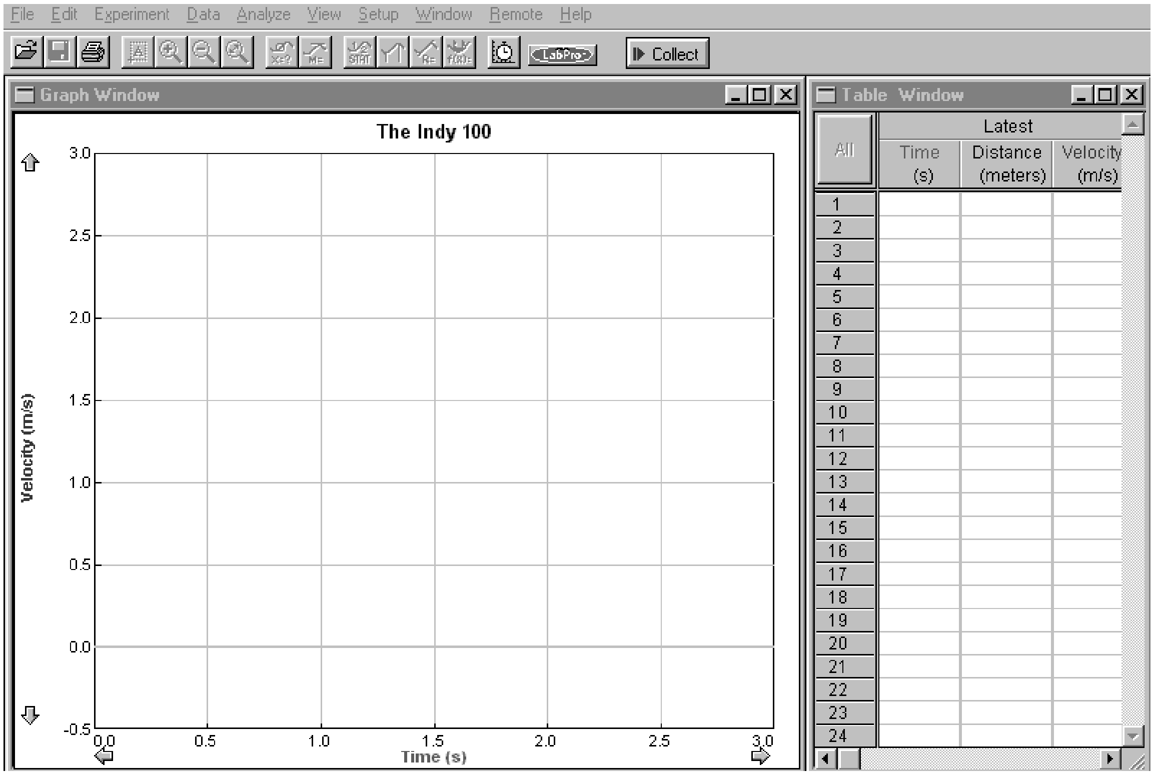
Procedure:

1. Set up the computer to do the experiment:
   a. Go to File, Open, click Middle School With Computers, then select EXP 35 Indy 100



   b. You will see this screen:

   c. Open Exp 35 Motion MBL to get this screen:



d. Collect data by clicking 

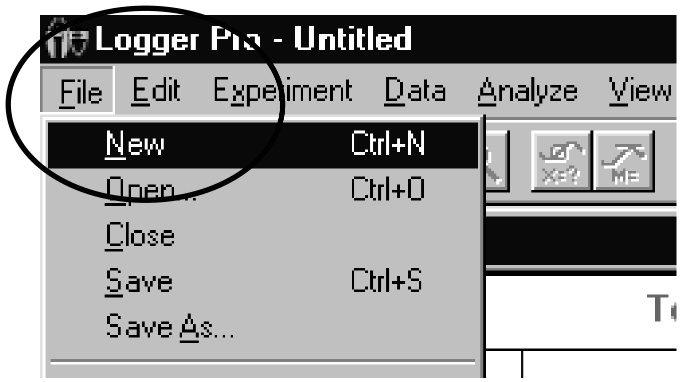
e. Examine the statistics of the experiment by clicking 

2. Follow the procedure on page 35 – 1 of *Middle School Science With Computers*.

Using Teacher-made Labs:

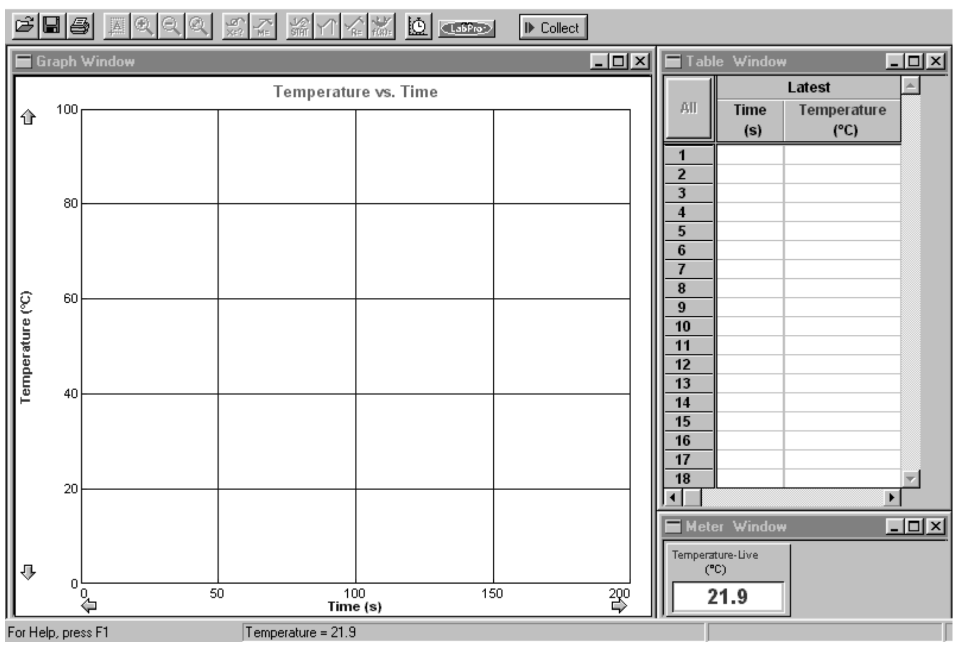
You are not limited to using labs included with Logger *Pro*. It is very easy to set up the computer for any activity.

1. Plug in the sensor you want use for the lab.
2. Go to **File**, select **New**:

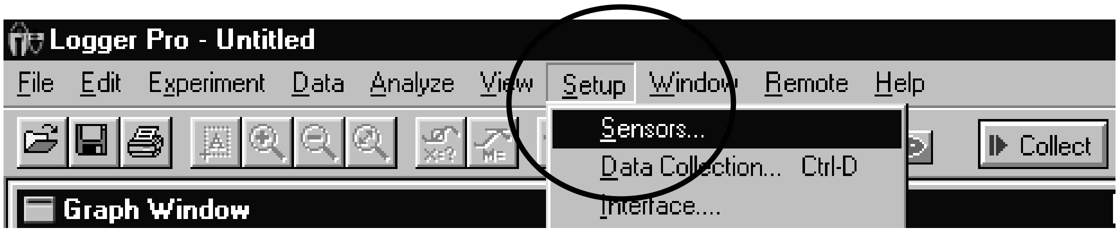


3. If the sensor is an Auto-ID sensor the appropriate graph will be displayed:

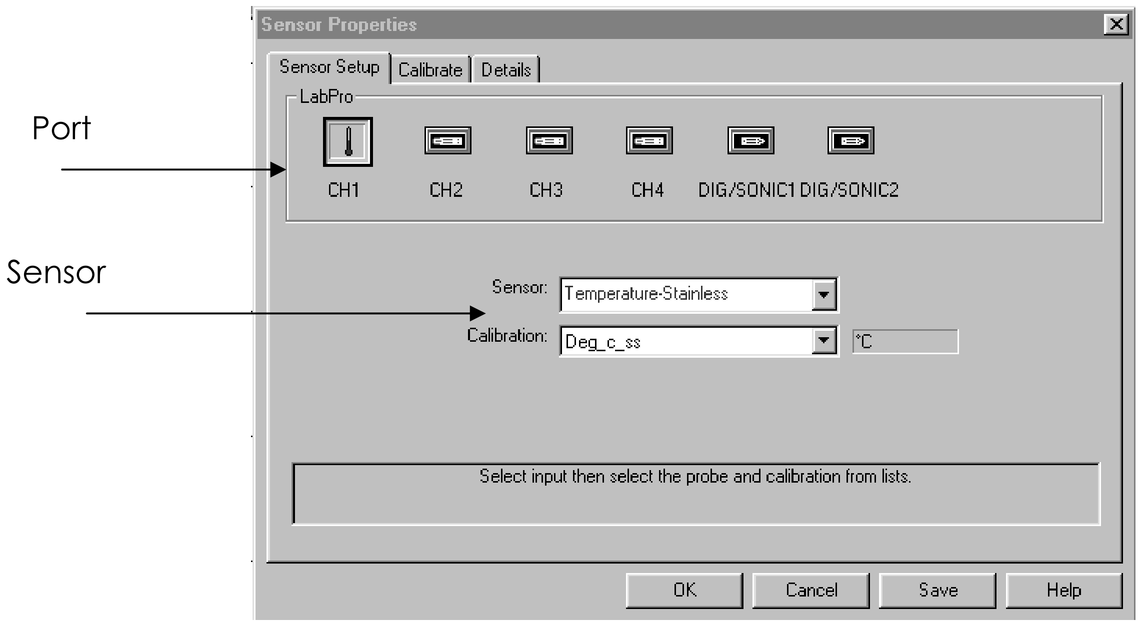
This is the screen that is displayed when the temperature sensor is connected



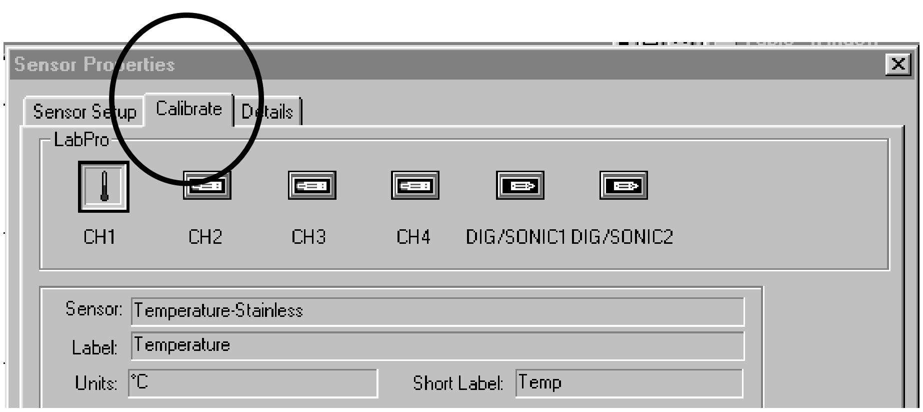
4. Click on **Setup** , then **Sensors**:



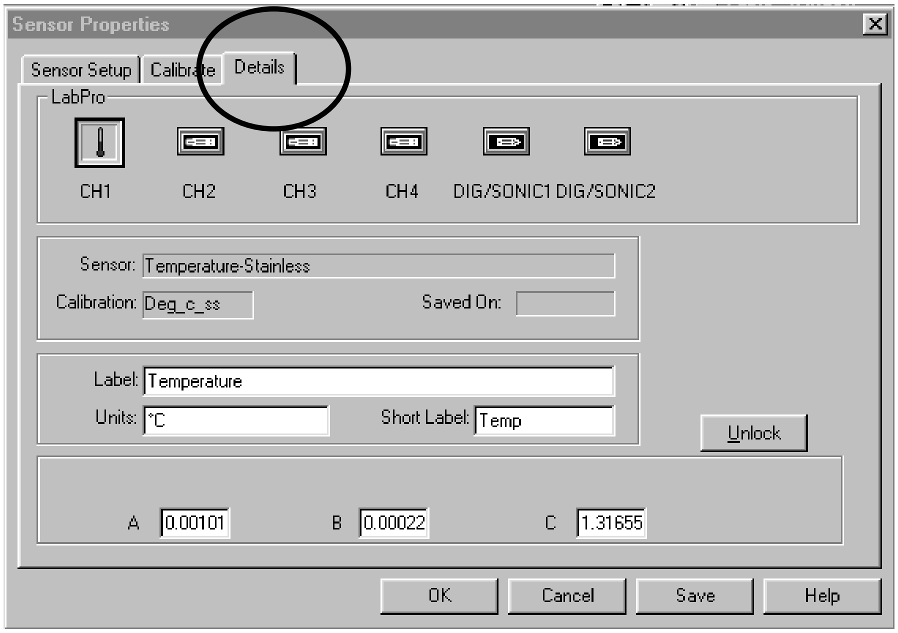
5. Make sure the correct sensor and port are being used:



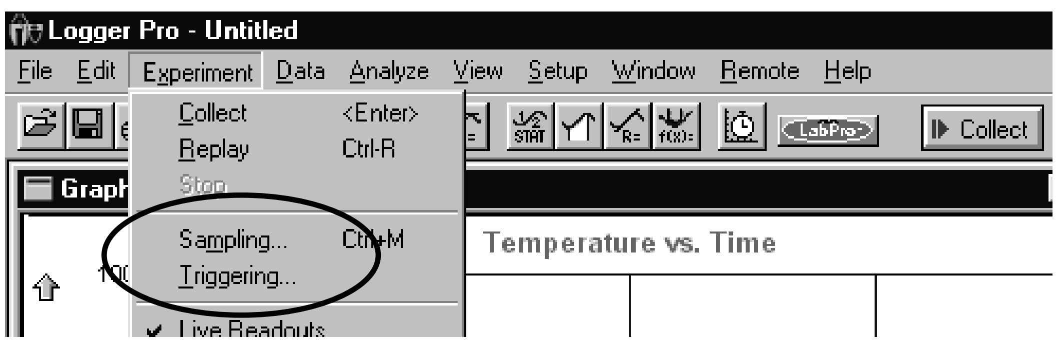
6. Click the **Calibrate** tab and check that information:



7. Click the **Details** tab and double check that information also:



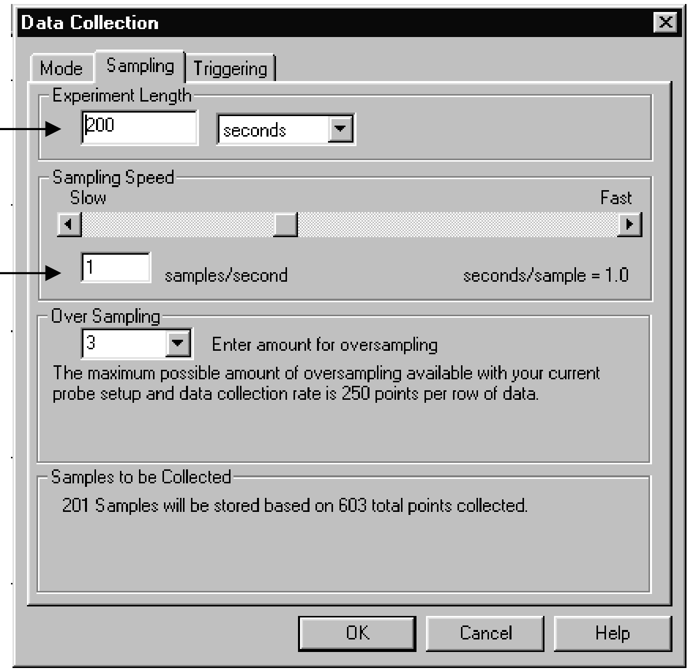
8. To set up the parameters for the experiment go to Experiment and then Sampling or Triggering or clicking :



9. Set the parameters for the experiment:

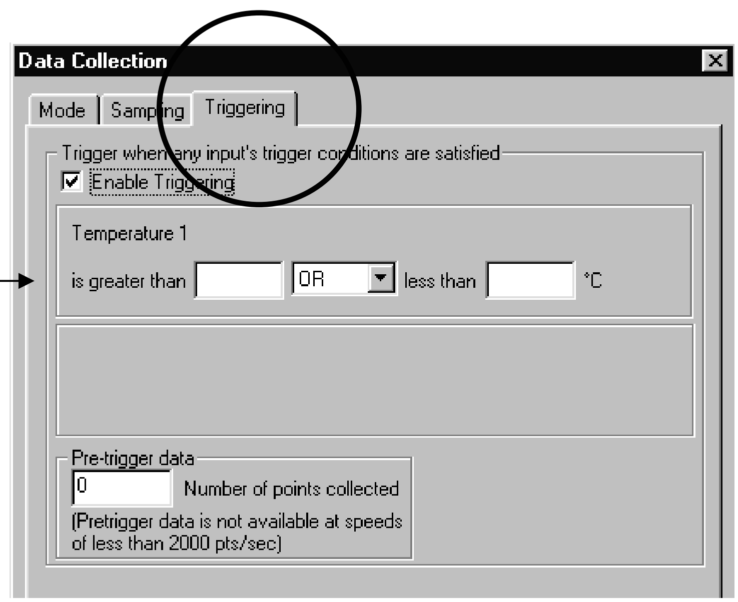
Set the experiment length

Set the number of samples

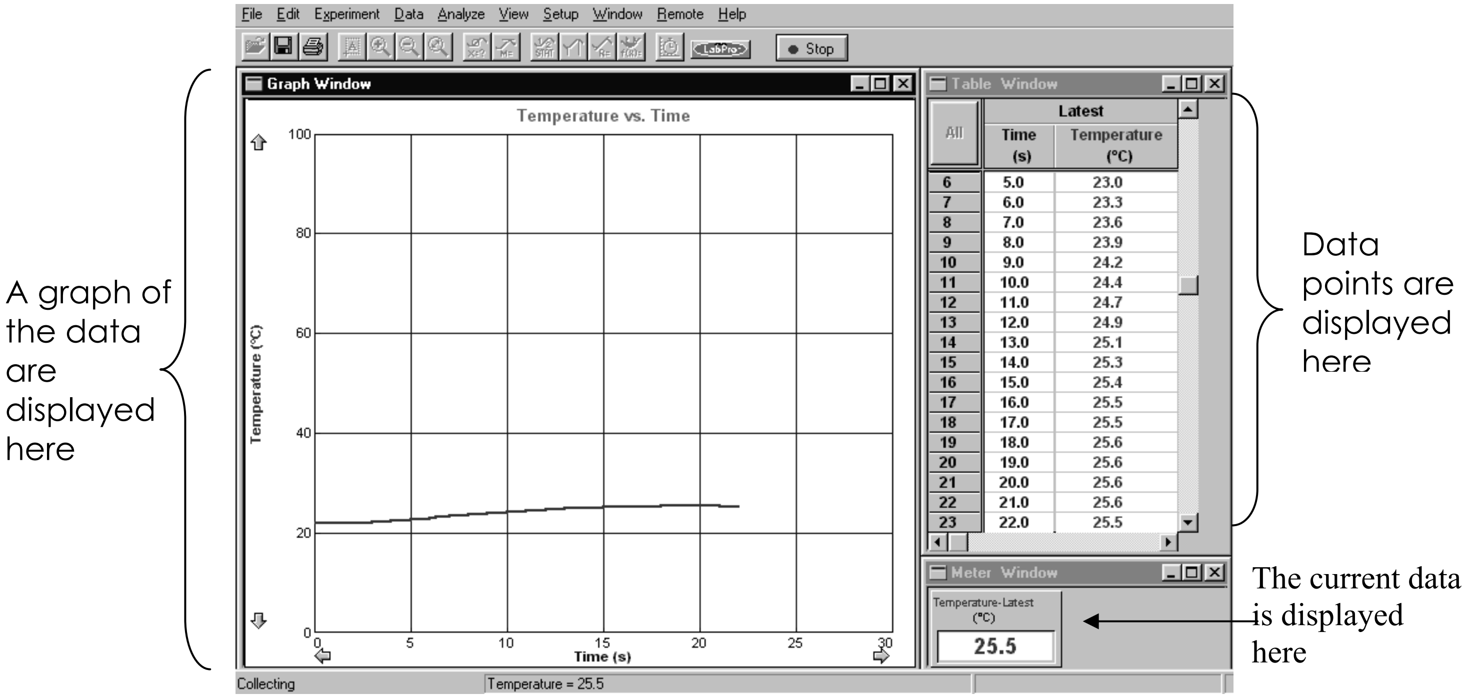


10. To collect data by triggering, click the triggering tab and set the parameters:

Specify conditions for data collection

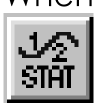


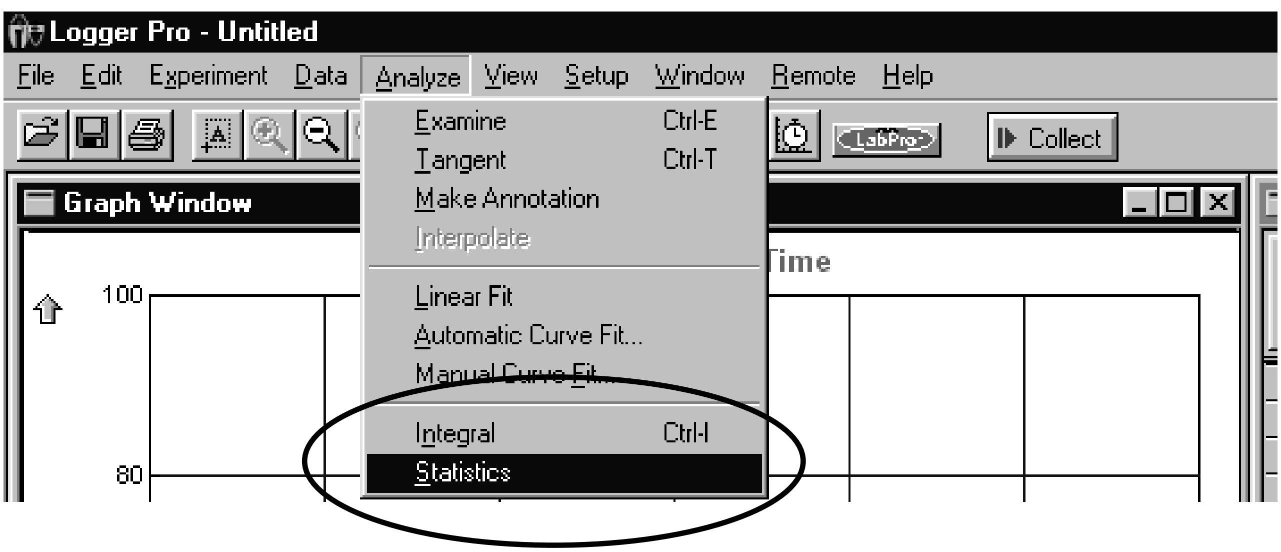
11. Click  to begin collecting data. This type of screen will be displayed:



12. Stop the data collection at any time by clicking 

13. When data collection is completed click on **Analyze**, then **Statistics** or





Evaporation

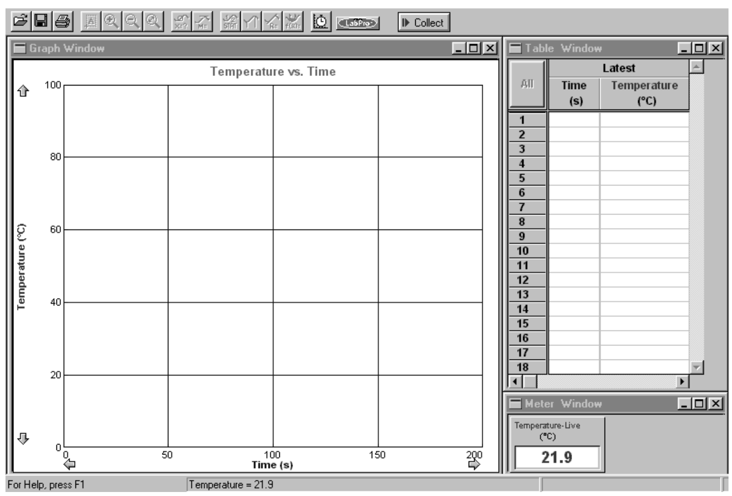
Problem: To explore cooling through evaporation

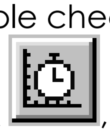
Materials:

LabPro with temperature sensor
Cotton balls
Water
Isopropyl alcohol
Small fan

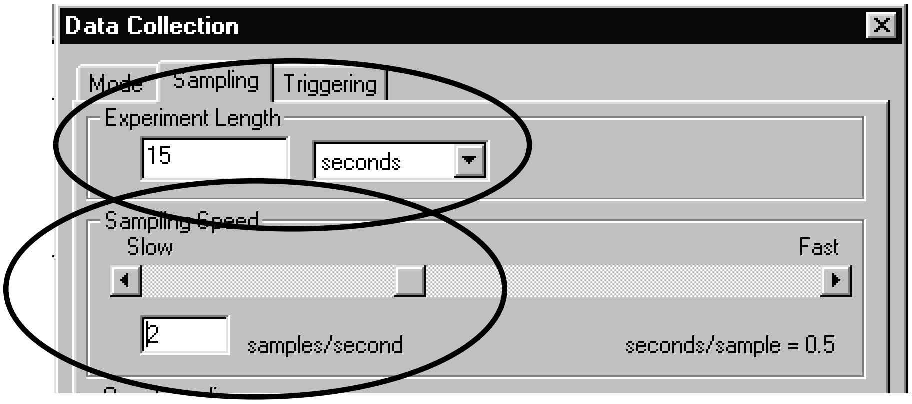
Procedure:

1. Set up Logger *Pro* to run the experiment:
   a. Connect the temperature sensor to the LabPro
   b. Go to **File**, select **New**
   c. The temperature screen will be displayed:



   d. Click on **Setup**, then **Sensors** and double check the port and sensor
   e. Double check **Calibration** and **Details**
   f. Click , select **Sampling**.

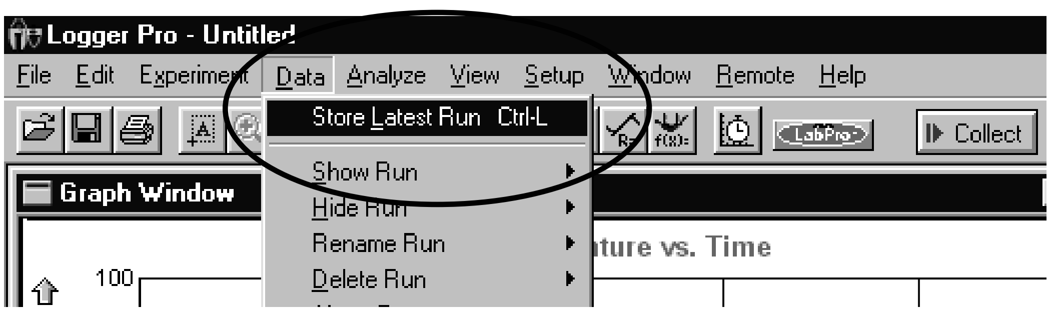
g. Choose 15 seconds for the experiment length and 2 samples per second for the experiment speed:



h. You are now ready to collect data

2. Wrap a cotton ball around the end of temperature sensor. Soak the cotton in room temperature water.
3. Turn on the fan and let the fan blow over the sensor.
4. Press  to begin taking data.

5. When data collection is completed, click **Data**, **Store Latest Run**:



6. Replace the water-soaked cotton ball with one soaked in isopropyl alcohol and repeat the procedure.

Conclusion:

Write a paragraph describing your results. Use evidence to support what you say:

Using Programs Other Than DataMate

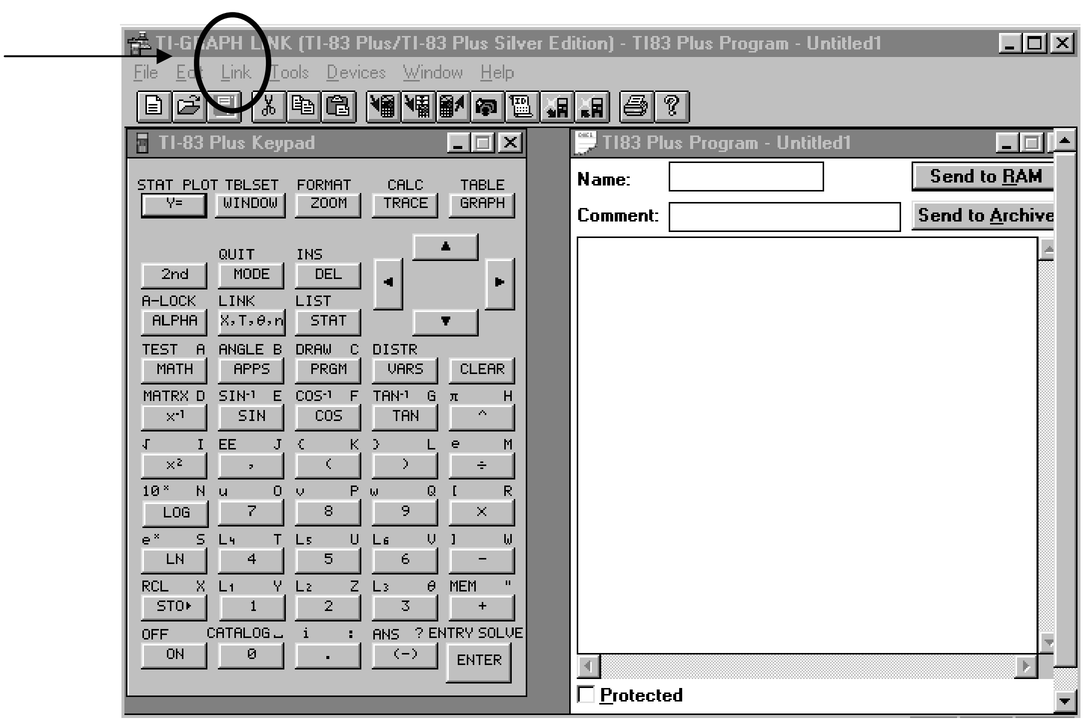
DataMate is not the only program you can use with the graphing calculator and the LabPro™. However, before you can use these other programs, you must first load them into the calculator. To do this, you must first load the **TI-Graph Link** and the data collection programs into your computer.
The Graph-Link program and cable are necessary to send programs from a computer to a calculator.

Where to Get Programs:

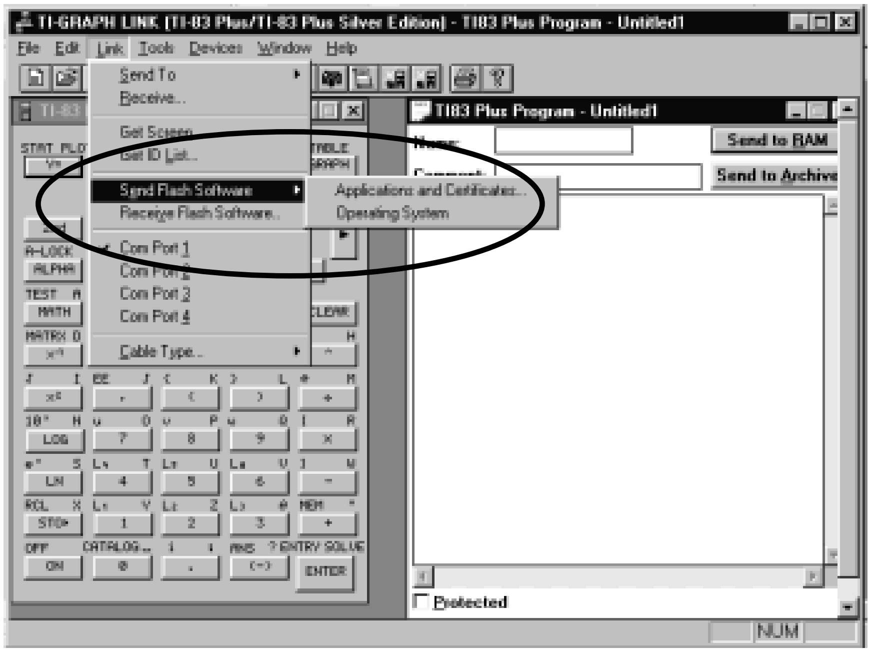
Programs may be downloaded from http://www.vernier.com/calc/index.html or http://education.ti.com/global/archreadme.html
Programs are also available on TI Resource disks and with the Vernier activity manuals.

Using Graph-Link to load Programs / Apps:

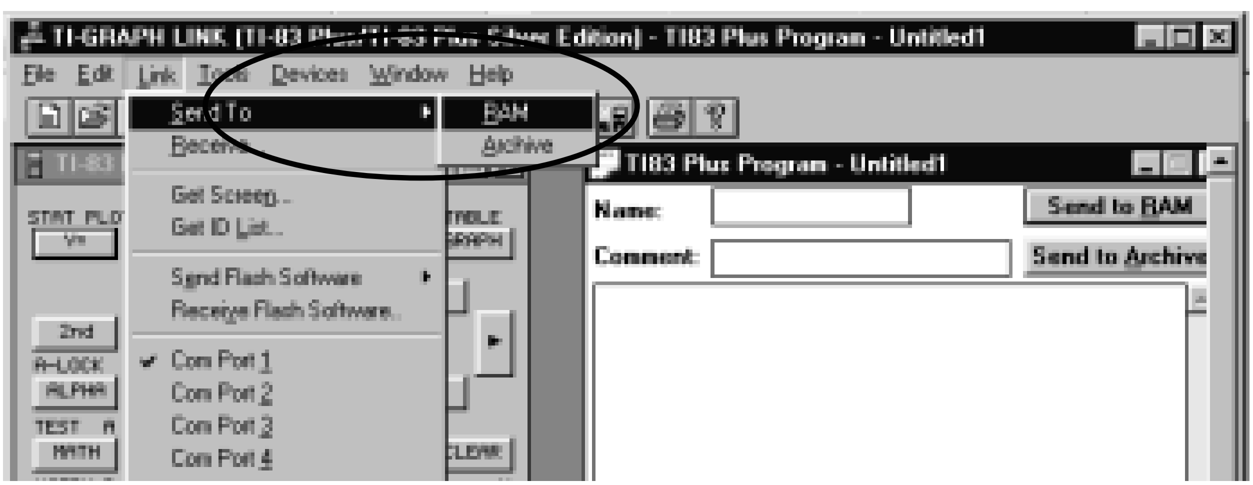
1. Connect the TI-Graph link cable to the computer and the bottom of the calculator.
2. Open the Graph-Link program
3. Choose **Link** from the top menu bar



4. Select **Send Flash Software** from the drop down menu, and choose applications and certificates if you want to load a **flash application onto the calculator**.



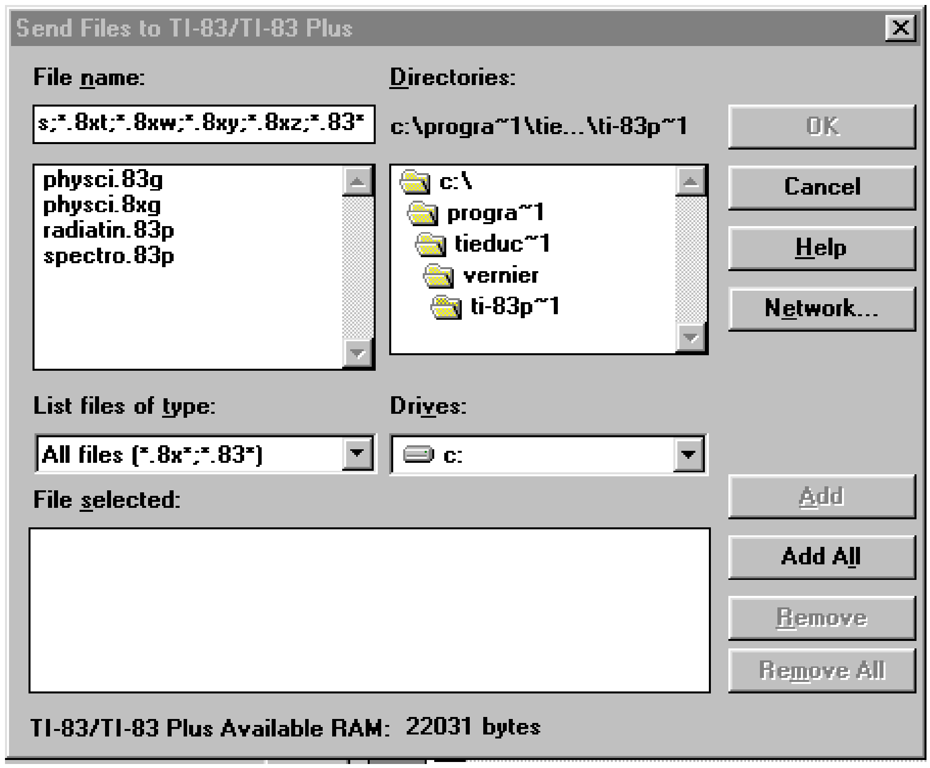
5. Select **Send to** from the drop down menu, and choose RAM if you want to load a **program onto the calculator**.



6. In the right hand window of this screen you will see the folder with the icons of the program files you have loaded on your hard drive. Double click on the program file to open it.Double click on the TI-Education file to open it.
7. Double click on the Vernier file to open it.
8. Double click on the TI 83p file to open it.

9. The programs loaded into the computer will be listed in the window on the left-hand side of the screen. For middles school, **Physci83g** and **Chembio83g** are the most useful programs to use. The "g" indicated that this is a group of several different programs.

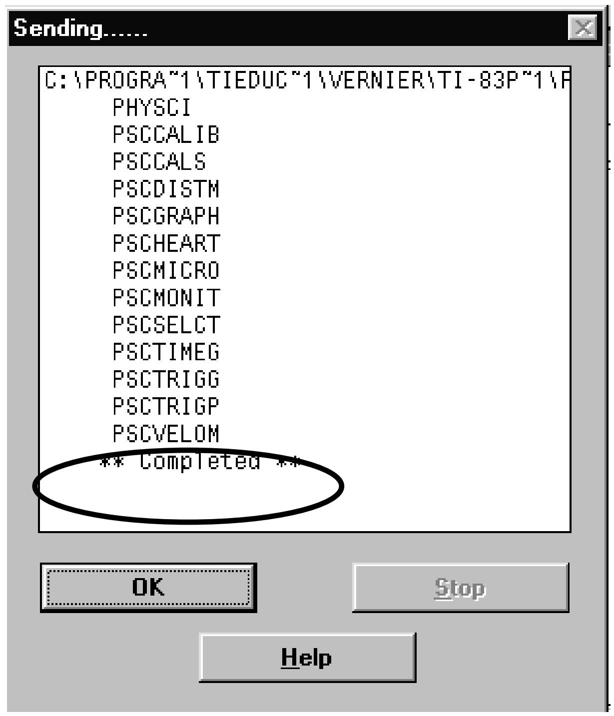
Programs →



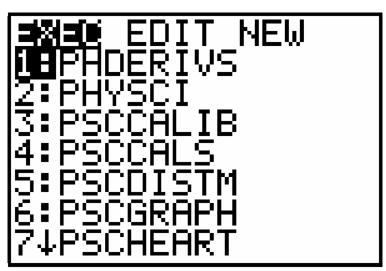
10. Click on the program or application and then click add.
11. You will see the program or application listed in the window at the bottom of the screen.

12. Turn the calculator on.
13. Click OK. This will begin sending the programs or applications from the computer to the calculator.

14. You will see the programs listed as they load on the computer screen, but the calculator screen will be blank.



15. When the download is complete, click OK.
16. To test to make sure the programs or applications are loaded, press 8 or 9. The newly loaded programs or applications will be listed in the calculator window.

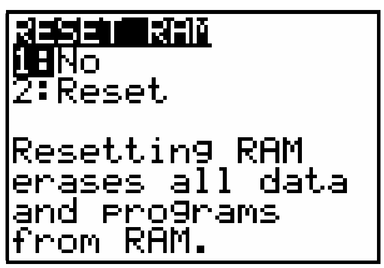


Removing Programs From the Calculator:

1. Press –, press MEM (the + button)
2. Select **7:Reset**

3. Select **All Memory**. Select **1:All Ram**.

4. You will get a warning message stating that this will remove all data and programs



5. Select **Reset**.

Linking Calculator to Calculator:

The **unit-to-unit link cable** lets you link calculator to calculator or a LabPro.
By linking two calculators, you can transfer programs and numerical data between the calculators.
To communicate between two calculators, you must set up one calculator to **SEND** data and one calculator to **RECEIVE** data.

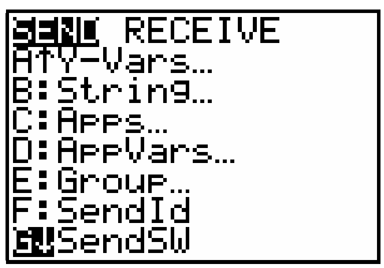
To set up a TI – 83+ calculator to RECEIVE

1. Press –, Press [LINK]

2. Use ~ | to highlight **RECEIVE**. Press β
3. The message **Waiting…** is displayed
4. Press –, press [QUIT] to exit the receive mode

To set up a TI – 83+ calculator to SEND

1. Press –, Press [LINK]
2. **SEND** should be highlighted. Use ~ | to choose the type of data you want to send. Usually it will be Lists, Programs, or Apps



3. Press β
4. Use ~ | to highlight **TRANSMIT**
5. Select which items you which to share, Press β to begin sending

Measuring Motion

Distance vs Time

PROBLEM:
To measure distance and use a graph represent the motion

MATERIALS:
Graphing calculator loaded with PHYSCI program
LabPro
Motion detector
Meter stick
Masking tape

PROCEDURE:
1. Attach the motion detector on a table or cabinet 15 cm above your waist.
2. Use masking tape to make a 4 meter line on the floor in front of the motion detector. Mark the tape at 1 meter intervals.
3. Prepare the graphing calculator and LabPro:

(a) Plug the motion detector into the **DIG / SONIC** port of the LabPro unit.
(b) Use the link cable to connect the calculator to the LabPro unit. Plug the cable into the bottom of both the calculator and the LabPro.
(c) Turn the calculator on.
(d) Turn the LabPro on.
(e) Press the **PRGM** key on the calculator.
(f) Select **PHYSCI**.
(g) Press. **ENTER**
(h) Press **ENTER** until you come to *****MAIN MENU*****
(i) Select **1:SET UP PROBES**
(j) Enter **1** after **ENTER NUMBER OF PROBES**. Press β.
(k) Select 7**:MORE PROBES**, Select **3:MOTION**
(l) Back at the *****MAIN MENU***** select **6:MATCH**. Select **1:DISTANCE**.
(m) Follow the directions on the calculator screen.
(n) Press **ENTER**. You will have an "empty" graph.

4. Stand at the tape mark one meter form the motion detector.
5. Begin walking as your partner presses **ENTER**.
6. Walk to the two meter mark and stop.
7. Observe the graph. Draw your graph in the DATA section.
8. Press **ENTER**. At ******OPTIONS****** select **2:NEW MATCH**.
9. Follow the directions on the calculator screen.
10. Press **ENTER**. This will show a graph that you are to try to match.
11. Observe the graph and decide what you will have to do to make another graph just like it. *Note*: Distance tick marks are 1 meter apart. Data will be collected for 5 seconds.
12. Take your starting position in front of the motion detector.

13. Begin walking as your partner presses **ENTER**.
14. Walk according to your plan.
15. Observe the graph that was made of your walk. Draw this graph in the DATA section.

DATA:

Sketch of graph 1

Sketch of graph 2

ANALYSIS & CONCLUSIONS:

1. Describe what you had to do to match the graphs.

2. Sketch a distance vs time graph for a car that starts slowly from a stopped position, moves down the street faster, stops at a stop sign, and then starts slowly again.

More Labs & Activities For Middle School Science

The Work of Muscles

Problem: How does muscle fatigue and rest affect work output?

Hypothesis:

____
____
____

Materials

Book or weight — Stop watch or clock with a second hand
Graphing calculator

Procedure:

1. Set up the calculator to collect data:
   a. Press 3 (TI-73) or ϖ, choose Edit, then 1:Edit (TI-83/+)
   b. Clear all data from lists : ~ | to highlight the List you want to clear, press ' , then β
   c. Enter number 1 – 10 in List 1. This is the number of the 15 – second periods.
   d. ~ to List 2. You will record your data in this list.
2. Place your elbow on your thigh with your lower flat and hold a book or weight in your hand. KEEP YOUR ELBOW ON YOUR THIGH, USE THE SAME ARM FOR THE ENTIRE EXPERIMENT, DO NOT LOWER YOUR HEAD & BODY
3. Raise and lower your hand as many times as you can for 15 seconds, counting out loud. Have your partner enter the number of times you lifted the weight in **List 2**.
4. WITHOUT RESTING, repeat for another 15-second interval. Enter your data.
5. Repeat for a total 10 times.
6. Rest for at least 10 minutes while your partner collects his/her data.
7. Repeat steps 2- 4, this time resting for 45 seconds between each 15-second trial. Enter this data in **List 3**.

Data:

Use the calculator to graph your data:

1. For a TI-73:
   a. Press —, press ε (the O button)
   b. Select 1: **Plot 1**
   c. Make sure the plot in ON
   d. Choose the line graph (2nd icon)
   e. Xlist is L_1, Ylist is L_2.

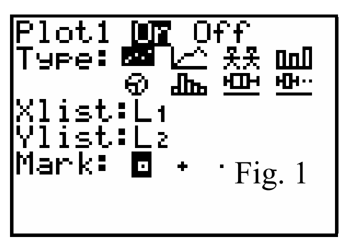


Fig. 1

f. Select a mark for your graph. (see Fig. 1)

g. Press –, press ε (the o button)
h. Select 2: Plot 2
i. Make sure the plot in ON
j. Choose the line graph (2nd icon)
k. Xlist is L_1 Ylist **must be L_3** – to change to L_3 press –, then ϖ (the 3 button)
l. Select 3:L_3 Press β. (see Fig. 2)

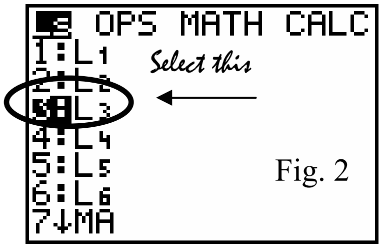


Fig. 2

m. Choose a different mark for the second line on your graph. (see Fig. 3)
n. Press q , Select 7:ZoomStat

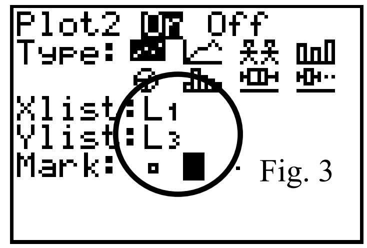


Fig. 3

2. For a TI-83/+
   a. Press –, press [STAT PLOT] (the o button)
   b. Select 1: Plot 1
   c. Make sure the plot in ON
   d. Choose the line graph (2nd icon)
   e. Xlist is L_1, Ylist is L_2.
   f. Select a mark for your graph. (see Fig. 4)

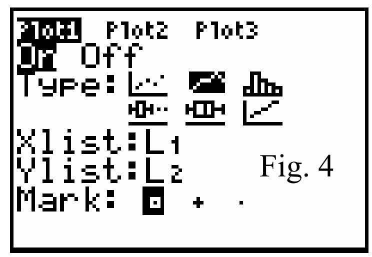


Fig. 4

   g. Press –, press ε (the o button)
   h. Select 2: Plot 2
   i. Make sure the plot in ON
   j. Choose the line graph (2nd icon)
   k. Xlist is L_1 Ylist **must be L_3** – to change to L_3 press –, then 3 (the ϖ button)
   l. Select 3:L_3 Press β. (see Fig. 5)

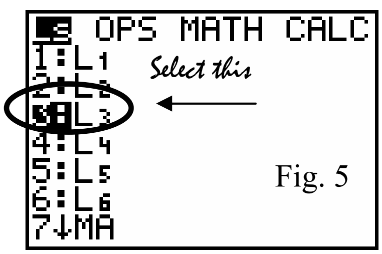


Fig. 5

   m. Choose a different mark for the second line on your graph. (see Fig. 6)
   n. Press q , Select 9:ZoomStat

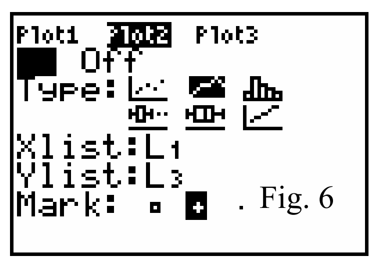


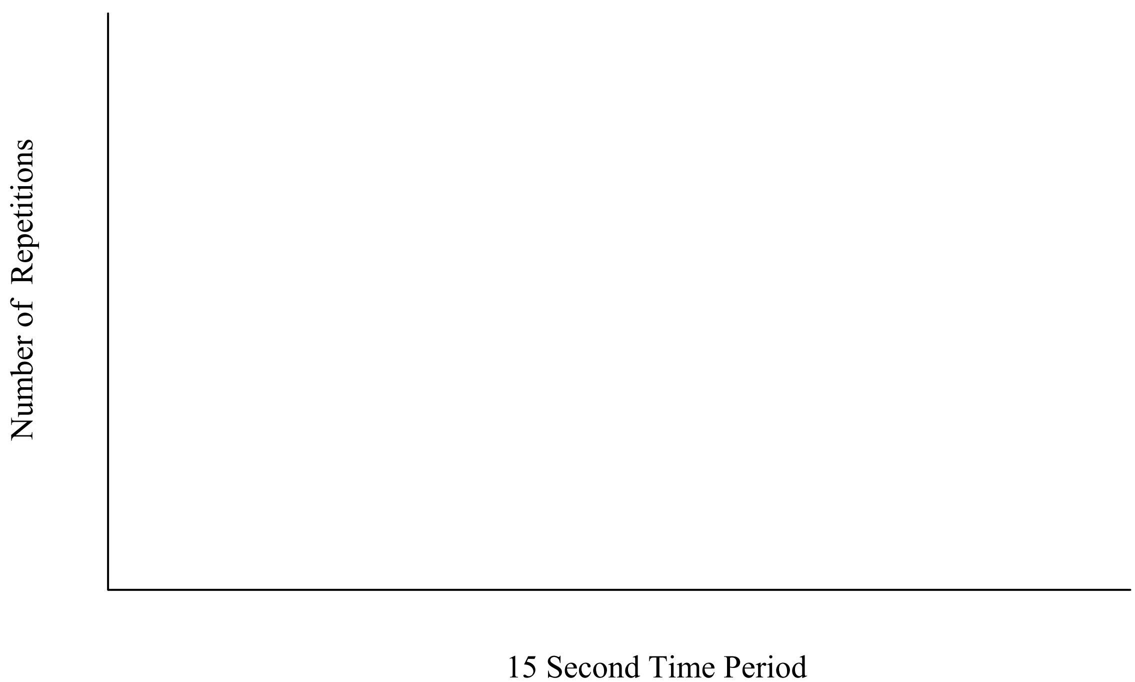
Fig. 6

You make also record your data here:

15-Second Period	Number of Repetitions Without Rest	Number of Repetitions With Rest
1		

2		
3		
4		
5		
6		
7		
8		
9		
10		

Sketch a graph of your data here:



Analysis and Conclusions:

1. How did your arm feel after the 10th 15-second period without rest?

____

____

____

2. Explain why your arm felt this way.

____

____

____

____

3. How did your arm feel after the 10th 15-second period with rest?

____

____

____

4. Was there a difference in the way your arm felt between the two procedures? Why or why not?

____

____

____

5. How could you test your explanation?

____

____

____

____

____

____

____

Hot Water

Question: How does the rate of cooling in shallow water compare to the rate of cooling in deeper water?

Prediction:

____

____

____

Materials:

LabPro with Temperature sensor

Hot water

1 large beaker or cup

Flat, shallow pan

Procedure:

1. Set up the LabPro and temperature sensor for data collection:
   a. Put the temperature sensor into CH1 of the LabPro.
   b. Turn the LabPro & calculator ⊥.
   c. Press 9 Select DataMate.

2. Fill the cup with 250 ml of hot water.
3. Pour the cup of water into the flat, shallow pan.
4. Put the temperature sensor in the water and Select **2:Start** to begin collecting data.
5. When the data collection is finished, make a sketch of the graph;
6. Fill the cup with another 250 ml of hat water. Leave the water in the cup.
7. Put the temperature sensor in the water and Select **2:Start** to begin collecting data.
8. When the data collection is finished, make a sketch of the graph;
9. Compare the two graphs.

Shallow Pan

Large Cup

Conclusion:

1. How do the two graphs compare?

____

____

____

2. What does this tell you about the cooling of water in deep water compared to shallow water?

____

____

____

3. What other questions does this information raise?

____

____

____

4. How can they be answered?

____

____

____

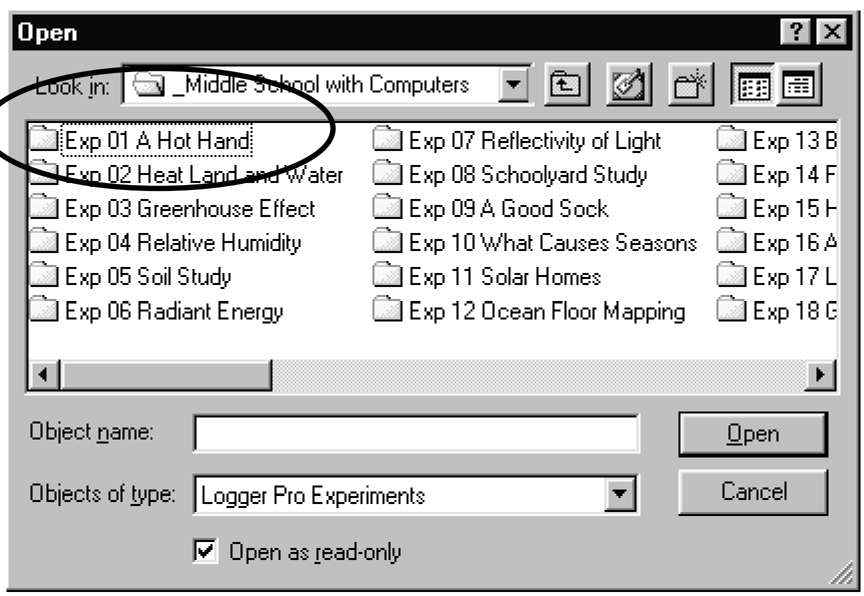
A Hot Hand

Materials:

LabPro interface with temperature sensor
Cup
Water
Paper towel

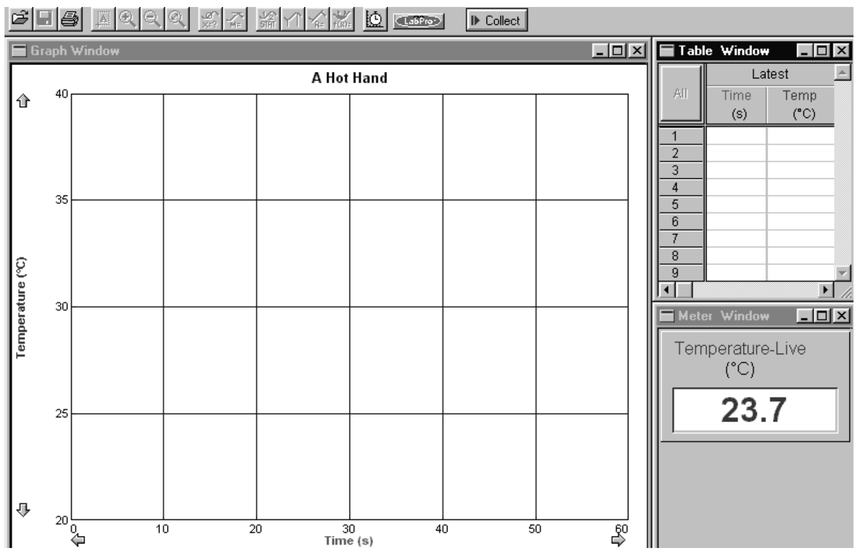
Procedure:

1. Set up the computer to do the experiment:
   a. Go to File, Open, click Middle School With Computers, then select EXP 01 A Hot Hand

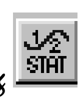


   b. This screen will be displayed:

c. *Choose the appropriate sensor and this screen will be shown:*



d. *Collect data by clicking* 

e. *Examine the statistics of the experiment by clicking* 

3. *Follow the procedure on page 1 – 1 of Middle School Science With Computers.*

Name___________________
Science 7-_____

How Much Energy?

Question: Do different parts of the world get different amounts of the Sun's energy?

Materials:

Globe
Tape
LabPro system with 2 temperature sensors
Lamp
Ruler

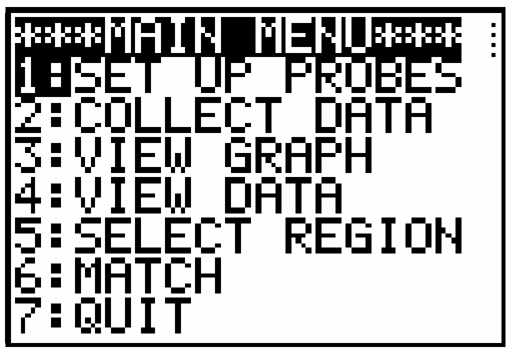
Procedure:

1. Place the lamp 30cm from the globe, with the tilt of the globe facing the lamp.
2. Shine the lamp directly on the globe's equator.
3. Tape a temperature sensor to the globe's equator. **<u>This sensor must be plugged into Channel 1 of the LabPro</u>**.
4. Tape the other temperature sensor to the North Pole. **<u>This sensor must be plugged into Channel 2 of the LabPro</u>**.
5. Prepare the LabPro and calculator:
    a. Turn the LabPro and calculator ⊥.

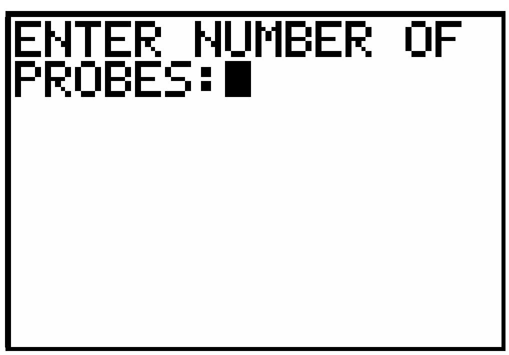
    b. Press 8 on the calculator; you will see this screen:

c. Select **1:PHYSCI** by pressing β or 1.

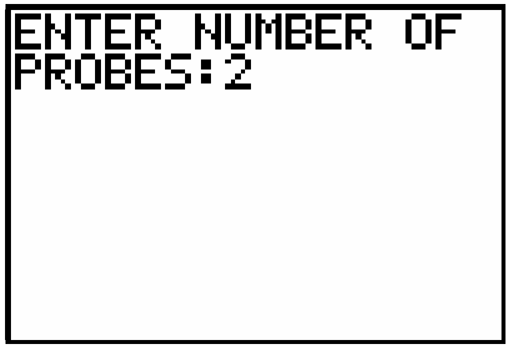
d. Press β until you come to this screen:



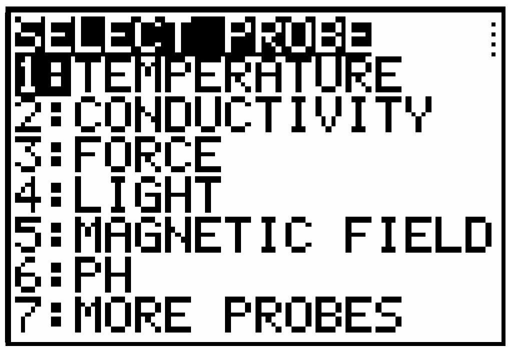
e. Select **1:SET UP PROBES** by pressing β or 1. Now your screen should look like this:



f. Enter “2” as the number of probes you are using:



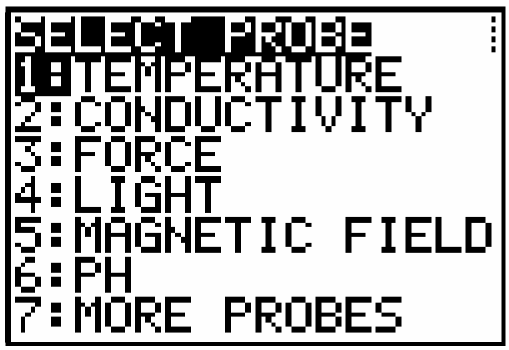
g. Press β. Now you have this screen:



h. Select **1:TEMPERATURE** by pressing β or 1. Your screen will look like this:

i. Enter "**1**" as the Channel Number:

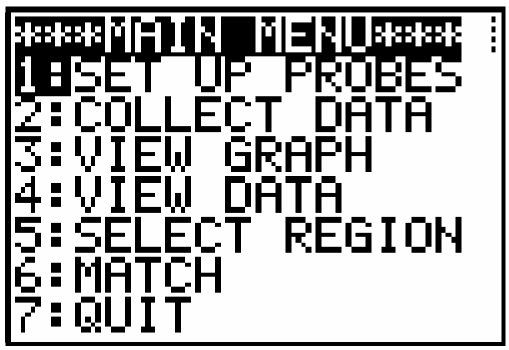
j. Press β, and your screen will again look like this:



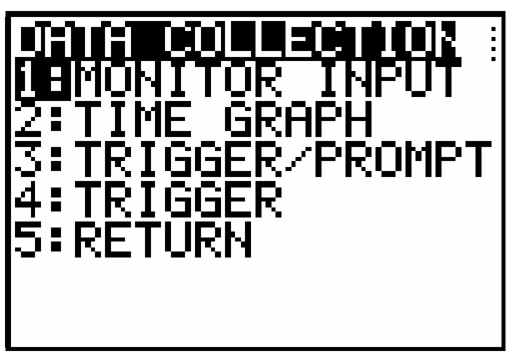
k. Select **1:TEMPERATURE** by pressing β or 1. Your screen will look like this:

l. Enter "**2**" as the Channel Number:

m. Press β, and you will get this screen:



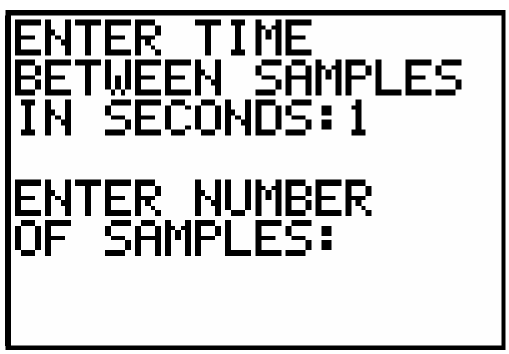
n. Select **2:COLLECT DATA** by pressing 2 or using the # to highlight 2 and pressing β. Now your screen looks like this:



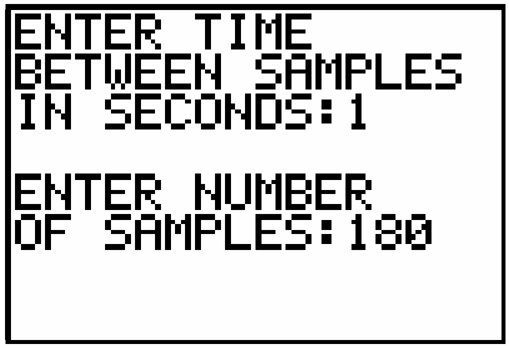
o. Select **2:TIME GRAPH** by pressing 2 or using the # to highlight 2 and pressing β. Now your screen looks like this:

p. Enter “1” as the time between seconds:

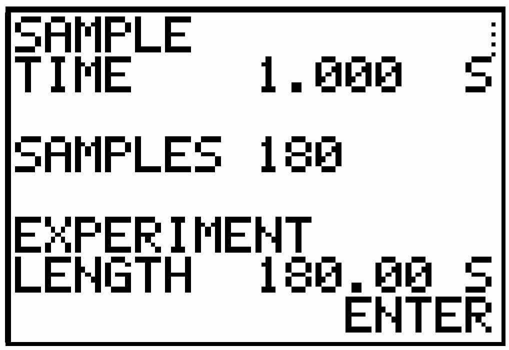
q. Press β:



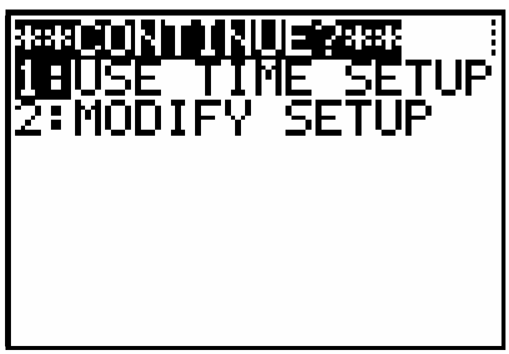
r. Enter 180 as the **Number of Samples**:



s. Press β, and you should see this screen:



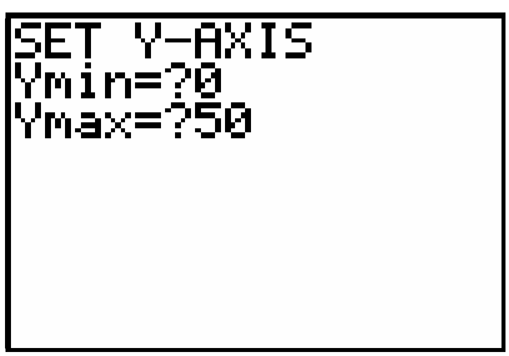
t. Press β:



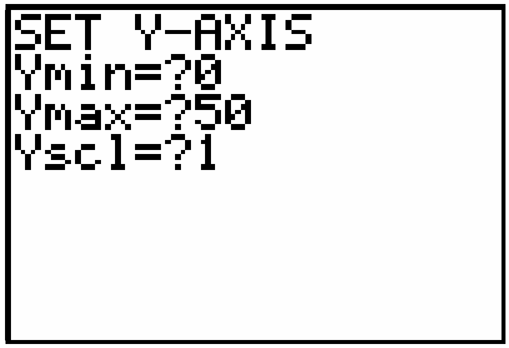
u. If your screen was correct, choose**1:USE TIME SETUP** to continue. If your screen was not correct choose **2:MODIFY SETUP** to change it. When you get to this screen:

v. Enter “0” as your lowest value for the Y-Axis:

w. Press β, and enter “50” as the highest value for the Y-Axis:

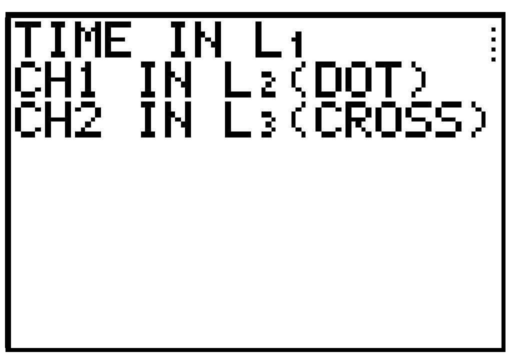


x. Press β, and enter"1" as the scale you will use on your graph:



y. Press β, and your screen will look like this:

6. When you are ready to begin collecting data, press β.
7. When the data collection is finished, the calculator screen will look like this:



8. Press β to see the graph of the sensor in Channel 1 (the sensor at the equator).
9. Press β again to see the graph of the sensor in Channel 2 (the sensor at the North Pole).

10. Press β again to see both graphs together.

Analysis:

1. Which part of the world receives the most energy? Explain your answer.

2. The Earth is tilted 23.5 degrees. What would the data look like it were tilted 50 degrees? Explain your answer.

3. What would the data look like if the Earth were tilted 10 degrees? Explain your answer.

4. Predict what the data would be if the temperature sensor was placed at the South Pole. Explain your answer.

Conclusion:

Write a paragraph describing what you learned in this activity.

Resources:

There are many resources available for the LabPro and the older CBL interface. Many of these resources are online.

Vernier and Texas Instruments sell activity books designed specifically for middle school science classes.
Additionally, all three major publishers in the Texas adoption include a probeware manual as one of the ancillary materials.

Online resources for activities & support:

- Texas Instruments Education web site - http://education.ti.com/index.html
- Sample Labs from the Vernier Lab books - http://www.vernier.com/cmat/
- Mobile Inquiry Technology - http://mit.concord.org/6thnotes/list-6.htm
- Science Teacher Stuff - http://www.scienceteacherstuff.com/techgraph.html
- Learning to use the LabPro - http://www.ncsu.edu/sciencejunction/route/usetech/MBL/