Scavenger Hunt

Number of lessons: 2 Lesson duration: 45 minutes

Lesson Objective:

- Gather information about light intensity in the classroom.
-

Learning Objectives:

- Use the RCX programmable brick and a light sensor to collect data about lighting conditions in the classroom.
- Use Robolab to set up a program to collect the data.
- Analyze the results of the scavenger hunt by uploading the data.
- Draw conclusions and make generalizations about light intensity in the room.

Materials:

- Computers
- IR Towers (1 per computer)
- RCX programmable bricks (1 per 2 students)
- Light sensors and connecting wires (1 per 2 students)
- Five sets of programming directions
- Engineer's Instruction and Recording Sheet

Organizational tips:

Try to set the computers in different locations in the classroom in order to avoid congestion.

Assign two groups to each computer.

Each group will build their own "scavenger"; the two groups will set up the computer program together, each group creating a separate file.

Emphasize that each person in the group must participate in setting up the program.

Monitor each group to make sure they are setting everything up according to the directions.

Vocabulary:

- RCX Brick
- Download
- Upload
- Analyze
- Light sensor
- Data point
- Sampling rate

Procedure:

- Discuss how light sensors work.
- Using the monitor demonstrate in Robolab Investigator level 1 the options for collecting light data (See instructions).
- Explain that the light will be recorded in numerical values; the higher the value the brighter the light.
- Discuss what you need in your program (frequency of sampling, duration of collection).
- Present the challenge of collecting light data.
- Distribute Engineer's Planning and recording sheet as well as directions packets to set up the program.
- Allow students to work with their partner to set up the program and test it.

- After they have had time to complete the testing and the worksheets, have a class discussion.

How did you decide where to go to find values within a certain range?

Did it make any difference if you change the frequency of sampling?

Extension:

Develop a project where collecting light data would be import. Set up a program to complete the project.

The Voting Booth

Number of Lessons: 3 Lesson Duration: 45 minutes

Lesson Objective:

- Identify a survey question about individuals in the class that can be answered by making one of two choices.
- Set up a "voting booth" to gather the data using the RCX programmable brick and touch sensors.
- Collect and analyze the data.

Learning Objectives:

- Use the RCX programmable brick and touch sensors to collect two choice data.
- Use Robolab to set up a program to collect the data.
- Analyze the results of the survey by uploading the data.
- Draw conclusions based on the results of the data.

Materials:

- Computers
- IR Towers (1 per computer)
- RCX programmable bricks (1 per 2 students)
- Touch sensors and connecting wires (2 per 2 students)
- Five sets of programming directions
- Engineer's Instruction and Recording Sheet

Organizational tips:

Try to set the computers in different locations in the classroom in order to avoid congestion.

Assign two groups to each computer.

Each group will build their own "voting booth"; the two groups will set up the computer program together, each group creating a separate file.

Emphasize that each person in the group must participate in setting up the program.

Monitor each group to make sure they are setting everything up according to the directions.

Vocabulary:

- RCX Brick
- Download
- Upload
- Analyze

Procedure:

Review the data collecting already done in *Data About Us.*

- Discuss ways in which the data in surveys of classmates have been represented and the results of the surveys tallied.
- Review the Scavenger Hunt lesson.
    - How did we use the RCX to collect data about light?
    - What other equipment did we need?
    - What program level did we use?
    - How did we write the program?
    - How did we upload the data?

    - What did we learn from the data?
- Present the lesson objective and introduce the touch sensor.
- How can we use the touch sensor to collect data?
    - How would it be different from/similar to using the light sensor?
    - What will the graph tell us about the information?
- Elicit ideas about how to program the RCX to collect the information.
- Explain how the touch sensor records information on the program and how you can change the frequency settings.
- Distribute Engineer's Planning sheet to students and have them develop a survey question.
- Distribute the direction packets and have students set up the program.
- When everyone has finished setting up Robolab, have a group discussion about any difficulties people encountered.
- Distribute the lego materials and have students construct their voting booths.
- Discuss a procedure to help everyone collect data in a timely and efficient manner.
- Allow time to collect and upload data.
- Using the monitor and one of the ibooks have a class discussion of how to interpret the data for one of the group's questions.
- Allow students time to record their results in bar graph form and to write their statements about their findings.
- Have a discussion with the group about their finding and their success in using the touch sensors.

Grade Five

Lesson Three: Measuring Water Temperature

Lesson Objective: To use a temperature sensor to measure and analyze the water temperature from three different sources

Learning Objectives:

- Measuring temperature using sensors
- Programming in Robolab, Investigator, program level 1
- Analysis of several sets of data

Challenge: To measure the temperature of three different water sources collecting data points every second for 25 seconds for each sample.

Materials:

Engineer's Programming Sheet
Programmer's Icon Sheet
Scientist's Data Analysis Recording Sheet
Robolab software
RCX
Robolab Temperature sensor
Water from three different sources, such as from the tap, the water cooler, and an outside pond/swamp

Vocabulary:

Temperature sensor
Data point
Fahrenheit
Celsius

Procedure:

The lesson begins with discussion of temperature. Questions you might ask could include:

- Why might we be interested in the temperature of something?
- What does the temperature mean?
- How would you measure your body temperature?
- Does anyone know what a normal body temperature should be? (98.6°F or 37°C)
- What would a difference in temperature mean?
- What are the ways we can measure temperature? What units are used?

Show the students the Robolab temperature sensor. Explain that they can use this measuring devise like they would use a thermometer at home to measure the temperature of something. Explain that this thermometer does not need to be shaken down like an oral thermometer they might have used.

Next show the RCX. Discuss how to use the RCX. Ask the students for examples of how they have already used it. Instruct the students the **proper** use and care of the RCX. Remind the students to turn the power off when not in use.

Next, introduce the challenge- to measure the temperature of three different water sources. Elicit from the students possible water sources. Have the class choose three sources to work with. Explain that they will be working with a partner (or whatever groupings you choose) to write a program to collect data. They need to collect data points every second for 25 seconds for each sample of water. The partners will then upload their data on to the Robolab software, Upload Area. Using the View and Compare Area of the software, the students will then analyze the results and write about it in their Scientist's Data Analysis Recording sheet.

- Distribute the student work sheet, Engineer's Programming & Data Sheet.
- The partners need to first plan out their program using the icons.
- Once this is completed, they should put the program on the computer and download it on to the RCX.
- The partners will then collect data from one of the water sources.
- Uploading the data is the next step.
- The partners will then collect data from the second water source, upload the data and repeat for the third water source.
- Analysis of the three sets of data is the final step in this challenge.

The final part of the lesson is when the students will be instructed on how to properly care for, put away, and store Lego materials.

Programming:

The students will program the temperature sensors in Robolab: Investigator software. Students should first plan out their program using the "Engineering Programming Sheet" and the "Programmer's Icon Sheet".

After planning out their program on paper, the students should:

1. Click on the "Investigator" icon after opening up the software.
2. They should then click on their teacher's name in the "Theme Box" and then click on "New Project" in the "Project Box" to start their program.
3. The window that opens should say "Program Level 1". The box on the upper right of the window (it should say Program 1) can be highlighted and the students can type in a name for their program.

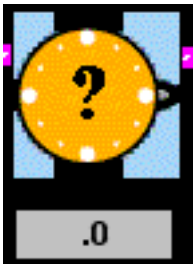
4. In the project work area, holding down the mouse over the picture & selecting the icon desired can change the icons on

the screen. The students should select the temperature sensor with the °F.

5. Under the temperature icon on the program, a data-sampling icon will automatically come up (see below). This takes data for the time indicated. In this case it is for every second. The

students can change the time data points are taken by holding down on this icon & selecting a different picture. For this challenge, one second is the correct amount of time.

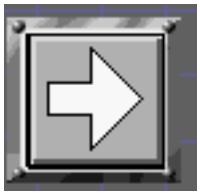
6. To the right of the temperature icon will be a "wait for command". The amount of time to sample data is selected here. The students should select the watch with the question mark



(see below).

- In the gray space underneath the watch they should type in the amount of time desired. In this case the students should type in 25.

7. When they have finished selecting the program, the students can click on the arrow (see below) under the icons to download their program on the RCX. (Be sure the RCX is turned on).



8. They should then use the RCX to take temperature data for their first water source.

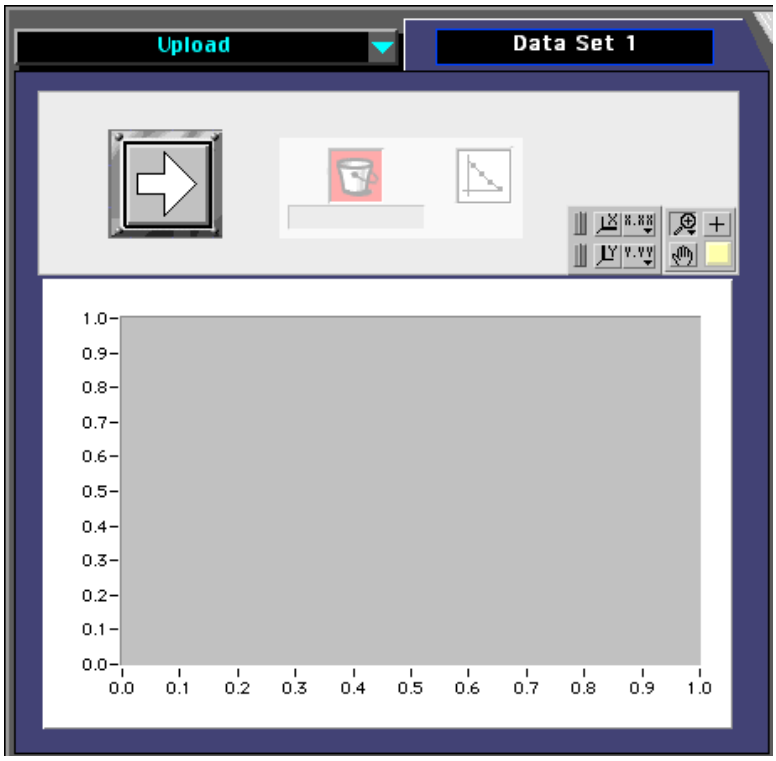
    - This is done by connecting one end of the temperature sensor to port 1 and placing the other end of the sensor in the sample of water.
- Turn the RCX on using the red on/off button
- Push the green "Run" button to collect the data. The students will notice the little person on the RCX readout screen appears to be running.
- When the person stops running the data is finished being collected.

9. When finished collecting data, the students need to upload

their data onto their program on the computer. Using window to the left side of the screen (see above),

- Select the "paper with the arrow" icon.

- This window will come up to the right:



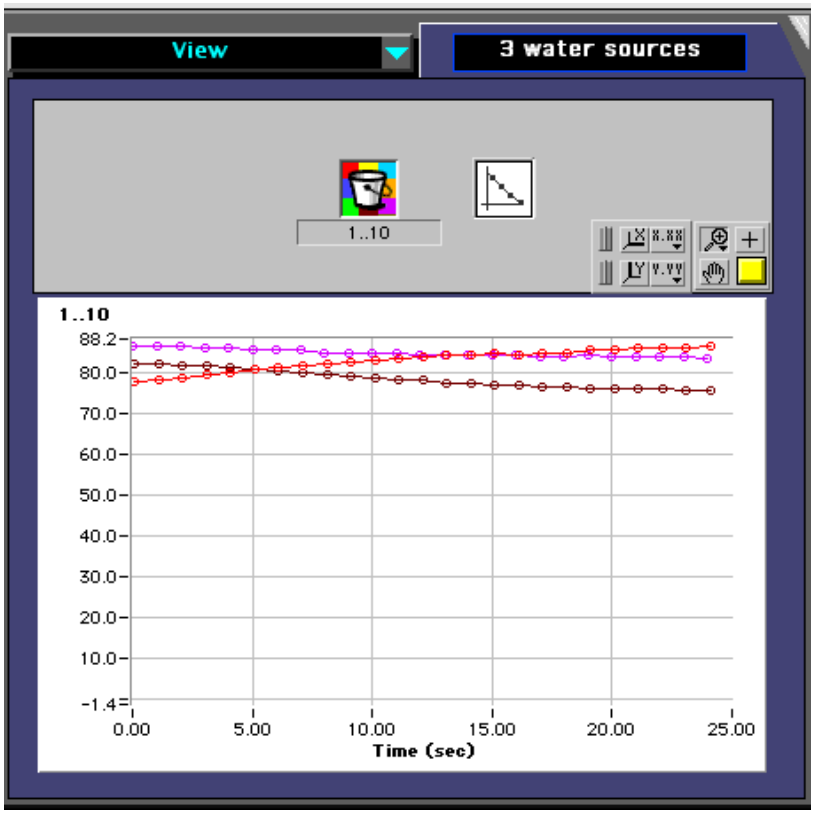
- The students can click on the arrow to upload the data. The RCX must be on & pointing to the tower to do this.
- When finished uploading they can then highlight "Data Set 1" and type in a name for the source of their water.
- The students need to give each set of data a different bin (or bucket) color. To do this, hold down the bin icon & select the desired color. Click underneath the bin to type in the water source name.

10. The students should repeat these step 1-9 for the other two water sources.

Analysis:

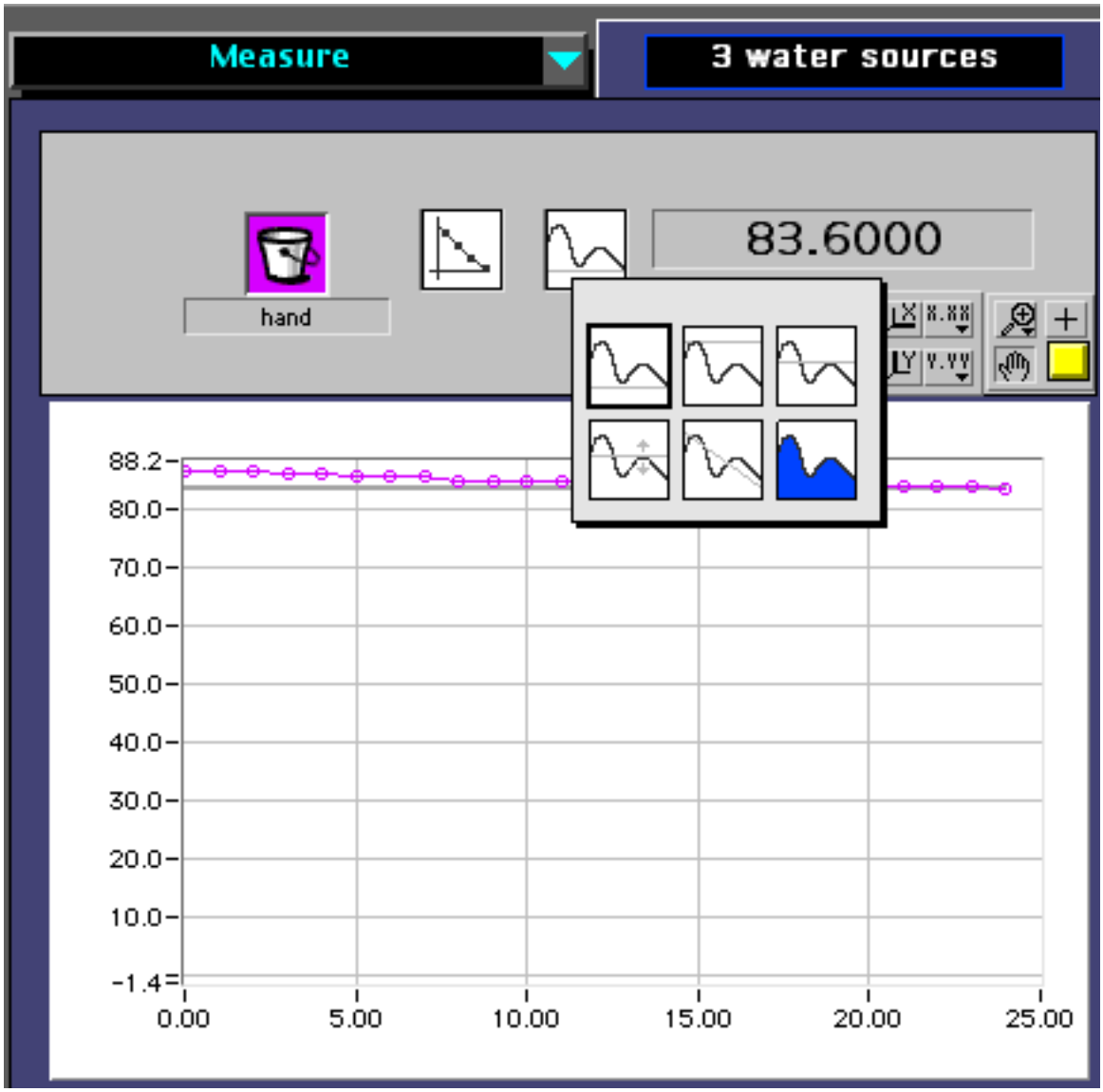
Distribute the Scientist's Data Analysis Recording Sheet for this part of the lab. Analysis is done in the "View and Compare Area" of the software. Click on the double bin icon (see below).

- After clicking on the View and Compare icon, the screen to the right looks like this:



- The multicolored bin compares all 3 sets of data. Using this work area, the students should describe each graph and read the maximum and minimum temperatures for each water source, recording their responses on their Scientist's Data Analysis Recording Sheet.

Next students will get into the "Measure" template in this work area. By holding down the "View" template, students can select the "Measure" template. The screen should look like:

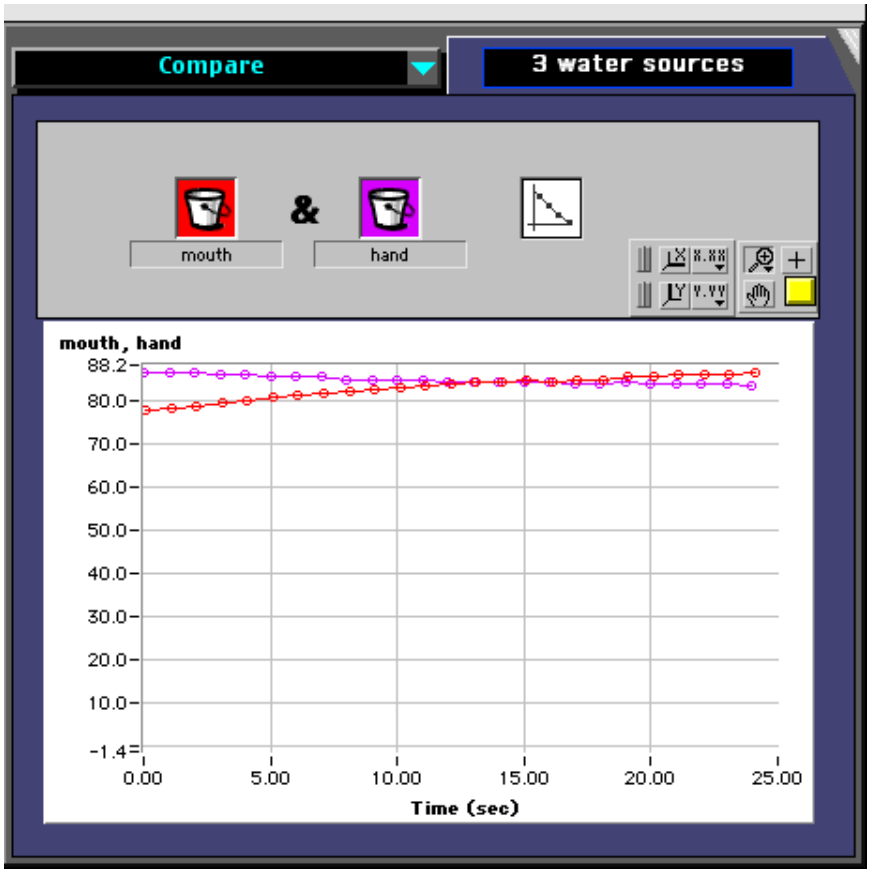


This area of the software allows students to select the maximum and minimum buttons to get the exact value for their sample. For each water sample, the students should click on the maximum, minimum and the mean buttons to find out the exact value. This temperature should be recorded on their response sheet.

Maximum Value Minimum Value Mean Value

(average)

Finally the students can click on the "Compare" template in this work area. By holding down the "Measure" template, students can select the "Compare" template. The screen should look like:



By selecting two bins of their data, students can compare their data and record their observations on the response sheet.

Extensions:

- Students can run a comparison analysis using degree Celsius (°C)
- Students can test warm water samples
- Students can write a program that includes music or sound (plays a sound if a certain temperature is reached)
- Students can design another experiment using the temperature sensor to answer a student designed question
- Students can design an experiment to test the accuracy of the thermometers

Assessment:

- Student Scientist's Data Analysis Recording Sheet
- Student Engineer's Programming Sheet
- completion of the challenge with teacher interview and observations
- successful programming and analysis of the temperature data

Trouble Shooting:

- some students will be very familiar with using Robolab sensors and software while other students will have limited experience

RCX Use Reminders:

- Attach the temperature sensor to ports 1,2 or 3
- If the students drop the RCX, or you change its batteries, it may loose its firmware (its "brains") & may not work properly.
- If the firmware is missing on the RCX, the four zeros will be missing on the readout of the RCX. It will not run properly. To download the firmware, go into the "administrator" and select "download firmware". (Be sure that the RCX is turned on & pointing at the tower.) Downloading firmware can take 3-4 minutes. When finished click on "Test RCX Communication" to check the firmware.

Resources:

Lego Dacta "Simple and Motorized Machines" teacher guide
Robolab: Setting Started; Lego 1998
Robolab: Setting Started 2; Lego 1999

links to web sites
Tufts Engineering www.ceeo.tufts.edu/curriculum

Engineer: _____ Date: _____

Partner: _____

Scientist's Data Analysis Recording Sheet

After clicking on the View and Compare icon, select the multicolored bin to bring up all 3 graphs to compare. Complete the table below about the graphs.

Water Source	Highest Temperature (°F)	Lowest Temperature (°F)	Bin color	Describe the shape of this graph

Next hold down the "View" button and select the **"Measure"** template. Using the maximum, minimum and mean icons complete the table below.

Water Source	Bin Color	Maximum Temperature (°F)	Minimum Temperature (°F)	Mean Temperature (°F)

Finally hold down the "Measure" button and select the **"Compare"** template.
Select 2 sets of water data by selecting their colored bin.
Our two water sources are: _____ &
_____.

- At what time is the water temperature the same for these 2 water samples? _____ What temperature is it? _____

Now compare 2 other sets of data. Write your answers on the back.

Engineer: _____ Date: _____

Partner: _____

Engineer's Programming Sheet

Your programming challenge is to measure the temperature of a water source for 25 seconds collecting data points every second. Use the icons on the Programmer's Icon Sheet to plan out your program.

Program:

1. Now using your **Program**, program the computer by-
- Click on the "Investigator" icon after opening up the Robolab software.
- Click on your teacher's name in the "Theme Box" and then click on "New Project" in the "Project Box"
    - Save under both partner's names

2. Use the **Programming Help Card** to put your program on the computer if needed
3. Download the program on to your RCX.
4. Collect data on the RCX.

5. Use the **Uploading Help Card** to upload your data, recording the name of the water source on the program.
6. Repeat steps 1-5 for the other two water sources. Click on the "+" sign to give you a new page for each set of data. Be sure to give each data set a different **color**.

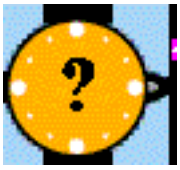
Programmer's Icon Sheet

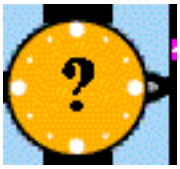
Cut and paste the icon desired on your "Engineering Programming Sheet"

Port 1 –

Sensor

Wait for Command (time interval):

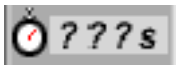




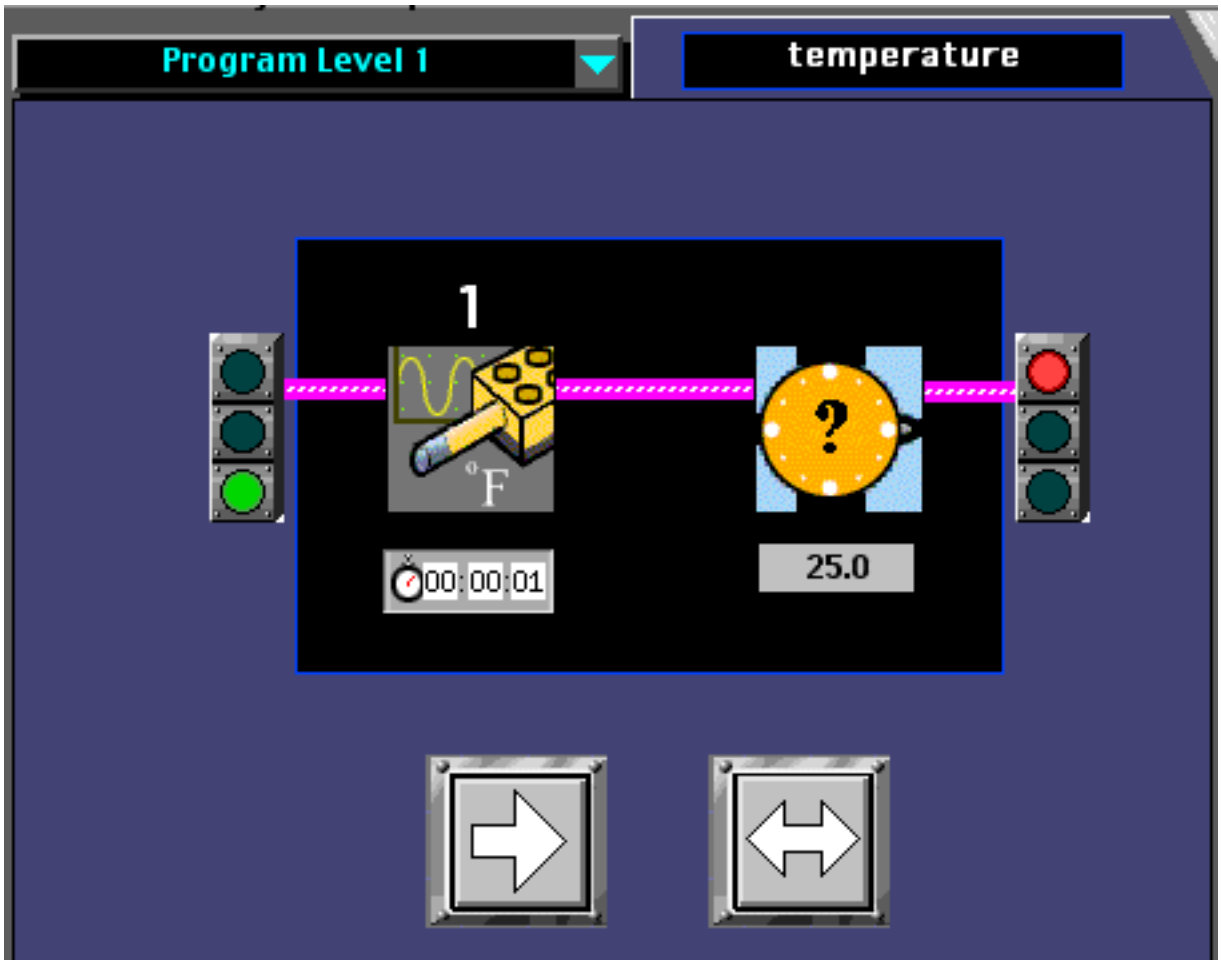
Time between data points: write in the time desired

Data sampling:

for 1 second for 1 minute for 1 hour you pick the time



Solution to programming challenge:



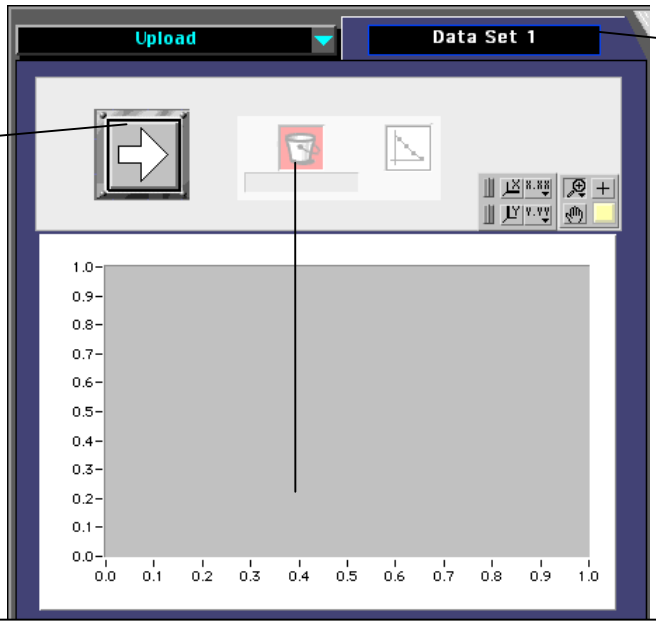
Uploading Help Card: Measuring Temperature

First:

Select this **Upload** icon to upload your data from the RCX

Click the plus sign, "+", for a new page for each new set of data

Then:



Click here to upload your data from the RCX to the computer. Be sure the RCX is turned on & pointing towards the tower.

Highlight, delete & type in a title for your data

When highlighted, the color of this bin or bucket can be changed. Give each set of data a different color by holding down the bin & selecting a different color.

Data Analysis Help Card: Measuring Temperature

First:

Select this **View and Compare** icon to analyze your data after uploading it from the RCX.

Then:

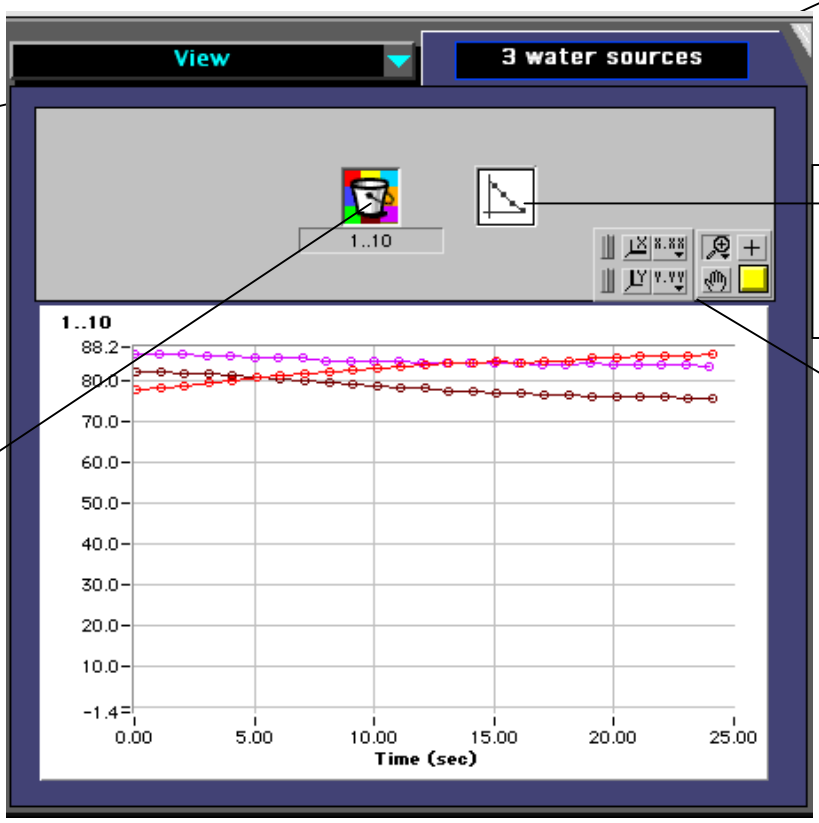
Name can be changed here

Hold down & select windows for **Measure** and **Compare** for analyzing data

Select type of graph by holding down this icon

The colored bins of your data can be selected for analysis. Multicolored bin shows all data.

Graph Tools allow you to change the way the graph looks by autoscaling x or y axis to your data, zooming in/out, grabbing parts of graph or change screen size of graph



Programming Help Card: Measuring Temperature

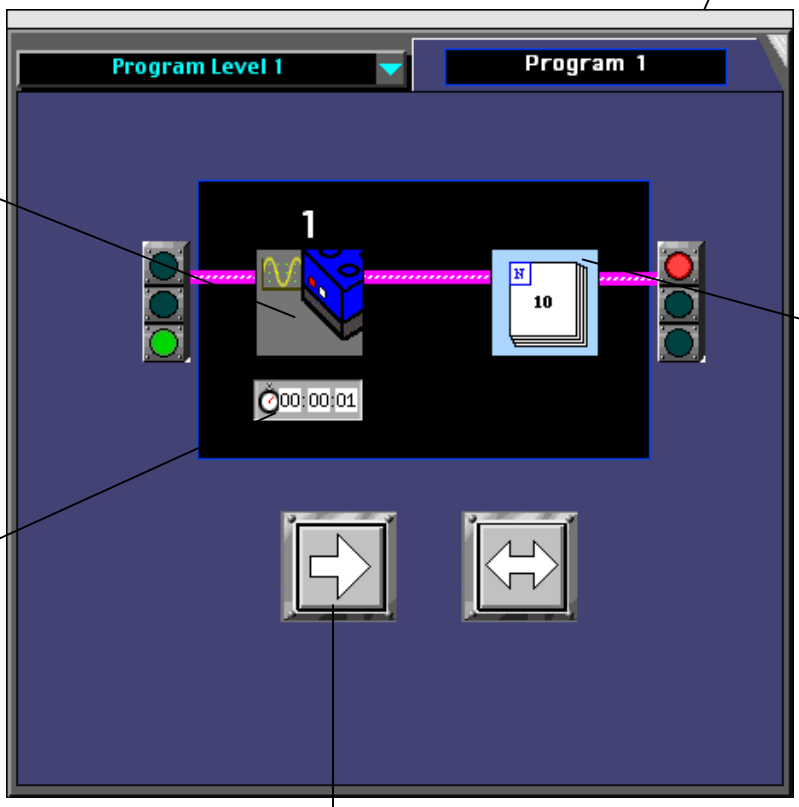
First:

Select this **Programming** icon to write your program in Robolab

Then:

Highlight, delete & type in a title for your program

Hold down to select a different sensor



Hold down to select a different data sampling time

Hold down to select a different "wait for command" (time interval)

Click here to download your program on to the RCX. Be sure to turn the RCX on by pressing the red on/off button

Grade Five

Lesson Four: Design your own Water Temperature Experiment

Lesson Objective: To use a temperature sensor to measure and analyze the water temperature for a particular question posed by the students.

Learning Objectives:

- Use the scientific method to solve a student-generated question.

Challenge: To use the temperature sensor to investigate a student-generated question.

Sample questions for the students to investigate:

- Does blowing on your hot chocolate really cool it faster than letting it sit out?
- Do different types of cups hold heat better?
- Does putting ice in a beverage really cool it off faster?
- What is the optimum temperature to drink hot chocolate?

Materials:

Engineer's Programming Sheet
Programmer's Icon Sheet
Scientist's Experiment Sheet
Robolab software
RCX
Robolab Temperature sensor

Vocabulary:

Hypothesis

Investigate

Procedure:

The lesson begins with review of temperature and the previous RCX investigation. Questions you might ask could include:

- What were some of the things you found out about the water samples you tested?
- What other questions came up because of your investigation?

The students should then be instructed to think about a question that could use the temperature probes to find the answer. They should write a question that they would like to investigate. The question is called a hypothesis. A good scientific investigation includes a hypothesis that can be tested. Some ideas of things the students could test are:

- Does blowing on your hot chocolate really cool it faster than letting it sit out?
- Do different types of cups hold heat better?
- Does putting ice in a beverage really cool it off faster?
- What is the optimum temperature to drink hot chocolate?

After deciding on a question or hypothesis, the students should complete the Scientist's Experiment sheet.

Extensions:

- Students can redesign their experiment to test some other problem that arose with their experiment

Assessment:

- Student lab report
- Student Engineer's Programming Sheet
- completion of the challenge with teacher interview and observations

Trouble Shooting:

- some students will be very familiar with using Robolab sensors and software while other students will have limited experience

RCX Use Reminders:

- Attach the temperature sensor to ports 1,2 or 3
- If the students drop the RCX, or you change its batteries, it may loose its firmware (its "brains") & may not work properly.
- If the firmware is missing on the RCX, the four zeros will be missing on the readout of the RCX. It will not run properly. To download the firmware, go into the "administrator" and select "download firmware". (Be sure that the RCX is turned on & pointing at the tower.) Downloading firmware can take 3-4 minutes. When finished click on "Test RCX Communication" to check the firmware.

Resources:

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Robolab: Setting Started; Lego 1998
Robolab: Setting Started 2; Lego 1999

links to web sites
Tufts Engineering www.ceeo.tufts.edu/curriculum

Engineer: _____ Date: _____

Partner: _____

Scientist's Experiment sheet

Our Hypothesis, or question to be investigated:

_____

_____

_____

_____

_____

_____

_____

Our Procedure or steps we will follow:

- _____
  _____
- _____
  _____
- _____
  _____
- _____
  _____
- _____
  _____
- _____
  _____

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Special Materials we will need:

- _____
- _____
- _____
- _____
- _____
- _____
- _____

Our Data: what kind of data will you be collecting to investigate the hypothesis?

What assumptions have you made?

- (such as placement of the Temperature probe, size cup, volume of water in each cup, starting temperature the same in both cups)

Analysis/ Conclusion:

- What did you find out about your hypothesis?

- What other questions or problems came up in solving your hypothesis?

- How would you revise your procedure to account for these problems?

Engineer: _____ Date: _____

Partner: _____

Engineer's Programming Sheet

Use the icons on the Programmer's Icon Sheet to plan out your program to investigate your hypothesis.

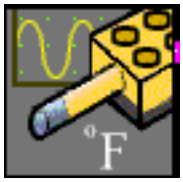
Program:

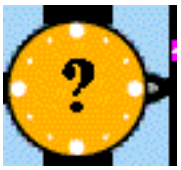
- Now using your **Program**, program the computer by-
- Click on the "Investigator" icon after opening up the Robolab software.
- Click on your teacher's name in the "Theme Box" and then click on "New Project" in the "Project Box"
    - Save under both partner's names
- Use the **Programming Help Card** (from previous temperature experiment) to put your program on the computer if needed
- Download the program on to your RCX.
- Collect data on the RCX.
- Upload your data, recording the name of the data source.
- Analyze the results.

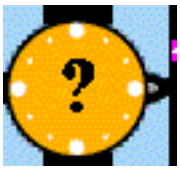
Programmer's Icon Sheet

Cut and paste the icon desired on your "Engineering Programming Sheet"

Port 1 –Wait for Command:





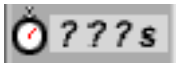


Time between data points: write in the time desired



Data sampling:

for 1 second for 1 minute for 1 hour you pick the time



Capturing the Wind

Materials:

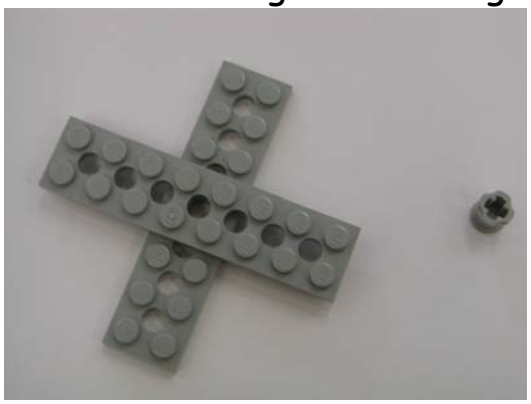
RCX
Rotation Sensor
Axle (long)
Bushings
Plates (with holes)
Thick Paper/Index Cards/Cups/etc
Tape/ Paper Clips

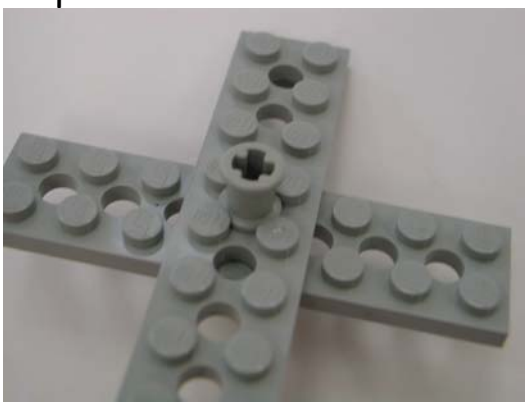
Procedure:

Building:

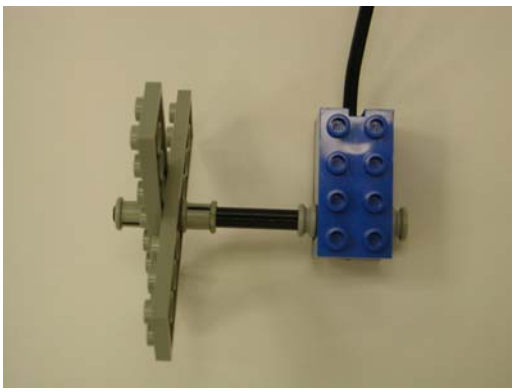
Many designs of wind sails can be used; this is a basic suggestion. Try changing the design- be creative!

Step 1: Attach two plates in a 'plus-sign' design. Be sure the holes line up where they cross! Then take a bushing and attach it to the plates as shown. Make sure the smooth edge faces up and the notched edge is touching the plate.

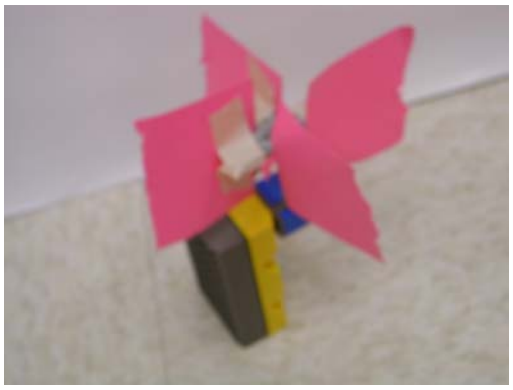


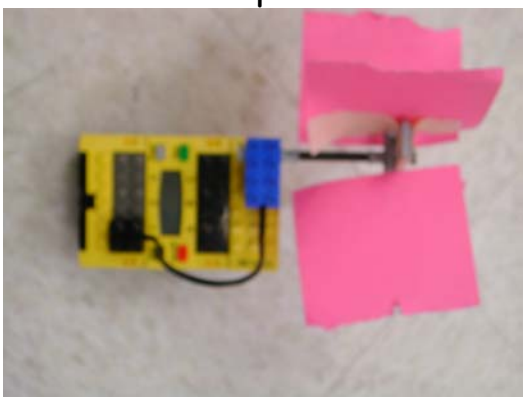


Step 2: Slide an axle through the plates and bushing. It is a good idea to secure the plates with a second bushing. Then slide the other end of the axle through a rotation sensor. Use bushings to secure the sensor also.



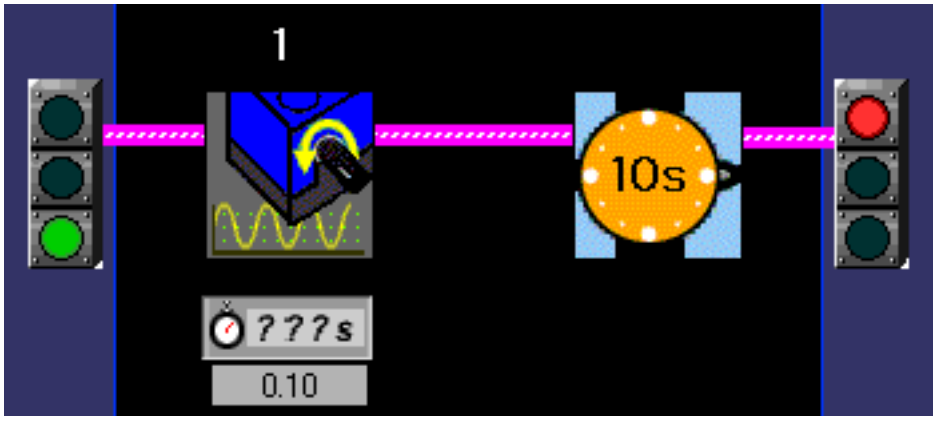
Step 3: Use thick paper, index cards, or cups to create sails. Tape or clip these to the plates. Attach the rotation sensor to the RCX. Make sure to plug the sensor onto port 1.





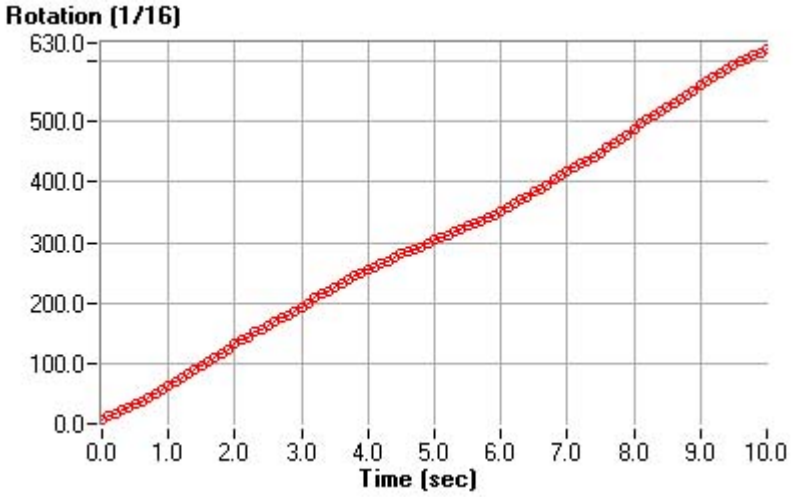
Programming:

Step 1: Open an investigator project. Write a program in level 1 to record rotation sensor data for a certain length of time. (Be sure to choose rotation not angle.) Adjust your sampling rate to something fast (a small decimal number). Your program will look like this:

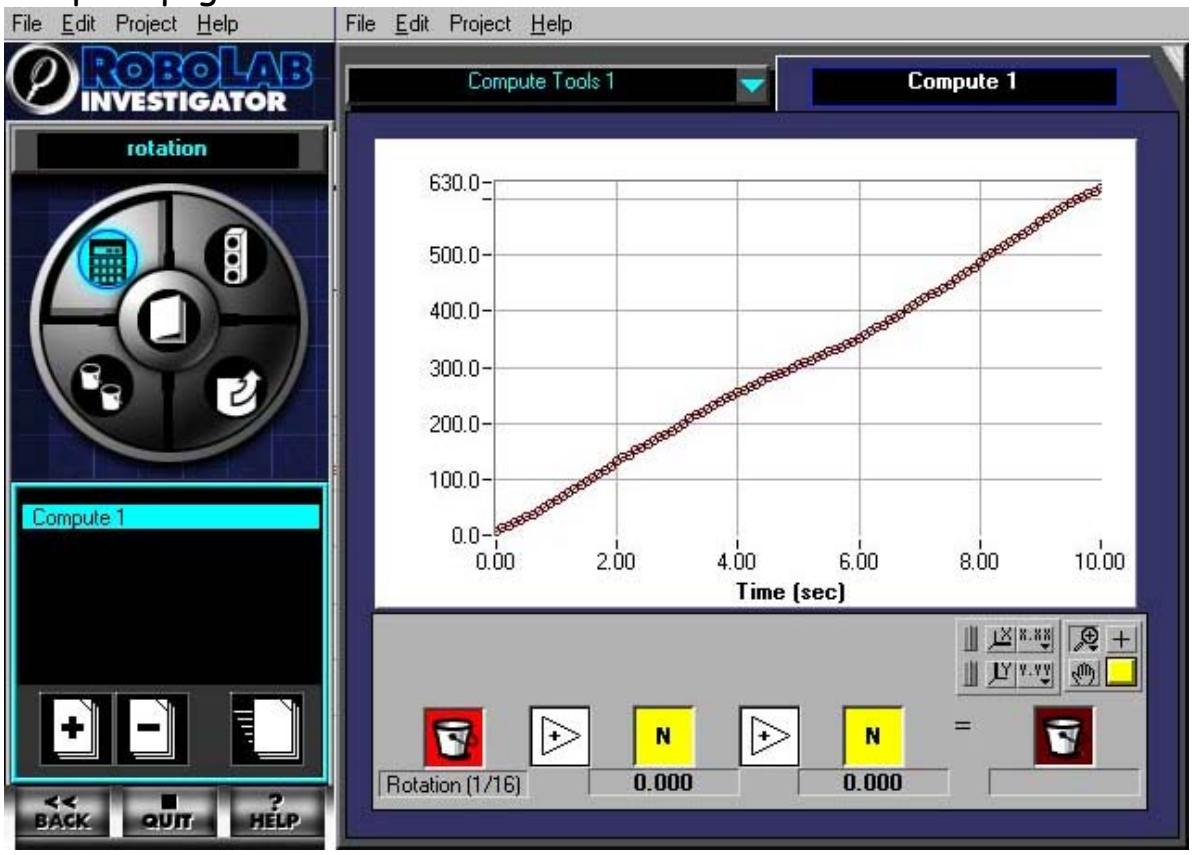


Step 2: Now you are ready to run your program. Download your program to the RCX and go measure the wind speed. Be sure your sails are spinning before you hit the RUN button.

Step 3: Upload your data. If the wind speed was constant, the graph will look like this:



Step 4: The rotation sensor measures in sixteenths of a rotation. (One full rotation of the axle would give you a reading of 16). In order to convert the data from sixteenths, go to the compute page. Your screen will look like this:



Step 5: Now use the compute tools to divide the red bin (where your data is) by 16. This will make the y-axis the number of rotations.

Step 6: Now you can change the color or label of your graph as you wish. To do this, click on the bin after the equal sign. Select the color you would like. To change the label, click on the box below the bin. Type in a new name for that bin. For example: