ACTIVITY CONTENTS:

Hot and Cold Cups

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Hot and Cold Cups Introduction

Discovery Question: How can I keep hot drinks hot and cold drinks cold?

This activity allows you to investigate how different kinds of containers keep solutions hot or cold.

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Thinking About the Question

How can I keep hot drinks hot and cold drinks cold?

We all like out hot drinks hot and our cold drinks cold. If we drink quickly it is no problem. However, if we wait for awhile the desired temperature is gone. Have you ever had the experience of pouring a cup of hot chocolate after coming inside on a cold day? You take a few sips, but it's too hot. Then you put it down and forget about it for awhile. When you remember your drink, it has cooled off so much it is no longer a hot drink.

You probably have noticed a variety of drink cups in the supermarket. There are paper and Styrofoam hot cups, as well as paper and plastic cold cups. Which one does the best job of keeping your drinks at just the right temperatures for the longest time? How can we find out?

Think about your experiences with various kinds of cups. Which would you choose as the best cup? On what basis would you make your choice? In your group discuss and make a list about your ideas about what variables might affect how long drinks stay hot or cold. Be prepared to discuss your ideas with the class.

Today you will test one of the variables that you identified. In your group write out the procedure you would follow if you wanted to know whether the material of the cup affected how long water stayed hot or cold. You will be able to use a temperature probe that is connected your computer to help in your investigation.

Go to the "Investigating the Question" after you have had a chance to discuss the procedure with the class.

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Hot and Cold Cups Materials

- temperature probe
- Various types of cups of equal size (Styrofoam, paper, cardboard, glass, plastic)
- crushed ice or ice cubes
- measuring cup or 100 ml transfer container for each group
- room temperature water
- warm water from coffee pot
- computer disk (for saving and sharing data)
- hot plate and container suitable for boiling water

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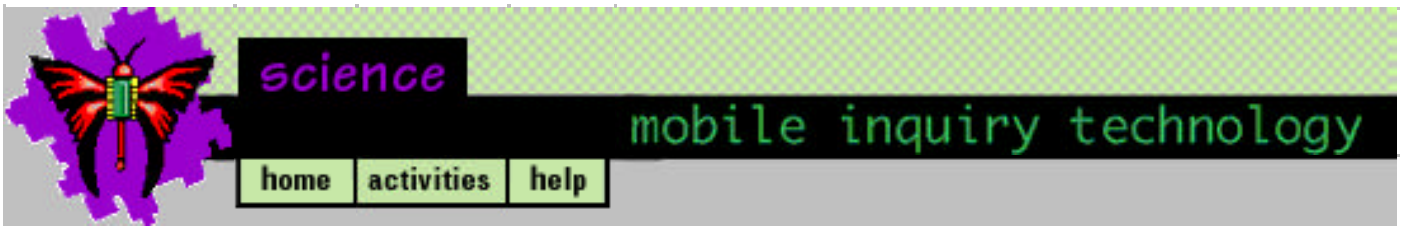

Hot and Cold Cups Safety

No specifc safety features needed for this activity.

Hot and Cold Cups Investigation I

Warming chilled water

1. Obtain a temperature probe and connect it to the computer. Start the DataLogger software. Refer to Technical Hints to see how to use the Data Logger software. Set the scale to 0 to 100 degrees Celsius. Set the program to run for 30 minutes.

2. Place 100 ml of chilled water in a cup of water. Let the probe record the temperature for 30 minutes.

3. While the probe is running, design a spreadsheet that records the types of cups found throughout all of the groups. Look at the sample set of cups at the front of the room to determine the headings. Refer to Technical Hints to create a spreadsheet.

4. In your group first, observe and record all the differences in the cups. Next, discuss and predict what will happen to the temperature of the cold water in the plastic, paper, and Styrofoam cups.

5. When the temperature recording is finished, enter the data into your spreadsheet by directly transferring data from the DataLogger program to your spreadsheet. Refer to Technical Hints to transfer data to the spreadsheet.

6. Answer question 1 in the "Analysis".

7. By sharing computer disks between groups, add the data from each group that used another kind of cup to your spreadsheet. Ask your teacher to see how to save and share your data.

8. Create a x-y line graph for all of the data for each kind of cup. Refer to Technical Hints to create a x-y line graph from your spreadsheet. Your graph will have a line for each kind of cup.

9. Answer question 2 in the "Analysis".

Hot and Cold Cups Investigation II

Cooling warm water

1. Place 100 ml of warm water in a cup of water. Let the probe record the temperature for 30 minutes. Make sure to set the scale to 0 to 100 degrees Celsius and the run time for 30 minutes. Refer to Technical Hints to see how to use the Data Logger software.

2. Design a new spreadsheet that records the types of cups found throughout all of the groups. Look at the sample set of cups at the front of the room to determine the headings. Refer to Technical Hints to create a spreadsheet.

3. When the temperature recording is finished, share data between groups that used another kind of cup to your spreadsheet. Ask your teacher how to make the transfer. Enter the data into your spreadsheet by directly transferring data from the DataLogger program to your spreadsheet. Refer to Technical Hints to transfer data to the spreadsheet.

4. Create a x-y line graph for all of the data for each kind of cup. Refer to Technical Hints to create a x-y line graph from your spreadsheet. Your graph will have a line for each kind of cup.

5. Answer questions 3-5 in the "Analysis".

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Hot and Cold Cups Investigation III

Observing overnight results

1. What would happen to the temperature of the water in the cups if you if left overnight? After discussing within your group, record your predictions on paper. Leave your cup out in an assigned location overnight.

2. Test the temperature of the cup in the morning with the temperature probe. Make sure to set the scale to 0 to 100 degrees Celsius. Refer to Technical Hints to see how to use the Data Logger software.

3. Report the temperature to the class.

4. Answer questions 6-7 in the "Analysis".

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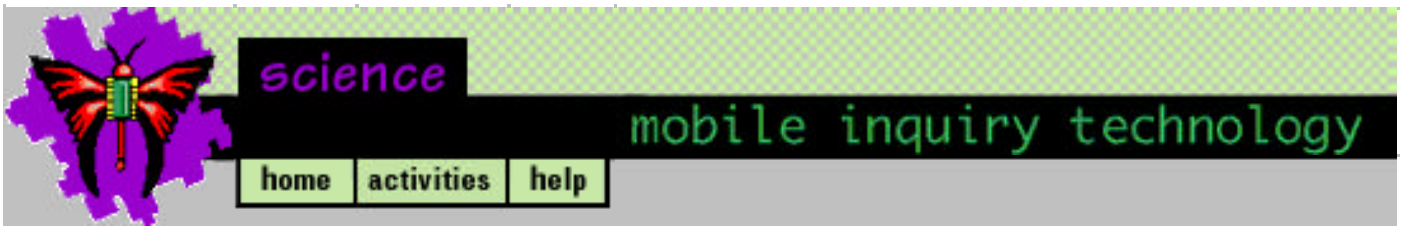

Hot and Cold Cups Technical Hints

- Using Data Logger software
- Creating a spreadsheet
- Transferring data to the spreadsheet
- Creating a x-y line graph from your spreadsheet

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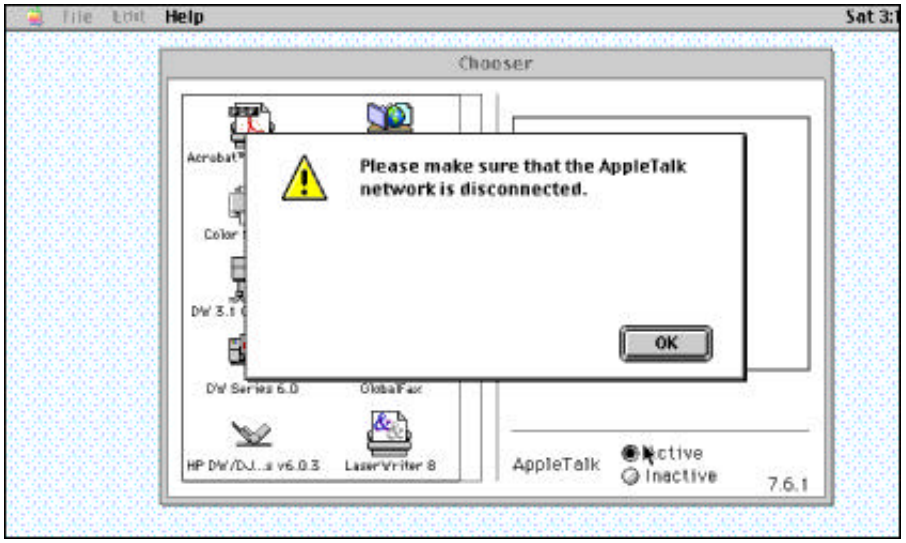
Hot and Cold Cups Technical Hints

To use Data Logger software with temperature probe:

1. Open the Chooser from under the Apple menu. Make sure AppleTalk is inactive.

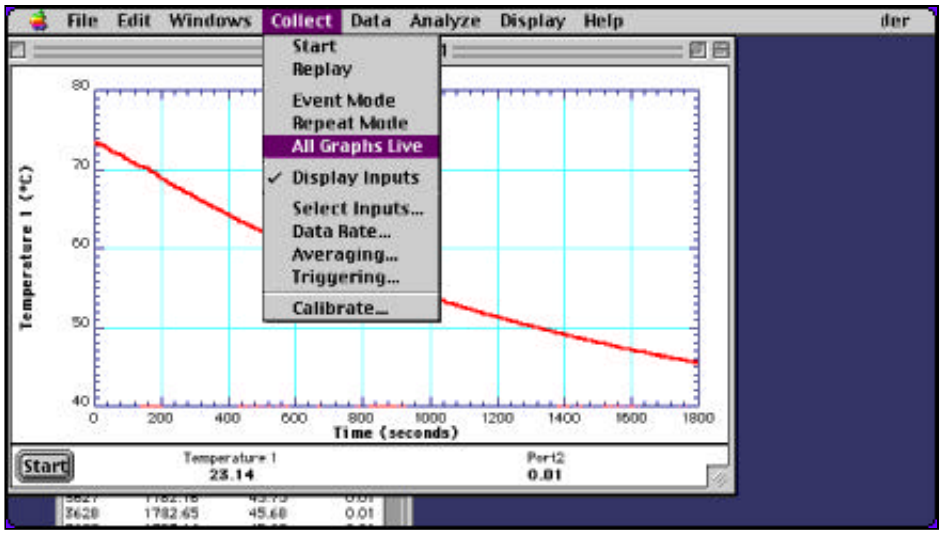


2. Attach the temperature probe to the serial port at the back of the computer.

3. Double click on file named "cctemperature". It will automatically ask you if you want to load the "cctemperature.CLB" (calibration file for temperature probe). Click OK.

4. Select the Collect menu and choose Data Rate. For this activity select 10 points per minute.

5. From the Display menu select One Graph. Also from the Display menu choose Set All Min, Max. For this experiment, select 0-30 for minutes and 0-100 for degrees Celsius. Click OK.



6. Click Start to begin to collect data.

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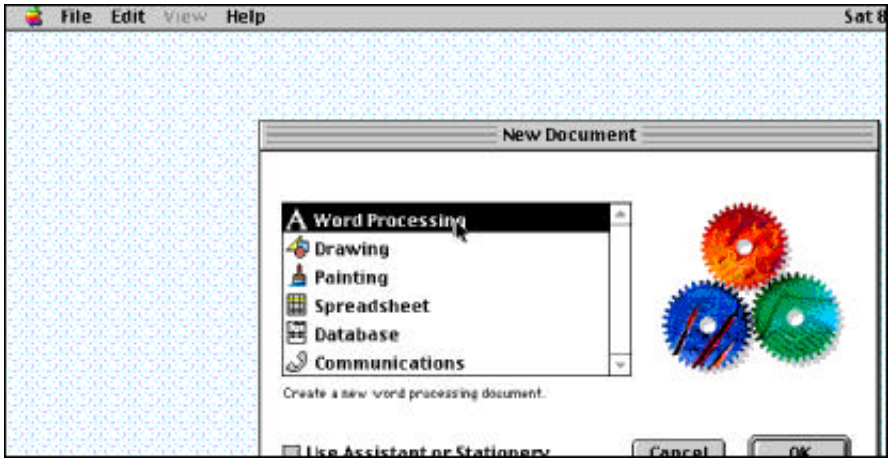
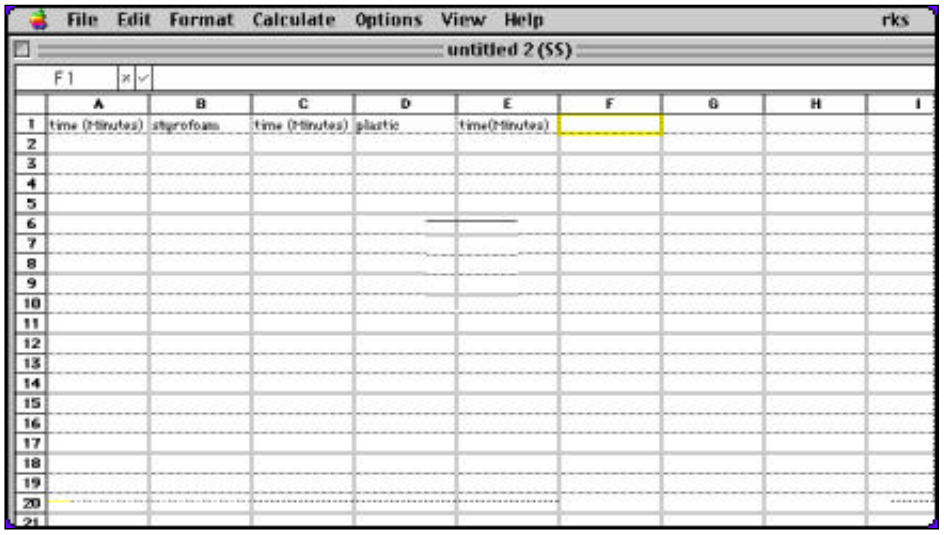
Hot and Cold Cups Technical Hints

To create a spreadsheet:

1. Select the spreadsheet option in ClarisWorks.



2. In Cell A1 type in time (minutes). Type first kind of cup in Cell B1. Each pair of adjoining columns must have time (minutes) and type of cup to create an x-y line graph.



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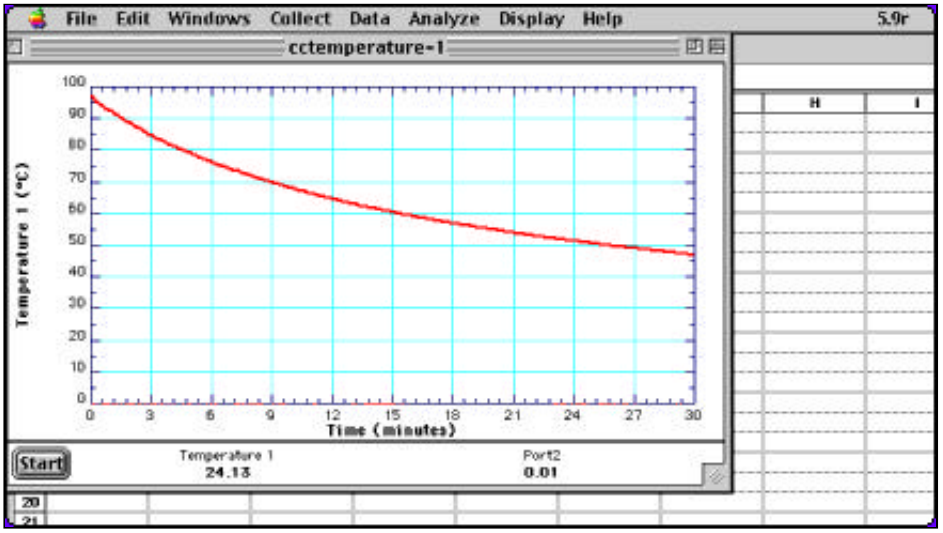
Hot and Cold Cups Technical Hints

To transfer data to the spreadsheet:

1. From the Windows menu in DataLogger, select Data A Table. Highlight all of the data in the first two columns. Press on the Open Apple key (next to the space bar) and the C key at the same time. The Edit menu should blink.

2. Move to your spreadsheet. Highlight Cell A1 and B1. Select Paste (or press the Open Apple key and the V key at the same time) to paste your data into the spreadsheet.



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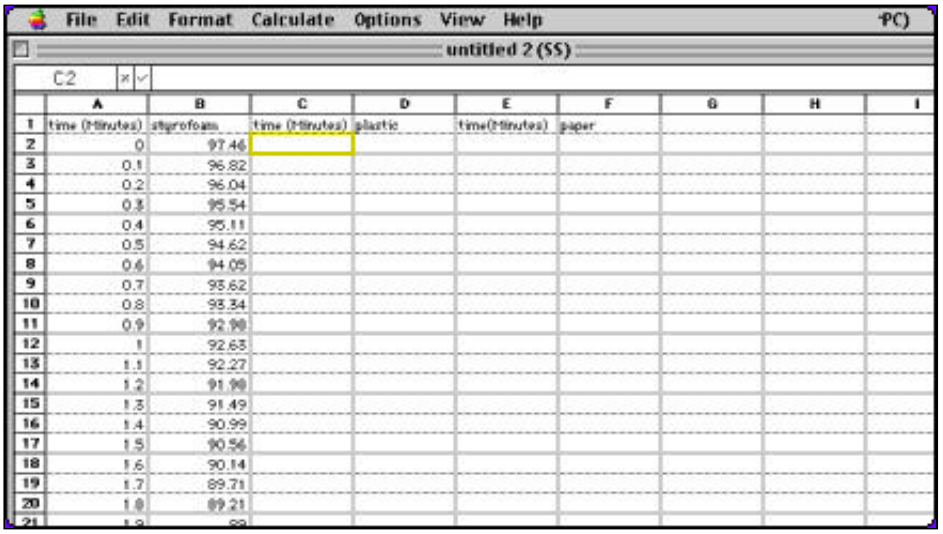
Hot and Cold Cups Technical Hints

To create a x-y line graph from your spreadsheet:

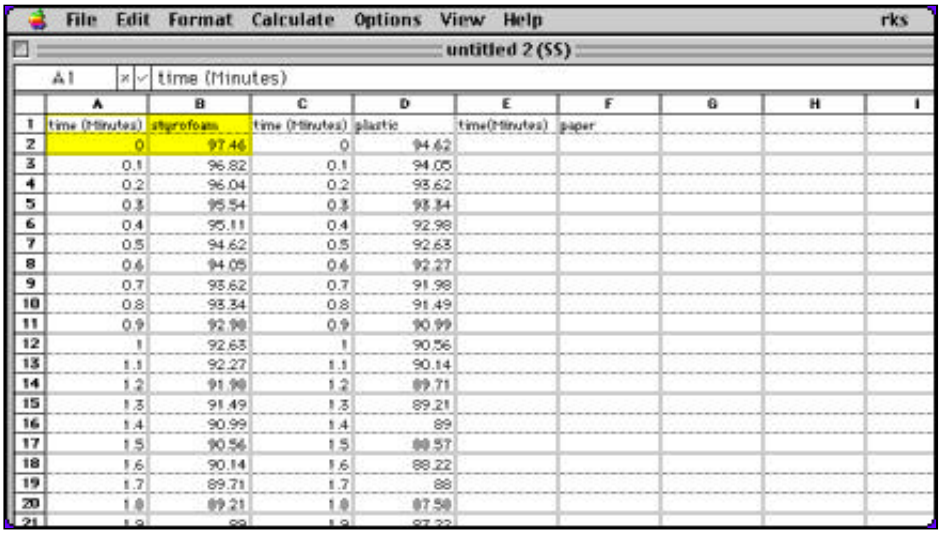
1. Highlight all data and title starting with Cell A1 in your spreadsheet. Select Make Chart from the Options menu. Choose the x-y line graph button.

2. Click on the Series button and choose the solid circle. Click OK.



	A	B	C	D	E	F	G	H	I
1	time (Minutes)	styrofoam	time (Minutes)	plastic	time(Minutes)	paper			
2	0	97.46							
3	0.1	96.82							
4	0.2	96.04							
5	0.3	95.54							
6	0.4	95.11							
7	0.5	94.62							
8	0.6	94.05							
9	0.7	93.62							
10	0.8	93.34							
11	0.9	92.98							
12	1	92.63							
13	1.1	92.27							
14	1.2	91.98							
15	1.3	91.49							
16	1.4	90.99							
17	1.5	90.56							
18	1.6	90.14							
19	1.7	89.71							
20	1.8	89.21							
21	1.9	88							

3. When adding more sets of data, transfer time (minutes) and temperature into the adjoining columns. Highlight the titles and all of the data and select Make Chart from the Options menu. Choose the x-y line graph button. Click the Series button and choose the solid circle. Click OK.



	A	B	C	D	E	F	G	H	I
1	time (Minutes)	styrofoam	time (Minutes)	plastic	time(Minutes)	paper			
2	0	97.46	0	94.62					
3	0.1	96.82	0.1	94.05					
4	0.2	96.04	0.2	93.62					
5	0.3	95.54	0.3	93.34					
6	0.4	95.11	0.4	92.98					
7	0.5	94.62	0.5	92.63					
8	0.6	94.05	0.6	92.27					
9	0.7	93.62	0.7	91.98					
10	0.8	93.34	0.8	91.49					
11	0.9	92.98	0.9	90.99					
12	1	92.63	1	90.56					
13	1.1	92.27	1.1	90.14					
14	1.2	91.98	1.2	89.71					
15	1.3	91.49	1.3	89.21					
16	1.4	90.99	1.4	89					
17	1.5	90.56	1.5	88.57					
18	1.6	90.14	1.6	88.22					
19	1.7	89.71	1.7	88					
20	1.8	89.21	1.8	87.58					
21	1.9	88	1.9	87.32					

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Hot and Cold Cups Analysis

Answer the following questions on paper:

1. Write a paragraph to explain how the temperature of the cold water changed in your cup? Make sure to include important information such as the change in temperature, the starting and ending temperature, and the range of your temperature data.

2. Observe the graph of the all of the types of cups. Write a paragraph comparing the differences in how the cold water changed temperatures in different kinds of cups.

3. Write a paragraph to explain how the temperature of the warm water changed in your cup? Make sure to include important information such as the change in temperature, the starting and ending temperature, and the range of your temperature data.

4. Oberve the graph of the all of the types of cups. Write a paragraph comparing how the warm water changed temperatures in different kinds of cups.

5. Which kind of cup did the best job of keeping hot water hot and cold water cold? Explain your reasons.

6. How did your test results compare to your prediction when your cup stayed out all night? How did the temperatures from the other groups compare to yours?

7. Are there any variables other than the kind of cup that may have affected the outcome of your experiment? For example, did the location of your cup overnight affect the temperature in the morning?

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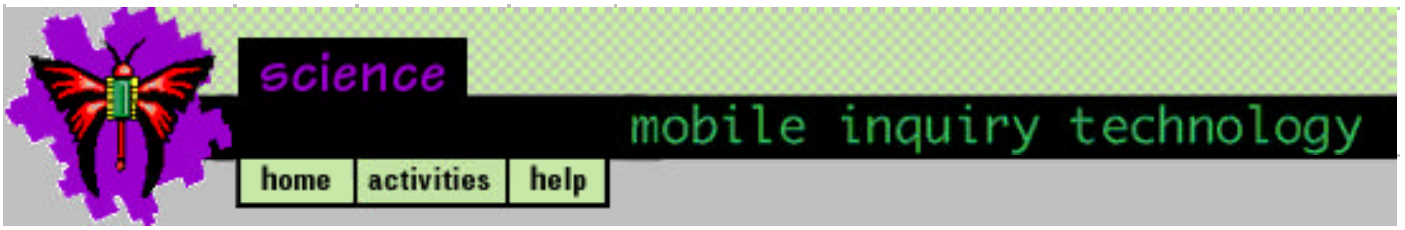

Hot and Cold Cups Further Investigation

- Investigate other variables, such as the size of the cup or amount of water in the cups that may cause differences in temperature.
- Design and build a container that will slow the melting of a certain size ice cube.

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