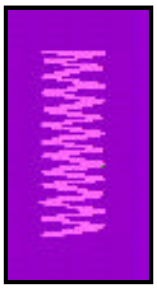
ACTIVITY CONTENTS:

Making Waves

back | activity contents | next

Making Waves Introduction

Discovery Question: How can motions be repeated?



This activity will investigate the making of different types of waves.

back activity contents next

Thinking About the Question

How can motions be repeated?

Some objects fall over when they are pushed or pulled while other objects move freely. Think about a tree blowing in the wind. The upper branches of the tree move with the wind. Once the wind ends, the tree sways back and forth until it comes to rest at its original position. This type of repeated motion occurs often in other situations. While you are playing with a yo-yo, the toy moves up and down and up and down. When a car is stuck in the snow, the driver rocks the car forward and backward until it is freed. An expectant father pacing in a waiting room also shows repeated motion. Can you think of any more examples of repeated motion? Discuss this question with your group and write down some of your ideas to share with the class.

Bats fly back and forth in a cave at night to find their food. While flying at night, a bat emits squeaks that reflect off the walls of caves and flying insects. These squeaks return to the bat's nervous system and are used as clues to determine the location and shape of objects. The bat can tell where the next meal is and when to avoid other objects. A sonar ranger (also called an ultrasonic detector) uses technology for a similar purpose. This type of motion detector sends out high frequency sound waves out to a target object and waits for it to come back. Bat and sonar rangers "know" how fast sound travels. By timing how long the sound travels it can determine the distance of the object.

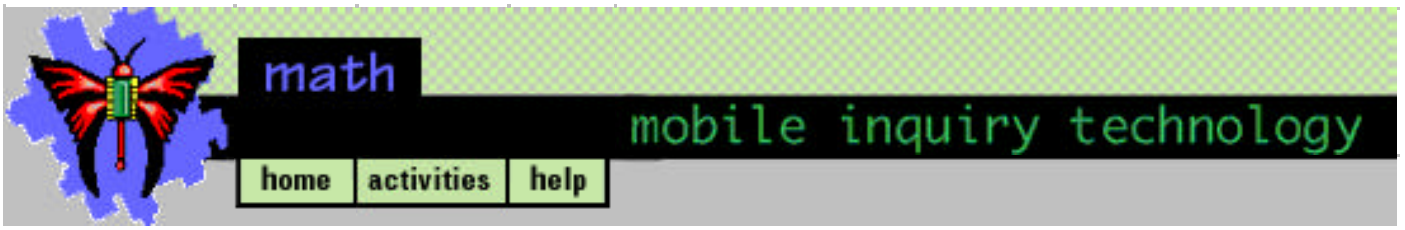
A sonar ranger uses a motion detector that sends out high frequency sound waves to a target object and waits for it to come back. The sonar ranger measures the time needed for the wave to leave and return to the detector. The software determines and displays the distance the pulse covered based on the speed of sound. Try it out for yourself with the sonar ranger! Go to the "Investigations" to find out how.

back | activity contents | next

Making Waves Materials

- sonar ranger (ultrasonic motion detector)
- CCSR (sonar ranger) software
- small flat box with lid

back activity contents next



Making Waves Safety

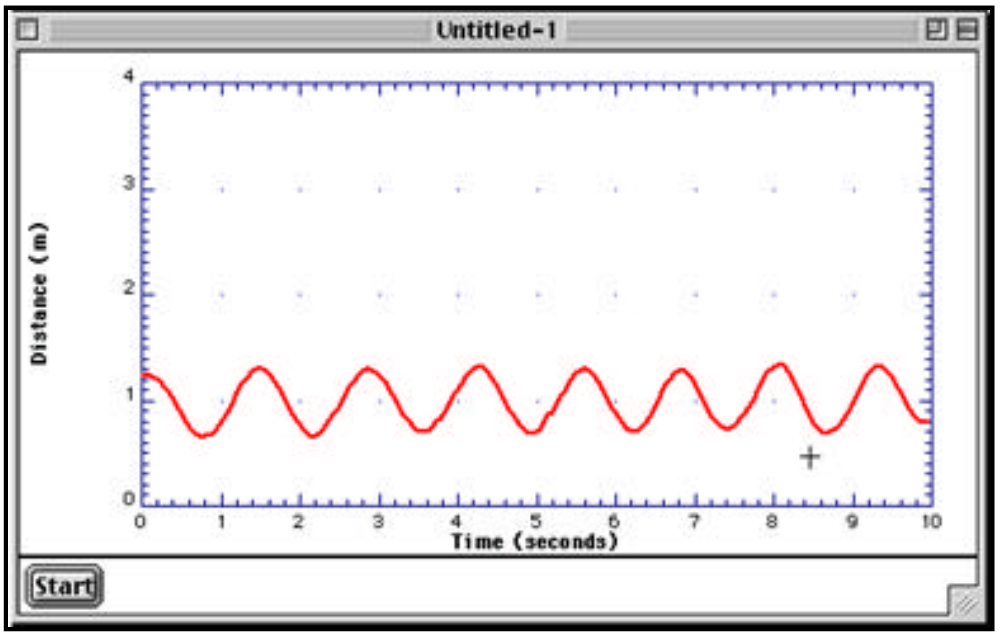
If more than one sonar ranger is used in a classroom, separate each probe by at least two meters to prevent measurement interference.

back activity contents next

Making Waves Investigation I

Observing and making curved waves

Look at the following wave. This is a copy of a real sonar ranger graph. Describe the wave to your partner(s). What changes over time does it represent? How could you reproduce this type of wave using the sonar ranger? Discuss with your partner(s) the needed movement to make this type of wave.



When you are sure of your method, place a flat box in front of the sonar ranger to make a curved wave. Stand approximately 1 meter away from the sonar ranger while your partner directly points the sonar ranger at the box. Move the box back and forth to produce your wave while using sonar ranger software on the computer. Make sure that the sonar ranger software is set to one distance-time graph display. Refer to Technical Hints to run sonar ranger software. Repeat until you capture a curved wave. What motion must you make with the box? Let your partner(s) also try to make the curved wave. Print out the best graph. Refer to Technical Hints to see how to print a graph.

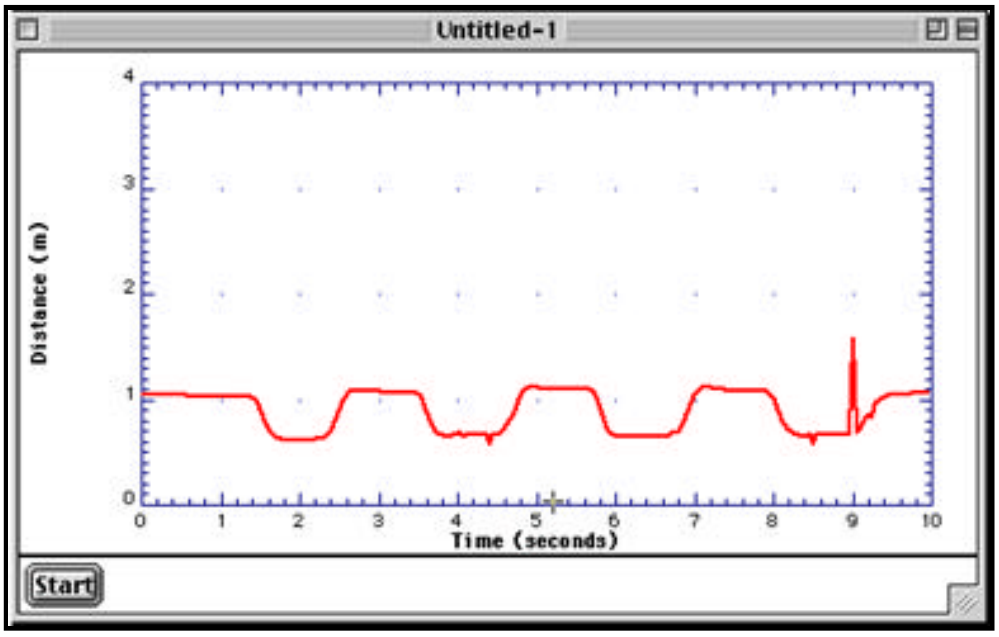
Discuss with your partners how to make taller and shorter curved waves. Test it out!

back | activity contents | next

Making Waves Investigation II

Observing and making a square wave

Observe the square wave above. This is a copy of a real sonar ranger graph. Discuss with your partner(s) how to reproduce this type of wave. What motion must you make with the box? Do you notice anything about differences or similarities in the direction or speed of the box when making a square or curved wave? Note the slight changes in the graph due to sideways movement or shaking of the box. Maybe you can do better!



When you are sure of your method, use the flat box in front of the sonar ranger to make the square wave. Stand approximately 1 meter away from the sonar ranger while your partner directs the detector at the box. Move the box back and forth to produce your wave while using the sonar ranger software on the computer. Make sure that the sonar ranger software is set to show one distance-time graph display. Refer to Technical Hints to run the sonar ranger software. Repeat until you capture a square wave. Let your partner(s) also try to make the square wave. Print out the best graph. Refer to Technical Hints to see how to print a graph.

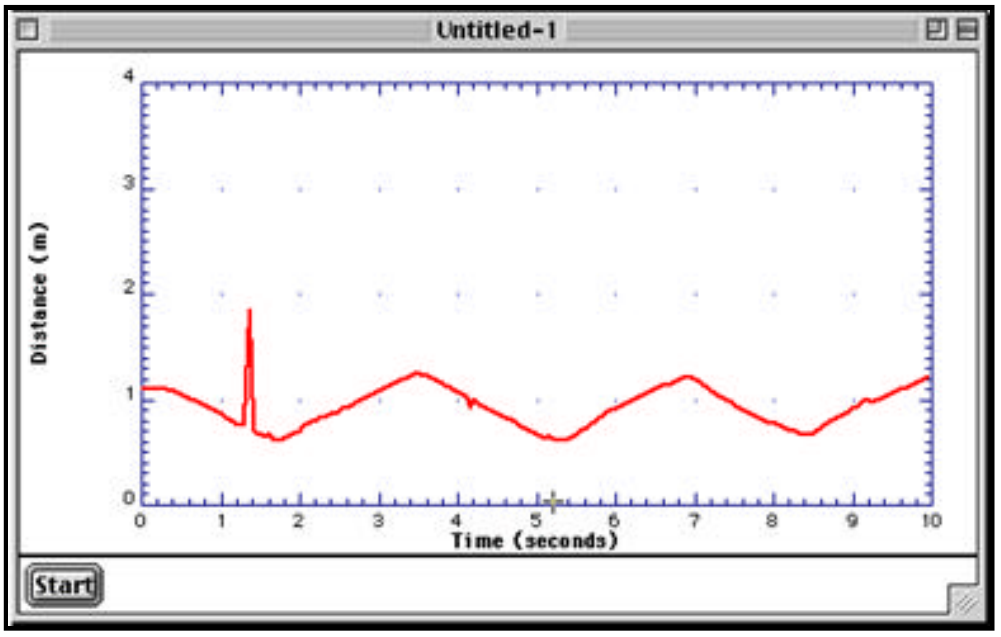
Discuss with your partners how to make wider and slimmer square waves. Test it out!

back | activity contents | next

Making Waves Investigation III

Observing and making a triangular wave

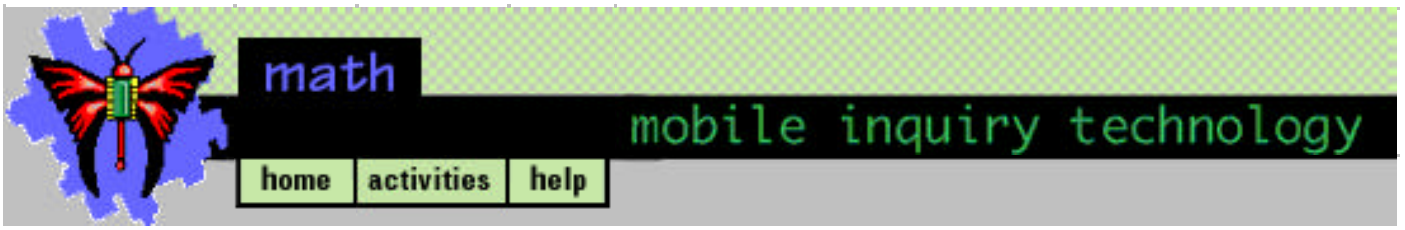
Observe the triangular wave above. This is a copy of a real sonar ranger graph. Discuss with your partner(s) how to reproduce this type of wave. This one is tough. You may choose to use the ceiling instead of the box for reflection. What motion must you make with the box? Do you need to change the direction or speed suddenly? Again, note the slight variations in the graph due to a sideways movement of the box.



When you are sure of your method, use the flat box in front of the sonar ranger to make the triangular wave. Stand approximately 1 meter away from the sonar ranger while your partner directs the detector at the box. Move the box back and forth to produce your wave while using the sonar ranger software on the computer. Make sure that the sonar ranger software is set to one distance-time graph display. Refer to Technical Hints to run the sonar ranger software. Repeat until you capture a triangular wave. Let your partner(s) also try to make the triangular wave. Print out the best graph. Refer to Technical Hints to see how to print a graph.

Discuss with your partners how to make a greater or fewer number of triangular waves. Test it out!

back | activity contents | next



Making Waves Technical Hints

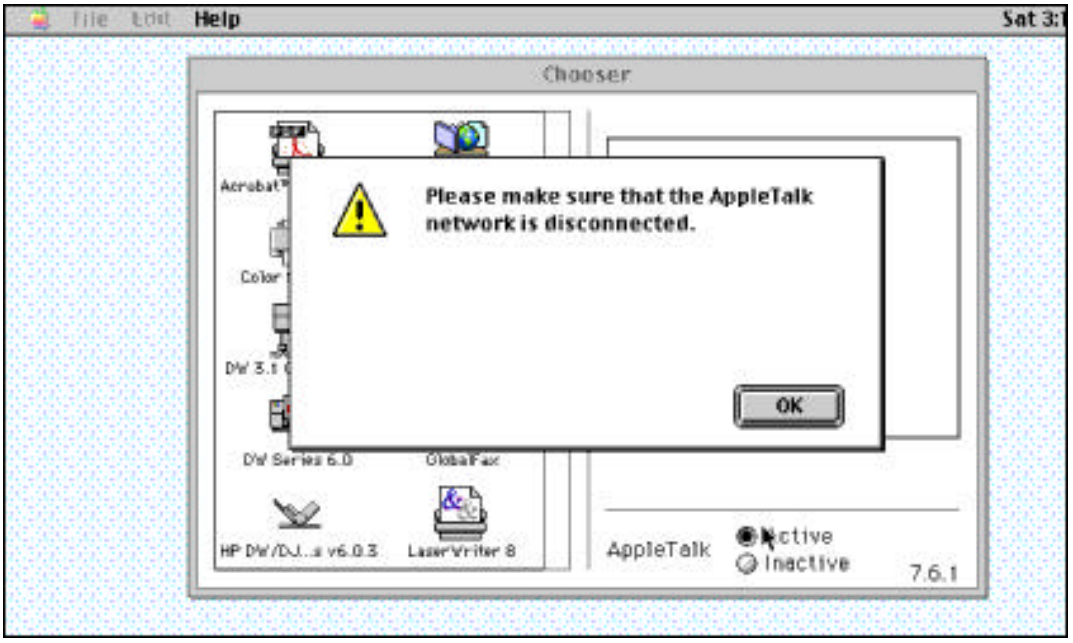
- Opening CCSR (sonar ranger) software
- Running CCSR (sonar ranger) software
- Setting one graph
- Printing the graph

back activity contents next

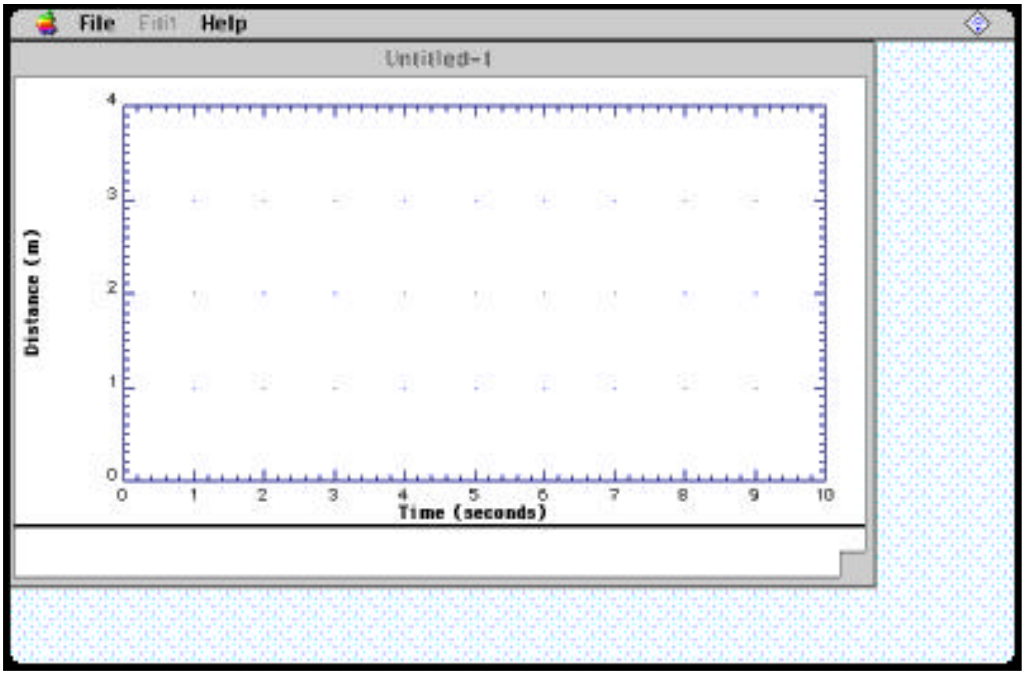
mobile inquiry technology
Making Waves Technical Hints

To open CCSR (sonar ranger) software:

Make sure that AppleTalk is turned **off** by selecting the Chooser from the Control Panel from below the Apple menu.



Start CCSR by double clicking on its icon.



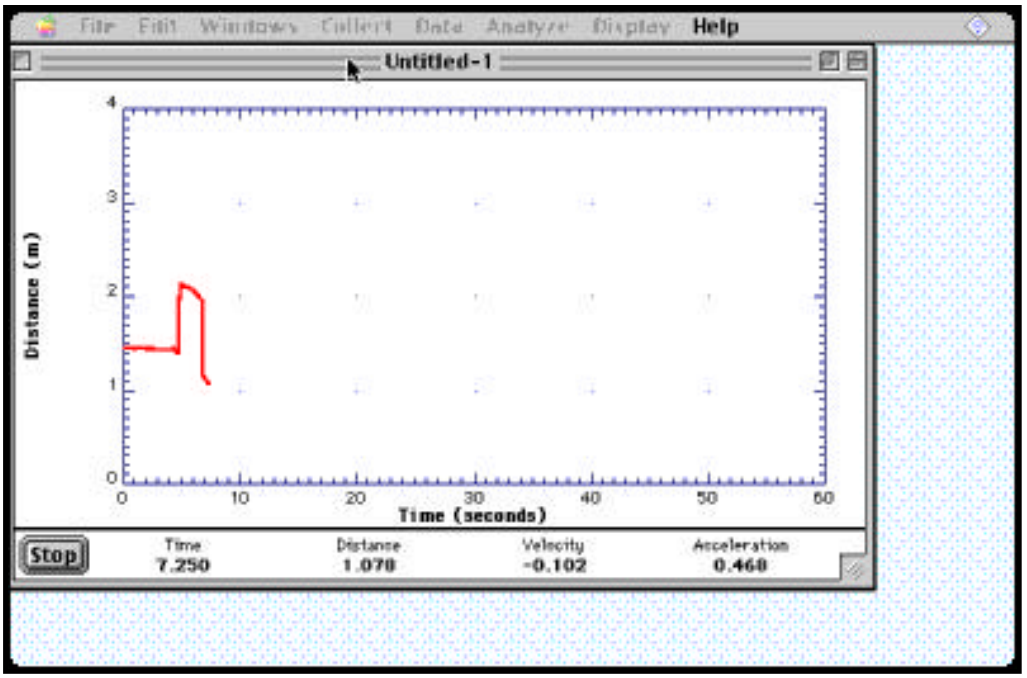
CLOSE

mobile inquiry technology
Making Waves Technical Hints

To run CCSR (sonar ranger) software:

1. After the CCSR opens, open the Display menu and click on Set all Min, Max. Change 10 seconds to 60 seconds. You may not use all the time, but it will be available if needed.

2. Open Collect menu, and click on Start

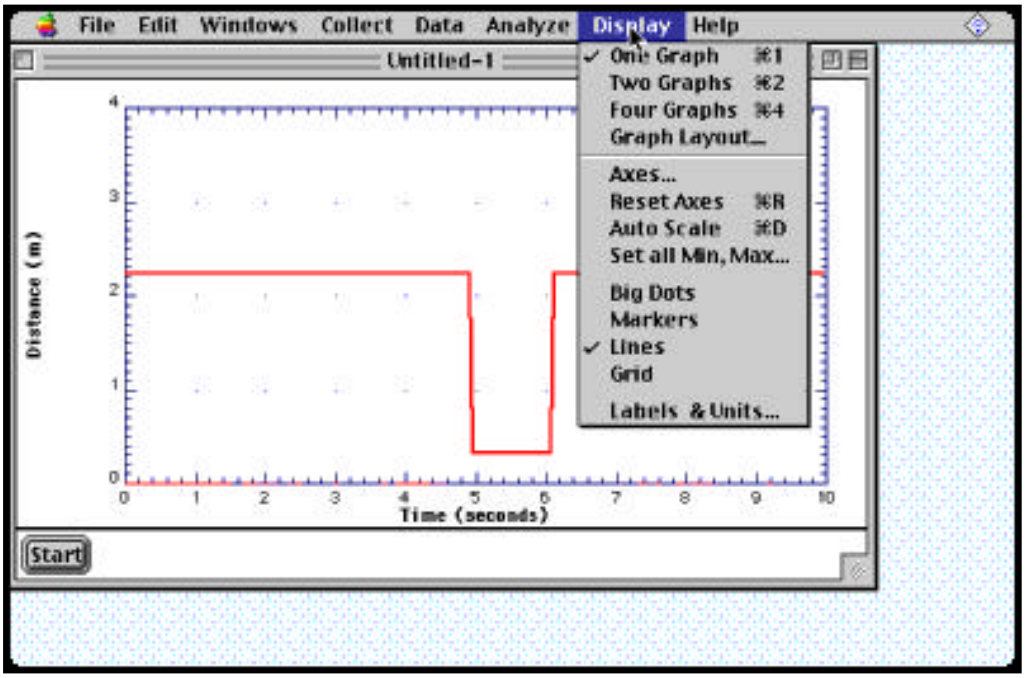


CLOSE

mobile inquiry technology
Making Waves Technical Hints

To set one graph:

1. Open the Display menu.
2. Select one graph. A distance-time graph will automatically appear.



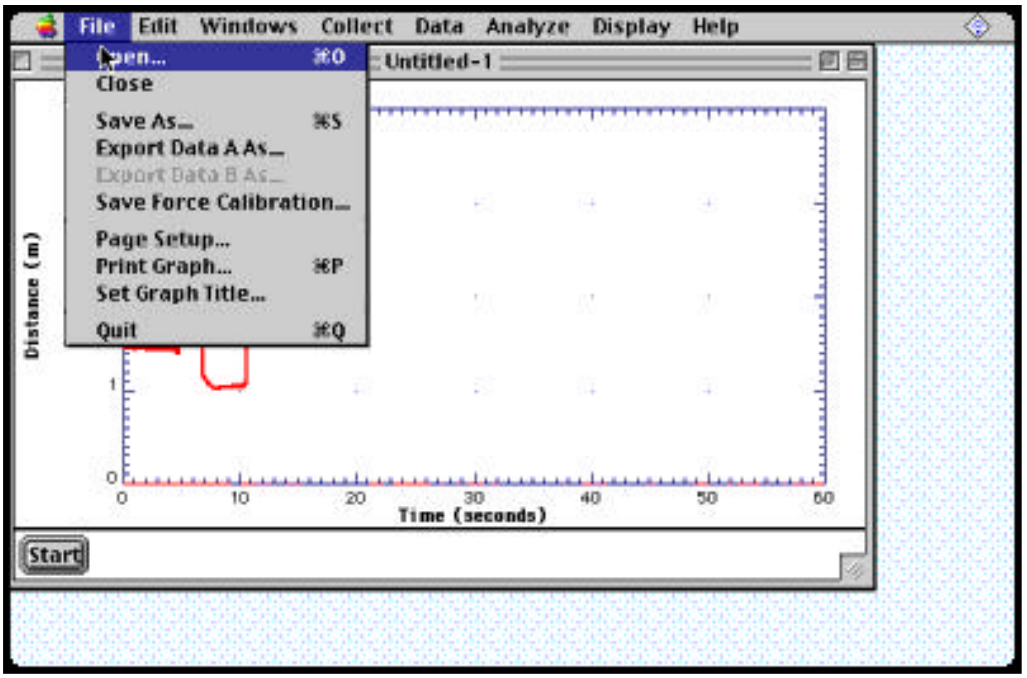
CLOSE

mobile inquiry technology
Making Waves Technical Hints

To print the graph:

1. Once your graph is finished, select Save As under File menu and name your graph. Say yes to saving calibration.

2. Open File menu, and click on Print Graph.



CLOSE

Making Waves Analysis

Using your graph print outs, answer the following questions on paper:

1. On each print out, describe clearly the motions needed to make each type of wave:

- curved wave
- square wave
- triangular wave

2. On each print out label the parts of a wave that shows the sonar ranger moving toward "T" the target and away "A" from the target.

3. On each print out label the part that shows when the sonar ranger was closest "C"to the target and furthest "F" from the target.

4. On each print out count the number of waves that you made in sixty seconds. Which motions included the greatest number of waves? (Scientists call the number of waves that occur in one second the **frequency**. The graph that showed the greatest number of waves in one minute had the highest frequency.)

5. On the back of one of the graph print outs make a list of similarities and differences among the graphs for the curved, square, and triangular waves.

6. Which was the hardest to reproduce? Why?

7. Can you identify an object in the real world that experiences these types of motions?

back | activity contents | next

Making Waves Further Investigation

Work with your team to create a wave design of your own using the sonar ranger. This could be any shape (square, curved, triangular, etc.) or combination of shapes. Challenge the other group to reproduce your wave with the sonar ranger.

back | activity contents | next