ACTIVITY CONTENTS:
Monitoring an Aquarium

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Monitoring an Aquarium Introduction

Discovery Question: What changes during a day in my aquarium?

This activity enables you to relate changes in light to levels of pH in your aquarium during a day.

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Thinking About the Question

What changes during a day in my aquarium?

Before you plan an experiment it might be useful to list some of what you already know about changes in each of the environmental factors in your aquarium. Discuss each of the questions below in your group and write down some of your ideas. You will be asked to share your thoughts so record your ideas carefully.

- What evidence have you observed that demonstrates that plants consume carbon dioxide?
- What evidence have you observed that demonstrates that animals produce carbon dioxide?
- What evidence have you observed that the day/night cycle affects how plants produce carbon dioxide?
- What do changes in the pH of a solution indicate about the amount of dissolved carbon dioxide in the water?
- If we record the pH of water in an aquarium with a few pieces of Elodea (water plant) and a few goldfish over the course of the day what changes , if any, might we see. Explain your reasoning?

We want to know how the day/night cycle effect the amount of carbon dioxide in an aquarium with plants and fish. We also want to know if any changes in carbon dioxide are due to interaction between changes in light and plants or changes in light and animals. Discuss your ideas about how to set up this investigation.

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Monitoring an Aquarium Materials

- light probe
- pH probe
- 2 computers per aquarium and group
- clean small aquarium (either 6-liter plastic or 2-liter plastic bottle will work)
- chlorine-free aged water (room temperature)
- goldfish (one or two per aquarium that require fish)
- goldfish food (crustaceans such as Gammarus)
- temperature probe
- sprigs of *Elodea* (available at local pet store)

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Monitoring an Aquarium Safety

Care and concern should be taken while experimenting with any live organism. Plan for the future home of the fish should be discussed before the investigation begins.

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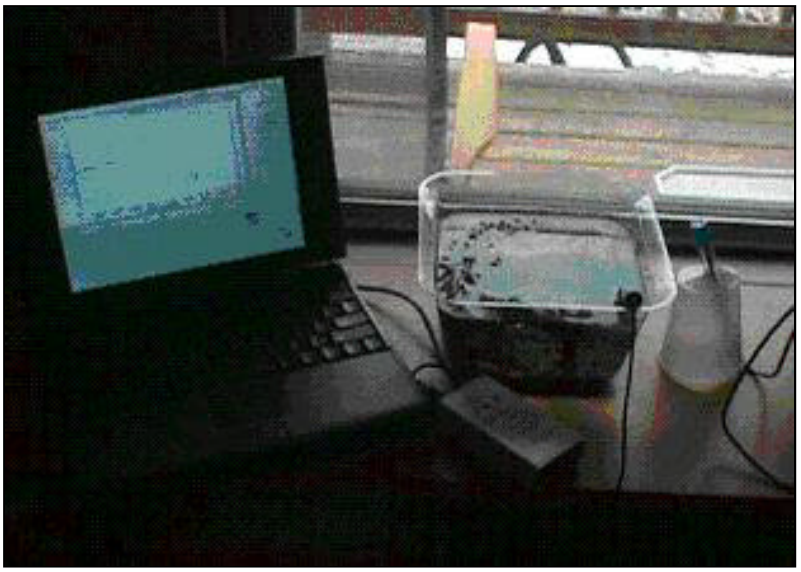
Monitoring an Aquarium Investigation I

Setting up your aquarium

1. Decide with the class the type of aquarium that you are testing (e.g., water only, water and *Elodea* , water and fish, and water, *Elodea* , and fish).

2. Place a light probe near your aquarium and close enough that it can be connected to one of the computers used by your group. The light probe needs to be mounted in a plastic cup (outside of the aquarium) to provide a stable support for the probe. Inverting (turning upside down) a plastic cup and punching a hole through the bottom to extend the light probe upwards works well.



3. Obtain a clean and dry aquarium. Fill it with the exact amount of "aged" water that your class has agreed on. Tap water often contains chlorine that is harmful to fish. When water is exposed (or aged) for one day to the air, chlorine evaporates into the air. If your group has decided to test their aquarium with additonal items (*Elodea* or fish), place them into your aquarium.

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Monitoring an Aquarium Investigation II

Initial testing of your aquarium

1. Test the light level on one computer at the exact same time that the other computer is testing the pH of the water in your aquarium. Take the readings for only 30 seconds. Refer to Technical Hints to see how to use DataLogger software to record light as one of the probes. Refer to Technical Hints to see how to use DataLogger software to record pH.

2. Compare your results with other groups by looking at Data Table A on the software. Refer to Technical Hints to see how to view the data inside the DataLogger software.

3. Answer Question 1 in "Analysis".

4. Create a spreadsheet to record light and pH readings. Columns should be made so that the same light reading is recorded alternately for an aquarium with just water, an aquarium with just water and *Elodea* , an aquarium with just water and fish, and an aquarium with water, *Elodea* and water. Refer to Technical Hints to see how to create a spreadsheet.

5. Select a location for your aquarium in the room that will have sufficient light during the day and will experience a dark cycle during the night.

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Monitoring an Aquarium Investigation III

Monitoring a day in the life of your aquarium

1. Keeping the exact same set-up for your aquarium and probes as initially tested, set the software to record both the pH value and light level at the same time for a 24-hour (86400 seconds) period.

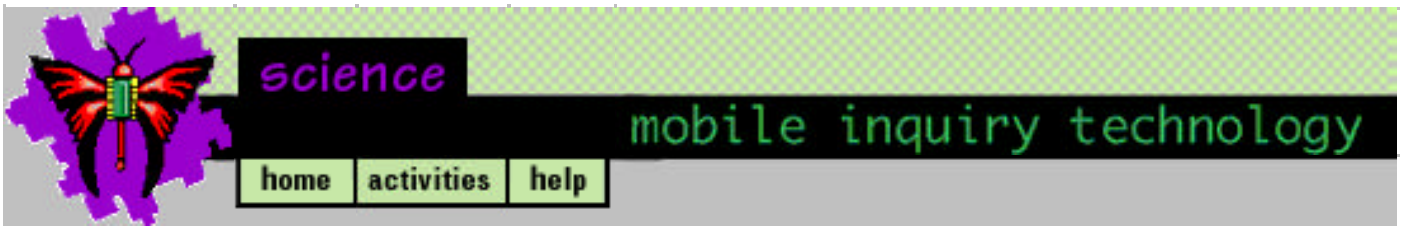
2. The whole class should start the collection at the same time.

3. After the collection is complete (on the next day), transfer your data into your spreadsheet. Refer to Technical Hints to see how to transfer your data to your spreadsheet.

4. Create different types of graphs to display the relationship between pH and light. Refer to Technical Hints to see how create graphs for your aquarium data.

5. Share your data with other groups so that all groups have data from all types of aquariums. Create several graphs to display the relationship between pH and light for all types of aquariums. Refer to Technical Hints to see how create graphs for your aquarium data. Discuss the relationship between light and pH with your group.

6. Answer Questions 2-5 in "Analysis".



Monitoring an Aquarium Technical Hints

- Using DataLogger software to record light
- Using DataLogger software to record pH
- Viewing the data inside the DataLogger software
- Creating a spreadsheet
- Transferring your data to your spreadsheet
- Creating different graphs for your aquarium data

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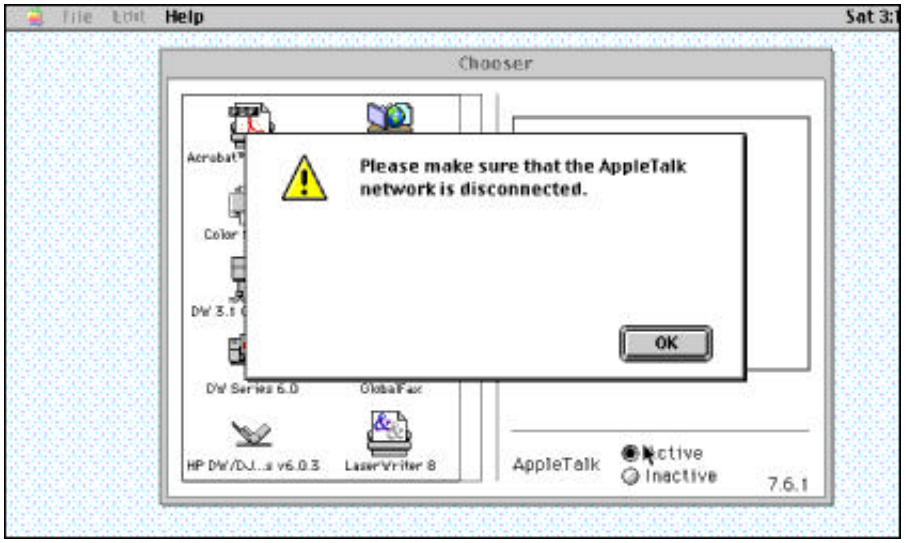
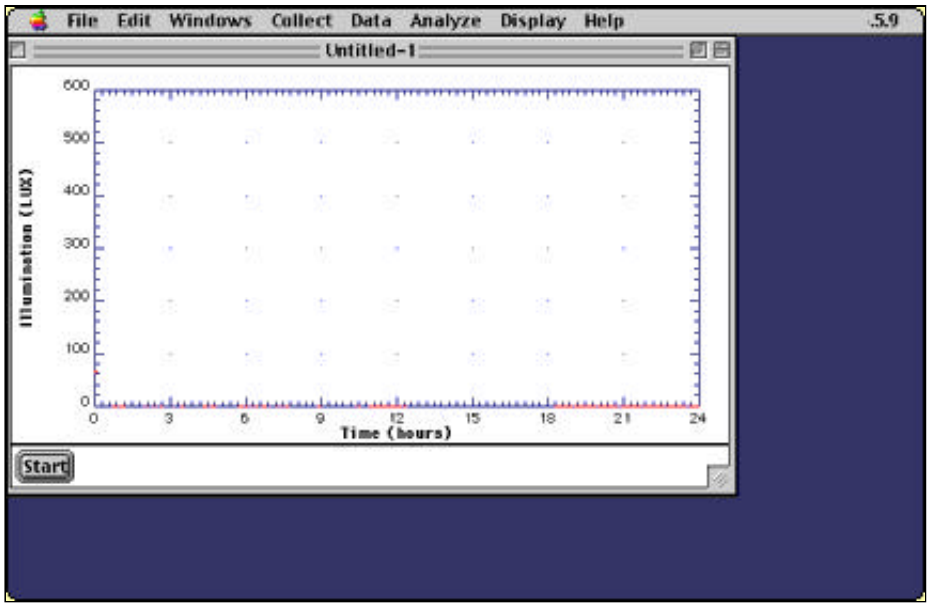
Monitoring an Aquarium Technical Hints

To use DataLogger software to record light:

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



2. Attach the light probe to the serial port at the back of the computer.
3. Double click on file named "cclight". It will automatically ask you if you want to load the "cclight.CLB" (calibration file for light probe). Click OK.
4. Select the Collect menu and choose Data Rate. For this activity select 10 points per hour.
5. From the Display menu select One Graph. Also from the Display menu choose Set All Min, Max. For this experiment, select 24 for hours and 0-600 for Lux. Click OK.



6. Click Start to begin to collect data.

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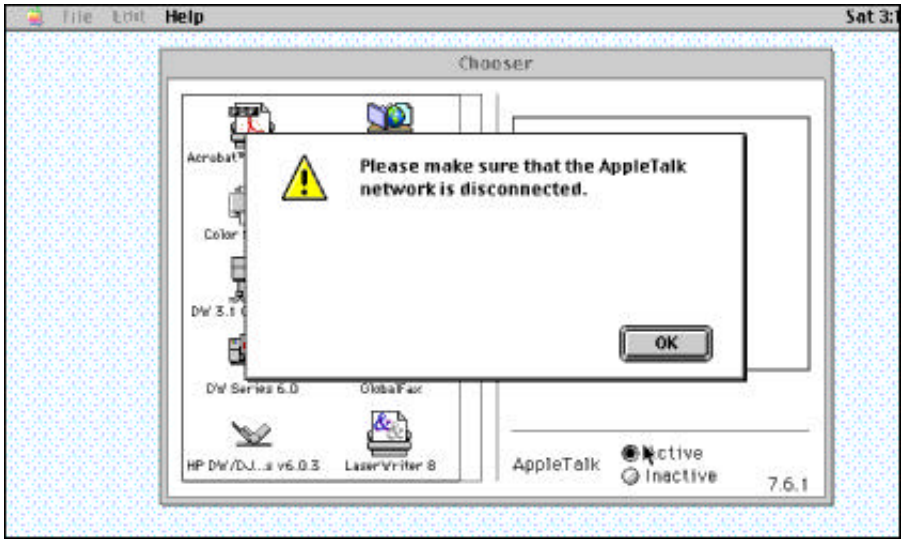
Monitoring an Aquarium Technical Hints

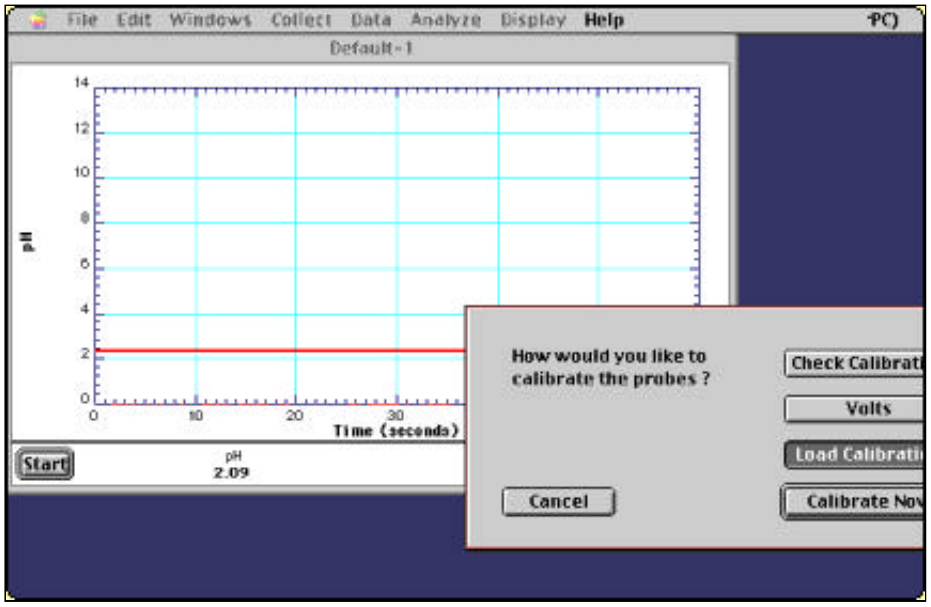
To use DataLogger software to record pH:

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



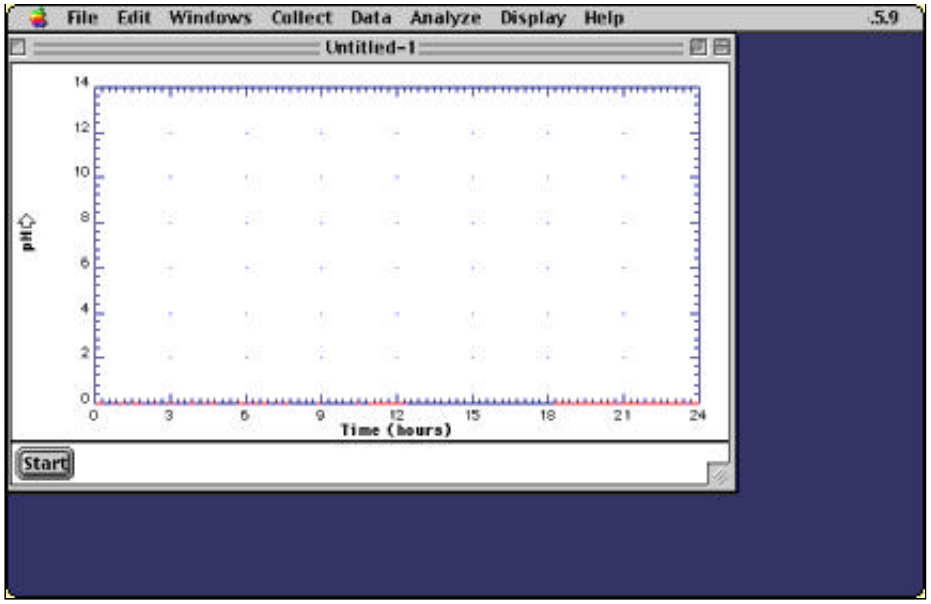
2. Attach the pH probe to port 1 of the interface box. Connect the serial port at the back of the computer to the modem/printer port.

3. Double click on the DataLogger software. It will automatically open. From the Collect menu choose Calibrate. Select Load Calibration for Just Port #1. From Experiment Files select pHTitration.CLB.



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

5. From the Display menu select One Graph. Also from the Display menu choose Set All Min, Max. For this experiment, select 24 for hours. Click OK. Select 0-14 for pH. Click OK.



6. Click on Start to begin collection.

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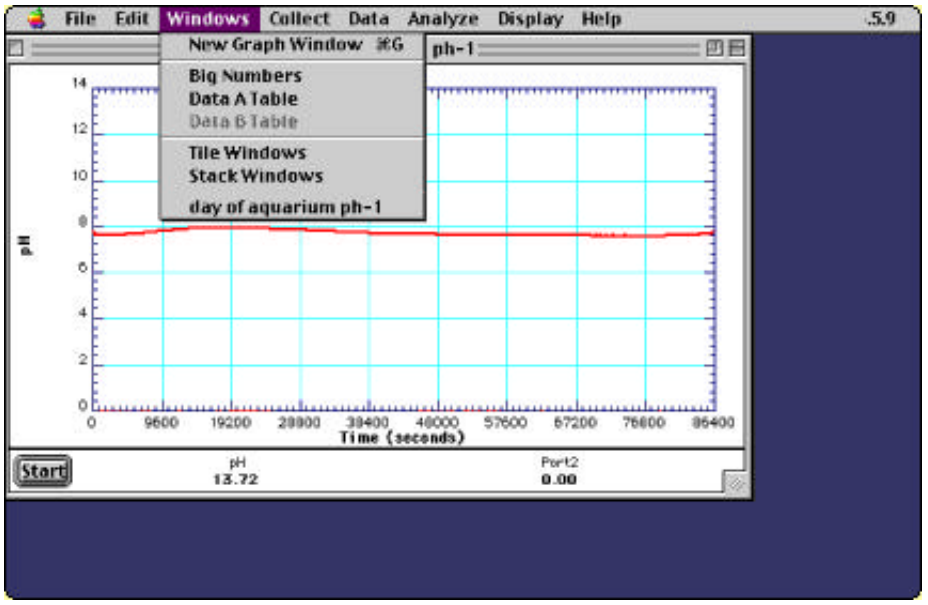
Monitoring an Aquarium Technical Hints

To view the data inside the DataLogger software:

1. Once the data is completed and the software has stopped, select Data A Table from the Windows menu.
2. You can scroll up and down by using the side arrows.



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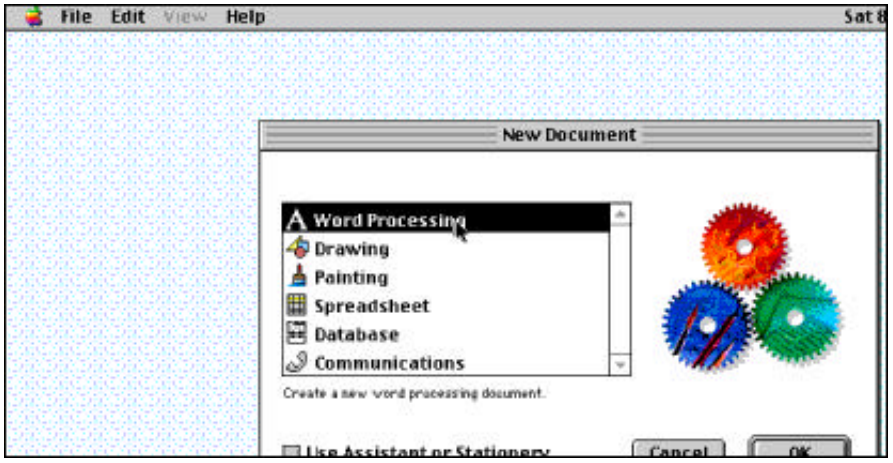
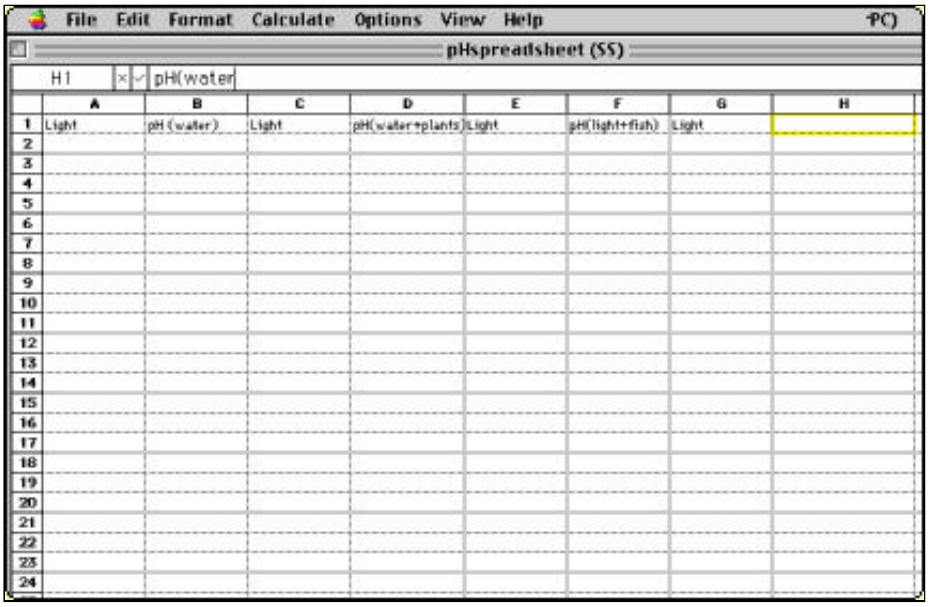
Monitoring an Aquarium Technical Hints

To create a spreadsheet:

1. Select the spreadsheet option in ClarisWorks.



2. Type the types of aquariums (water, water + plant, water + fish, water + fish + plant) alternately with light in every other column in Row1.



3. Click in the header between cells to drag the cells to a larger or smaller size.

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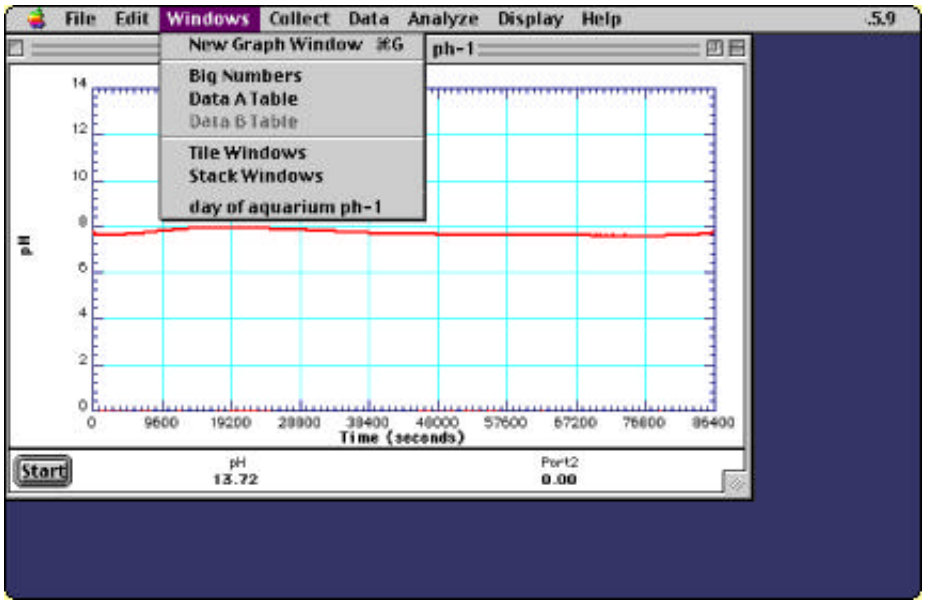
Monitoring an Aquarium Technical Hints

To transfer your data to your spreadsheet:

1. Highlight the column that you wish to transfer in Data A Table under the Windows menu. Choose Copy Table from the Edit menu. Open your spreadsheet and select the appropriate column for your data. Choose Paste or Copy Table from the Edit menu.
2. 

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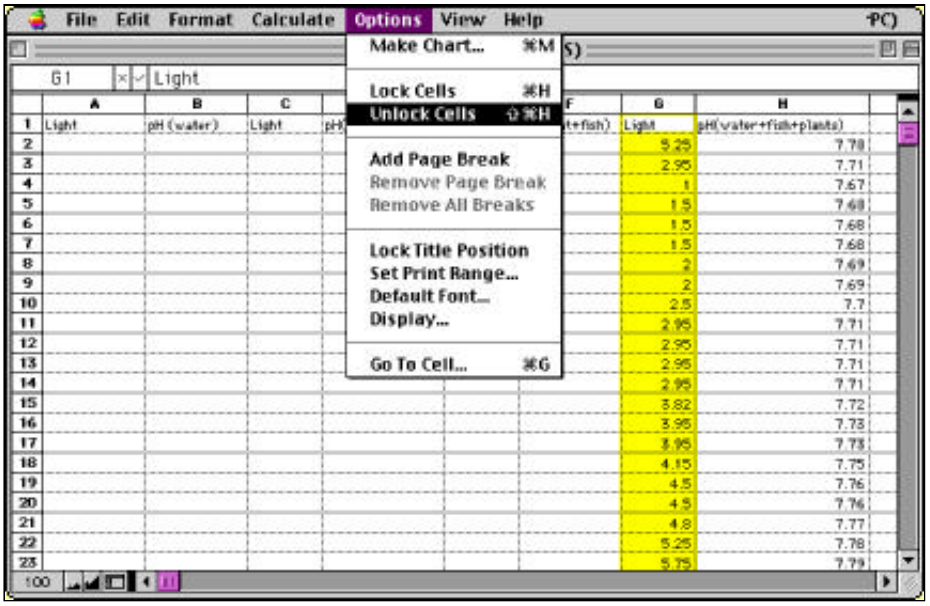
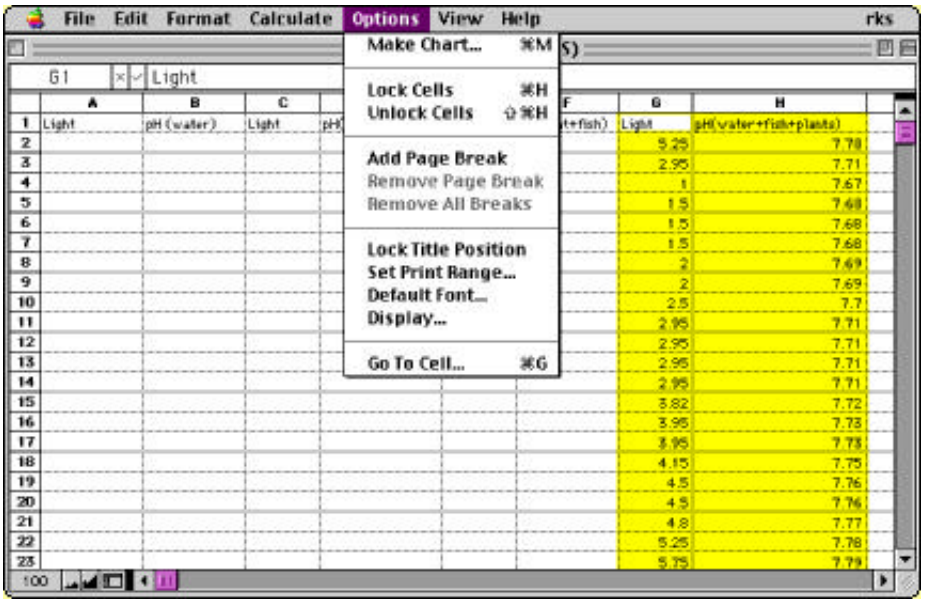
Monitoring an Aquarium Technical Hints

To create different graphs for your aquarium data:

1. To view the overall trend throughout the day of each variable, highlight the column of light or pH data and select Make Chart from the Option menu. Select bar chart. Click OK. You can expand or move the graph by clicking and dragging a corner.

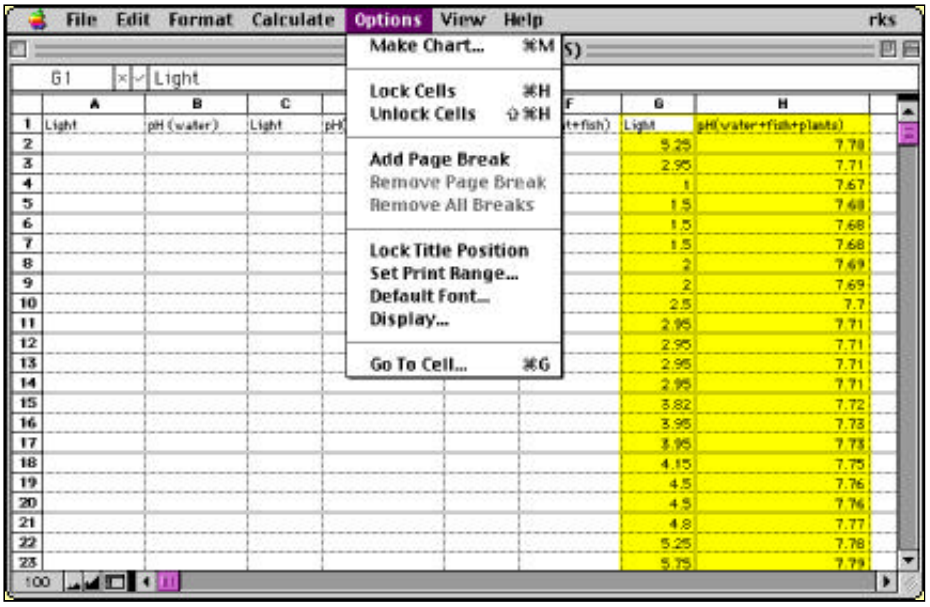


2. To make an overview of both light and pH on the same bar graph, highlight both columns on your spreadsheet. Select Make Chart from the Option menu. Highlight Area chart from the options. Choose the Series button and select the solid circle for displaying the points. Click OK. You can expand or move the graph by clicking and dragging a corner.



3. To make an x-y line graph highlight both columns (light and pH) and select Make Chart from the Options menu. Highlight x-y line graph. Choose the Series button and select the solid circle for displaying the points. Choose the Axes button and place your minimum and maximum value for pH in the appropriate

box. Click OK. You can expand the graph by clicking and dragging a corner.



4. When adding more sets of data, transfer light (lux) and pH into the adjoining columns. Highlight the titles and all of the data and select Make Chart from the Options menu. Choose graph button of your choice. If an x-y line or Area chart is shown, click the Series button and choose the solid circle. Click OK.

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Monitoring an Aquarium Analysis

Answer the following questions on paper:

- How do the initial pH values for the water, fish only, *Elodea* only, and fish and *Elodea* aquarium compare?
- How did the pH vary as the light decreased around your aquarium? As the light decreased, what happened to the pH?
- How do the changes in pH values during the day/night cycle compare in each of the different aquarium set-ups?
- Based on the data your class has collected in each aquarium, what ideas do you have about how light and carbon dioxide production are related? What role do plants play in the process? What role do goldfish play in the process?

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Monitoring an Aquarium Further Investigation

- Determine if the number of gold fish changes the amount of pH in the aquarium during a 24-hour period.
- Design and investigate the pH cycle for a week-long period. Did the amount of sunlight available during each day alter the amount of pH found?
- Design an investigation that includes the dissolved oxygen probe, pH probe, and light probe. Monitor how the changes of oxygen in the water, pH, and light are related.

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