EXPLORATIONS

Activity 15

Water Quality

Objectives

- To understand the meaning and effect of pH
- To understand the factors that affect pH

Materials

- TI-73
- Unit-to-unit cable
- CBL 2™
- pH sensor (with DIN adapter if necessary)
- Distilled water for rinsing sensor
- Beaker or container for rinse water
- Test cups
- Local water samples
- Data Collection and Analysis pages (p. 136 - 140)

In this activity you will

- Collect water samples from various locations in your community.
- Use the CBL 2™ with a pH sensor to check and compare the pH values of the various water samples.

Problem

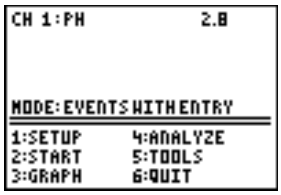
How do the pH values of water samples from your community compare to the pH value of distilled water?

Hypothesis

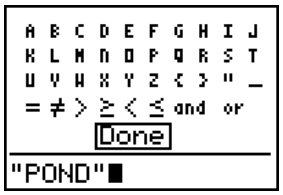
Before testing, answer the questions on the **Data Collection and Analysis** page to predict the pH of the water samples.

Procedure: Graphing the Data

1. Collect your water samples.
2. Plug the pH sensor into Channel 1 (**CH 1**) on the CBL 2 using the DIN adapter, if necessary.
3. Start the DATAMATE program.
4. The Main Screen is displayed. If **CH 1:PH** is displayed at the top of the screen, go to step 7. If **CH 1:PH** is not displayed, go to step 5.



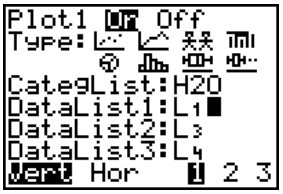
5. Select **1:SETUP**.
6. Select **CH1**. Select **2:PH**. Select **1:OK** to return to the Main Screen.
7. If **MODE:EVENTS WITH ENTRY** is displayed, go to step 10. If not, go to step 8.
8. Select **MODE**, and then select **3:EVENTS WITH ENTRY.**
9. Select **1:OK** to return to the Main Screen.
10. Before measuring the pH of your first sample and each time you get ready to measure a new sample, rinse the pH sensor as demonstrated by your teacher.
11. When you are ready to begin, select **2:START**. The screen displays **PRESS ENTER TO COLLECT OR STO TO STOP**.
12. Use the distilled water for your first sample. Place the pH sensor in the sample and gently swirl the container around the bottom of the pH sensor. When the pH reading is steady, press [ENTER].
13. The program asks you to enter a value. This value is the number of your sample, NOT the pH value. Type the number for this sample (for example, if this is your first sample, type **1**) and press [ENTER]. Record the sample name beside the number in the table on the **Data Collection and Analysis** page. The program returns to the data collection screen, ready for your next sample.
14. Repeat steps 10 through 13 two more times for this sample, using a number for the sample when the program asks for a value after you have the pH. After you enter the first sample number, the last number you used is displayed at the bottom of the screen.
15. Repeat steps 10 through 14 for each of your water samples.
16. After you have collected the pH value for the last sample, press [STO▶]. A scatter plot is displayed showing the pH value for all of the samples. Use [▶] and [◀] to move to each data point and record the values in the table on the **Data Collection and Analysis** page.
17. To exit from the DATAMATE program, press [ENTER] to return to the Main Screen. Select **6:QUIT** and press [ENTER].
18. To display the lists showing the results, press [LIST]. The sample numbers are stored in **L1**. The pH values are stored in **L2**.
19. To change the sample number in **L1** to the locations of the samples, highlight the first element in the list. Press [2nd] [TEXT]. Press [▼] and [▶] to move to the letters in the name, pressing [ENTER] after each one. The first name must be enclosed in quotation marks. When the name is finished, move to **Done**, and press [ENTER]. Press [ENTER] again to paste the name in the list. When you finish working with the lists, press [2nd] [QUIT] to return to the home screen.



Procedure: Graphing the Data

Create a bar graph to display the data.

1. Press 2nd [PLOT] **4:PlotsOff** ENTER to turn off all stat plots.
2. Press 2nd [PLOT] ENTER to select **Plot1**.
3. Press ENTER to select **On** (to turn on **Plot1**).
4. Select (the bar graph) for **Type**.
5. Plot **L1** (sample numbers) as the categorical list and **L2** as data list 1 (pH values).



6. Press ZOOM **7:ZoomStat** to set the window and display the graph.
7. Press TRACE to display the sample numbers with their pH values.

Data Analysis

Using the data you collected and the bar graph, answer the questions on the **Data Collection and Analysis** page to analyze your results.

Application

Fish stay healthy and reproduce best in aquatic habitats that have a pH range of about 6.3 through 6.8. Complete the questions on the **Data Collection and Analysis** page to analyze your data and predict which water sources would be able to support fish populations (based on just the attribute of pH).

Extensions

- Do a search on the Internet for acid rain. Find out what acid rain is and how it affects our environment. Look at your pH data for the water samples in your community. Do you think acid rain is possibly a problem in your area?
- Collect water samples, including rainwater, from a different community. Take three pH readings on each sample. Graph the results from each community as a box plot. Which plot shows more variance between the samples? Which community has the best water, with reference to pH? Explain your reasoning, using the graph as evidence.

Data Collection and Analysis

Name _____

Date _____

Activity 15: Water Quality

Problem

How do the pH values of water samples from your community compare to the pH value of distilled water?

Hypothesis

1. Before testing, complete the table below to predict the rank of each water sample in order by acidity (1 = highest acidity).

Water Sample Description	**Predicted Rank** (Highest pH to Lowest)

2. The pH values of the water samples in my community are _____ compared to the pH value of distilled water.

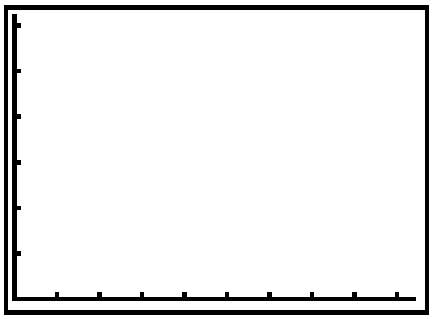
Data Collection

1. After you test the water samples, use the displayed scatter plot to enter the pH values in the table below.

   Note that the first three sample numbers represent the three tests on the first water sample, the second three numbers are for the three tests on the second sample, and so on. After you fill in the pH values, use the TI-73 to find the mean pH value for each sample. Then rank the water samples in order by acidity (1 = highest acidity).

Sample Number	**Water Sample Description**	**Trial 1 pH Value**	**Trial 2 pH Value**	**Trial 3 pH Value**	**Mean pH Value**	**Actual Rank** (Highest pH to Lowest)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

2. Sketch and label the bar graph below or print it out on the computer and attach it to this page.



Data Analysis

Use the table and graph to answer the following questions.

1. Compare the actual pH rankings to your predictions. Discuss any surprises or differences you find.

_____

_____

_____

_____

2. What was the range of pH values for your community water samples?

_____

3. Compare the pH values to distilled water.

_____

_____

_____

_____

4. What were your mean and median pH values for the samples you tested?

_____

_____

_____

_____

5. Which would best reflect the average pH of water samples in your community?

_____

6. Are there any conditions that may explain any pH values that seem extreme?

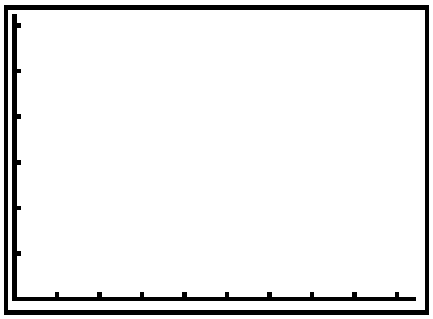
_____

_____

_____

_____

7. Plot the class data as a box plot. Were there any outliers? If so, explain any environmental or data collection conditions that may have caused them.



_____

_____

_____

_____

Conclusion

1. The pH values of the water samples in my community are _____ compared to the pH value of distilled water.
2. Write a summary paragraph about your findings. Include the following:
   - Range in data.
   - Median pH value.
   - Where do most of the pH values cluster?
   - Are there any conditions related to the extreme values?
   - Does this data support the possibility that acid rain is a factor in the pH of the water sources in your community?

_____

_____

_____

_____

Application

1. Use the data collection table and graph to indicate on the chart below which water samples in your community have pH values that could support fish populations. Remember, fish do best with a pH range of 6.3 to 6.8.

Water Sample Description	Mean pH Value	Support a Fish Population (Yes or No)

2. Write a persuasive paragraph convincing fishermen that your community would be a great or not-so-great place to fish.

_____

_____

_____

_____

Teacher Notes

Activity 15

Water Quality

Objectives

- To understand the meaning and effect of pH
- To understand the factors that affect pH

NSES Standards

- Physical Science: Properties and changes of properties in matter
- Earth and Space Science: Structure of the earth system
- Science in Personal and Social Perspectives: Populations, resources, and environments
- Science in Personal and Social Perspectives: Natural hazards

Preparation

- Plan for collection of water samples from various locations in your community. Label samples and plan for how groups of students will test the samples.
- Have students collect at least five samples.

  Suggested sources:

  - Distilled water from the store (the control)
  - Tap water
  - Rain water
  - Water from a puddle in the street
  - Melted snow
  - Pond water
  - Water from a stream/river/ocean
  - Water from the lawn
  - Water from an air conditioner
  - Aquarium water from a pet store
  - Water from a swimming pool
- Use small plastic bathroom cups housed in egg cartons for the water samples. Include distilled water as a baseline sample.
- Provide distilled water for rinsing the pH sensor between trials. Crook-necked bottles work well.

Management

- Assign these student jobs for this lab:
  - Materials/setup person (sets up samples, sensor)
  - Tech person (operates CBL 2™ and TI-73)

  - Data recorder (reads pH readings from the TI-73 at each collection interval)
  - Runner (brings CBL 2 and TI-73 to the computer to print graphs with TI-GRAPH LINK™ or TI™ Connect and brings **Data Collection and Analysis** pages to the teacher)

- Clear covered plastic shoeboxes will hold a CBL 2, pH sensor, cups, beaker, and other equipment neatly at each station.
- Students can record pH readings in their lab journals as they are displayed on the TI-73. This keeps them engaged throughout the data collection period and if they lose the data/graph later, they can still write up their lab reports. Students can also access the data in the TI-73 lists after data collection. You can send the lists to all students' calculators using APPS **1:Link**.

  a. Press APPS.

  b. Press ENTER to select **1:Link.**

  c. Select **4:List** and press ENTER.

  d. Press ▼ to move the ▸ beside the list you wish to send. Press ENTER.

  e. Repeat step **d** for each list you wish to send.

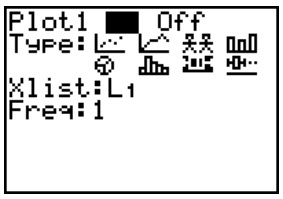
  f. Set the receiving unit by pressing APPS ENTER ▶ to select **RECEIVE**. Press ENTER. **Waiting…** displays on the TI-73 screen.

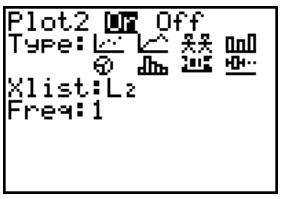
  g. On the sending unit, press ▶ to select **TRANSMIT** and press ENTER.

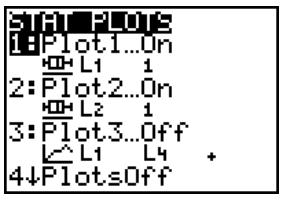
  For more permanent storage of data, use TI-GRAPH LINK™ or TI™ Connect to save the lists in a computer folder.

- Students can assess each other using a teamwork rubric after the lab. Provide a checklist of positive and negative behaviors. Copy these on quarter sheets of paper.
- If there is not time to complete, multiple trials, students can average the class data for the mean of each sample.

Settings for Plot Menu







Sample Box Plot