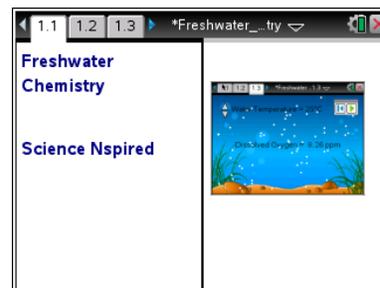




Science Objectives

- Students will investigate and discover relationships among dissolved oxygen levels, pH, and temperature.
- Students will manipulate the levels of temperature and pH to determine the effects on dissolved oxygen, population and species richness in a freshwater system.



Vocabulary

- dissolved oxygen
- pH
- temperature
- freshwater

About the Lesson

- In this lesson students result, students will:
 - Understand how the temperature of the water affects the dissolved oxygen levels.
 - Determine the best water temperatures and pH levels for freshwater fish population numbers and number of species.



TI-Nspire™ Navigator™

- Send out the .tns file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies:  TI-Nspire™ CX Handhelds,  TI-Nspire™ Apps for iPad®,  TI-Nspire™ Software

Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>

Lesson Files:

Student Activity

- Freshwater_Chemistry_Student.doc
- Freshwater_Chemistry_Student.pdf

TI-Nspire document

- Freshwater_Chemisry.tns



Discussion Points and Possible Answers

Have students read the background information stated on their activity sheet.

Move to page 1.2.

Have students answer question 1 in the .tns file, activity sheet, or both.

- Q1. What happens to the amount of oxygen that can be dissolved in water as the temperature of the water increases?

Answer: A. There is less oxygen in the water.

Move to page 1.3.

1. After reading the instructions on page 1.3, students should then close the directions box by selecting .
2. Students should select Play to begin the simulation. They should begin testing by moving the **Temperature** arrows up and down. Students should assume that all other water quality factors remain the same as temperature is manipulated. Students should observe the effects on dissolved oxygen when temperature is changed.



Tech Tip: To access the Directions again, select  > **Directions**

The dissolved oxygen data will be captured on the spreadsheet on page 1.4 and will also be graphed on page 1.5. If students select the reset button on page 1.3, the data will be cleared from the spreadsheet and the graph.



Tech Tip: To scroll through data in the spreadsheet on screen 1.4, students can press their finger anywhere on the screen and drag it up or down.

- Q4. As the temperature of the water increases, the amount of oxygen dissolved in the water also increases. True or False?

Answer: False



Move to page 2.1.

Have students answer question 5 in the .tns file, the activity sheet, or both.

Q5. Predict the effect of an increase in water temperature on fish living in the lake.

Sample Answer: B. The fish would have trouble breathing.

Student answers should reflect that the fish will have trouble breathing and possibly die because the amount of dissolved oxygen in the water will decrease as water temperature increases.

Move to pages 2.2 – 2.3.

3. After reading the instructions on pages 2.2 and 2.3, students should close the directions box by selecting . To begin the simulation, students should select the Play button.



Tech Tip: To access the Directions again, select  > **Directions**

4. Students will change the temperature of the water using the arrows and record the changes to the fish population and number of species present in the lake in the data table provided. Again, it can be assumed that all other water quality factors will remain the same while manipulating the temperature.



Tech Tip: Remind students to **ONLY CHANGE** the **TEMPERATURE** variable in order to control the other variables. To change the temperature after starting the simulation, students need to select the Pause button  to stop the action. The number of fish and number of species is NOT captured in this simulation, so students should record the displayed information on their activity sheet in the table as they make incremental changes to the temperature.



Effect of Temperature on Freshwater Fish Species

Temperature (°C)	Number of Fish in Population	Number of Species in Population	Temperature (°C)	Number of Fish in Population	Number of Species in Population
10°	100	6	26°	82	5
12°	100	6	28°	82	5
14°	100	6	30°	75	4
16°	100	6	32°	66	3
18°	100	6	34°	43	2
20°	100	6	36°	12	1
22°	100	6	38°	0	0
24°	91	6	40°	0	0

Move to page 2.4.

Have students answer question 6 on the device, the activity sheet, or both.

Q6. What is the best temperature range for fish in this lake?

Answer: Between 10 and 22 degrees Celsius

Move to page 3.1.

Have students answer question 7 on the device, the activity sheet, or both.

Q7. Do you think the pH of the water will affect the fish in a lake? Yes or No?

Answer: Yes

Move to page 3.2.

- After reading the instructions on page 3.2, students will **return to page 2.3** and RESET the simulation.
- Have students change the pH of the water using the minimized slider and record the changes to the fish population and number of species present in the lake. Again, it can be assumed that all other water quality factors will remain the same while manipulating the pH.



Tech Tip: Remind students to **ONLY CHANGE** the pH variable in order to control the other variables. To change the pH after starting the simulation, students need to select the Pause button to stop the action. The data is NOT captured, so students should record the displayed data on their sheet as they make changes to the pH values.



Effect of pH on Freshwater Fish Species

pH value	Number of Fish in Population	Number of Species in Population
1	0	0
2	0	0
3	4	1
4	10	1
5	30	2
6	55	3
7	100	6
8	100	6
9	50	3
10	20	1
11	8	1
12	0	0

Move to page 3.3.

Have students answer question 8 in the .tns file, on the activity sheet, or both. Have students answer question 9 on their activity sheet.

Q8. In what pH range was the number of fish species the highest in this lake?

Answer: C. 7-8

Q9. Explain how you interpreted the data to arrive at your answer to question 8.

Sample Answer: According to the data, pH 7 and pH 8 both support the highest population (100) and species (6) of fish.

Move to page 3.4.

Have students answer question 10 in the .tns file, on the activity sheet, or both.

Q10. You are working for your state's DNR (Department of Natural Resources). You have just tested a freshwater pond. If it is a "healthy" body of water, what values would you expect for its temperature and pH?

Sample Answer: The best ranges would be temperatures between 10-22 degrees Celsius, and a pH range of 7-8.



TI-Nspire Navigator Opportunities

Make a student a Live Presenter to illustrate show how to move the sliders. Throughout the activity, monitor student progress. At the end of the activity, collect the .tns file and save to Portfolio.

Wrap Up

When students are finished with the activity, retrieve the .tns file using TI-Nspire Navigator. Save grades to Portfolio. Discuss activity questions using Slide Show.

Assessment

- Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show will be utilized to give students immediate feedback on their assessment.
- Summative assessment could consist of questions/problems on the chapter test or a performance assessment involving collecting actual water quality data and analyzing it.