HEALTH of aquatic life a real problem?

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Activity Overview

What does water temperature, dissolved oxygen, and water clarity tell you about the health of an aquatic site?

Water temperature, dissolved oxygen, and water clarity can change the quality of an aquatic site. Changes in water temperature and clarity affect the amount of oxygen in water. Oxygen is critical to the health of aquatic life. Other factors including pH, weather conditions, and velocity of a stream can also affect the water quality of the site.

Researchers performed water quality tests to determine the health of their local aquatic site. Table 1 shows monthly average values for water temperature, turbidity, and dissolved oxygen. The data was collected at the same location. Students examine the data and use the TI-73 Explorer™ to analyze and graph the values. They explore the relationship between water temperature, turbidity, and dissolved oxygen and how these factors affect water quality.

Conclusion: As temperature increases, turbidity increases and dissolved oxygen decreases. High water temperature, poor water clarity, and low dissolved oxygen often indicate poor water quality. Cold and clear water causes oxygen levels in water to increase and provides a healthier environment for aquatic life.

Table 1

Month	Water Temperature (ºC)	Turbidity (NTU)	Dissolved Oxygen (mg/L)
1	6.2	3.2	12.4
2	10.1	8.8	10.1
3	12.7	20.1	9.2
4	17.1	34.7	6.9
5	15.3	28.1	7.4
6	19.8	39.9	6.1
7	25.8	55.9	4.3
8	24.8	50.7	4.7
9	18.8	38.6	6.4
10	17.9	36.2	6.8
11	11.2	13.4	9.7
12	9.1	7.2	10.6

Note: The months are represented by numbers in order to easily graph the values (1=January, 12=December).

Activity at a Glance

Grade: 4-9

Subject: Science

Category: Life Science, Earth Science, Physical Science

Topic: Living Things, Plants, Animals, Ecology, Photosynthesis, Water Quality, Erosion, Deposition, Chemical Properties

Time Required

- One 45-minute period

Level of Complexity

- Medium

Materials*

- TI-73 Explorer™
- TI Connect™ software
- TI Graph Link cable (To connect the TI-73 Explorer™ to the computer.)
- Link cable (To connect one TI-73 Explorer™ to another TI-73 Explorer™.)
- Water quality data file (water_quality_data.73g)

TI-73 Explorer™

* This activity has been written for the TI-73 Explorer™ but you can easily substitute the TI-83 or TI-83 Plus.

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Concept Background

- Air and water temperatures often determine the variety of species in aquatic habitats.
- In warm water, dissolved oxygen levels drop. Low oxygen levels can put aquatic life in danger.
- Usually fish cannot survive temperatures below 0ºC, and very few can tolerate temperatures above 36ºC.
- Most aquatic species need about 5 mg/L of dissolved oxygen to survive.
- Oxygen levels that remain under 1-2 mg/L for a few hours can cause the death of many fish.
- Plants need oxygen too! They take in oxygen during respiration.
- Aquatic sites with good water quality have dissolved oxygen levels between 8 and 10 mg/L. When the level is between 4 and 5 mg/L the site is heavily polluted.
- Scientists determine the water clarity of an aquatic site by measuring its turbidity. Turbidity is a measure of "how cloudy the water is."
- Aquatic sites with good water quality have turbidity levels below 5 NTU. Poor water clarity increases the temperature of the water which results in low levels of dissolved oxygen.

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National Education Standards

Content Standard A: Science As Inquiry
Students should learn about scientific inquiry and develop the abilities necessary to understand science concepts.

Content Standard B: Physical Science
Students should develop an understanding of properties and changes in matter, motion and force, and the transfer of energy.

English Language Arts Standard 3
Students should apply strategies to comprehend, interpret, evaluate, and appreciate text.

JASON

Classroom Management Tips

- Although the steps under Procedure may be lengthy, they are repetitive and easy to follow.

- Before you or your students follow the steps in Procedure, make sure to save any previously collected data you do not wish to delete. Refer to the Texas Instrument TI-73 Explorer™ manual for help.
- You may transfer the water quality data from the computer to a TI-73 Explorer™ and then from that device to another TI-73 Explorer™ (see Procedure).
- This activity works well with students working in groups or as a demonstration.
- Encourage students to answer the questions in Data Analysis in their *Journal*.
- Create your own student questions for use on your student's TI graphing devices using the Texas Instruments StudyCard applications. For more information go to http://education.ti.com/us/product/apps/studycards/scresources.html

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Vocabulary

Dissolved Oxygen The amount of oxygen in gas form present in water. It is usually measured in milligrams per liter (mg/L).

Ecosystem A group of organisms together with its environment, seen as a unit.

Gas Bubble Disease A condition where air bubbles block the flow of blood through vessels often causing death.

Habitat The environment where a particular plant or animal is normally found.

Photosynthesis The process by which plants harness the energy of the sun to make food. In photosynthesis, plants absorb carbon dioxide (CO_2) and give off oxygen (O_2). Thus, there is an overall accumulation of carbon (C) in the plant.

Thermal Pollution An increase in water temperature caused by adding relatively warm water to a body of water at a lower temperature.

Turbidity The ability of light to penetrate water. A measure of "how cloudy the water is." It is usually measured in Nephelometric Turbidity Units (NTU).

Watershed An area of land that delivers runoff water, sediment, and dissolved substances to surface water bodies such as rivers or lakes. All watersheds consist of boundaries, a basin, and collection areas.

Preparation

① Download and install TI Connect™ to your computer.

a. Go to http://education.ti.com/us/product/accessory/connectivity/down/download.html.
b. Follow directions to download the software installer to your computer.
c. Double-click the installer and follow the directions to set up TI Connect™.

② Transfer the water quality data (water_quality_data.73g) from the computer to your TI-73 Explorer™.

a. Connect the computer and the TI-73 Explorer™ with the TI Graph Link cable.
b. Drag the water quality data file (water_quality_data.73g) and drop it on the TI Connect icon which is installed on your desktop.

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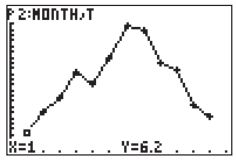
Data Analysis

A. Examine changes in water temperature over the year.

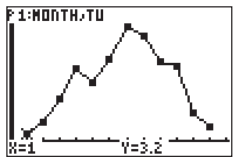
1 **Which month had the highest water temperature during the year?**
The highest water temperature was in July (25.8 ºC).



2 **Which month had the lowest water temperature during the year?**
The lowest water temperature was in January (6.2 ºC).

B. Examine changes in turbidity over the year.

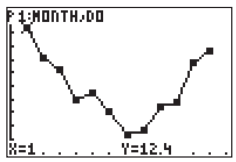
3 **Which month had the highest turbidity during the year?**
The highest turbidity was in July (55.9 NTU).



4 **Which month had the lowest turbidity during the year?**
The lowest turbidity was in January (3.2 NTU).

C. Examine changes in dissolved oxygen over the year.

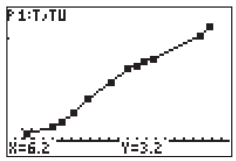
5 **Which month had the highest dissolved oxygen during the year?**
The highest dissolved oxygen was in January (12.4 mg/L).



6 **Which month had the lowest dissolved oxygen during the year?**
The lowest dissolved oxygen was in July (4.3 mg/L).

E. Examine the relationship between turbidity and water temperature.

7 **Does the turbidity level of the water increase or decrease as the water temperature increases?**
As water temperature increases turbidity increases.



8 **Based on your data and the information provided in the research article, at what temperature(s) was water clarity the best? When? Why?**
In January turbidity was 3.2 NTU. This was the lowest value during the year. Low turbidity means clear water, so in January the water clarity was the best.

9 **At what temperature(s) was water clarity the worst? When?**
In July turbidity was 55.9 NTU. This was the highest value during the year. High turbidity means poor water clarity, so in July the water clarity was the worst.

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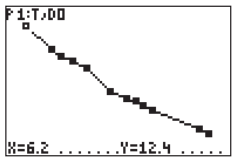
F. Examine the relationship between dissolved oxygen and water temperature.



10 **Does the dissolved oxygen in the water increase or decrease as the water temperature increases?**
As water temperature increases dissolved oxygen decreases.

11 **Based on your data and the information provided in the research article, at what temperature(s) was dissolved oxygen at its "healthiest" level? When? Why?**
In March the dissolved oxygen was 9.2 mg/L. Aquatic sites with good water quality have dissolved oxygen levels between 8 and 10 mg/L. Dissolved oxygen above or below this range may put aquatic life in danger.

12 **At what temperature(s) was the dissolved oxygen level low enough to put aquatic life in danger? When?**
In July the dissolved oxygen was 4.3 mg/L and the water temperature was 25.8 ºC. In August the dissolved oxygen was 4.7 mg/L and the water temperature was 24.8 ºC. When the dissolved oxygen level is between 4 and 5 mg/L, the site is heavily polluted.

13 **Based on your data and the information provided in the research article, during which month(s) was the water quality poor? During which month(s) was the water quality the best? Why?**
The water quality was poor in July and August. During these months the water temperature was high and the turbidity was above the acceptable range. Dissolved oxygen was below the acceptable range.
The water quality was the best in March. During March the water temperature, turbidity, and dissolved oxygen were within acceptable values.