

Great Graphs

Estuary Concepts

Estuaries are dynamic ecosystems with tremendous variability within and between them in physical, chemical, and biological components.

Ongoing research and monitoring is needed to increase our understanding of estuaries and to improve our ability to protect and sustain them.

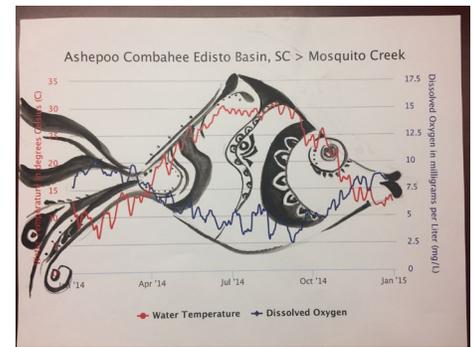
Learning Objectives

1. Understand how to create a graph to view data easily.
2. Read a graph to determine information about water in an estuary.
3. Determine the range of temperature and dissolved oxygen typically found in an estuary.

Teacher Background

This activity introduces students to the nature of estuaries, estuarine environmental factors, and two important abiotic factors—temperature and dissolved oxygen—and how they vary in estuaries. They will work to create a two-factor line graph over time and then read the graph to learn about the relationship between water temperature and dissolved oxygen. Then they can get creative and make art out of the graph they produce.

[Water temperature](#) expresses how hot or cold the water is. Heat is an indicator of the kinetic energy of water, or energy of motion. Increasing temperature indicates increasing energy, or molecular motion, of water.



Activity Information

Grade Level

2-5

Time Required

1 -3 class periods, depending

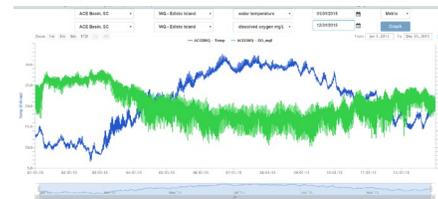
Topic

- Reading and Interpreting Graphs
- Art
- Water Properties

Overview

In this activity, students will examine data for abiotic factors that affect life in estuaries—dissolved oxygen and temperature. Students use real data to learn about water properties in an estuary and practice reading and interpreting graphs. Students will then make art out of their graphs.

SWMP measures water temperature using a thermistor, a metallic device that undergoes a predictable change in resistance in response to temperature changes. This resistance is measured and converted to a temperature reading in Celsius, Fahrenheit, or Kelvin.



Water temperature has many important effects on the biological, physical, and chemical aspects of aquatic environments. Warmer temperatures equal more growth and reproductive activity for plants and animals. This growth causes plants and animals to use more dissolved oxygen at warmer temperatures. Water temperature also has a huge impact on water density, which affects the physical aspects of water. Water at higher or lower temperatures will float on top of water that is 4 degrees Celsius. This is why ice floats. From a chemical aspect, water temperature affects the solubility of dissolved gases, including dissolved oxygen. Colder water holds more dissolved oxygen than warmer water.

[Dissolved oxygen](#) is the amount of oxygen dissolved in the water. It is the oxygen that aquatic plants and animals use to live. Dissolved oxygen is often called DO for short. SWMP uses a membrane-covered dissolved oxygen monitoring probe. Dissolved oxygen diffuses across the membrane and reacts with the probe surface. The amount of oxygen that diffuses across the membrane is measured and converted into a DO reading. Just as humans need air to breathe, aquatic organisms need dissolved oxygen to live. Fish, invertebrates, bacteria, and plants all need dissolved oxygen for respiration. Dissolved oxygen is also needed for the decomposition of organic matter.

Teacher Preparation

This activity can be done with water quality data from any of the 29 Reserves around the country. Familiarize yourself with the [online graphing tool](#) before you work with your students to use it. Depending on your students' ability, you can use one or all three student worksheets with included graphs to help them read and interpret it, or help them through creating the graph themselves and interpreting the results using the discussion questions.

Procedure or Activity Steps

1. You can create a graph on the SMARTboard with your students, they can work in teams of two to three, or individually. Have printed copies of the graphs for the art activity at the end. To print the graphs, click on the four lines on the right side of the graph. You can save the image as a .png or .jpeg or print it there.
2. Give students a specific Reserve site, time range, and water quality parameters to graph as a way of practice with the [online graphing tool](#). Suggestion: ACE Basin Reserve, Edisto Island Water Quality Site, Water Temperature from January 1-December 31 of any year.
3. Follow the discussion questions to work through reading the graph and determining what it tells you about the relationship between water temperature and dissolved oxygen.
4. Give students a specific Reserve site, time range, and water quality parameters to graph as a way of practice with the [online graphing tool](#). Suggestion: ACE Basin Reserve, Edisto Island Water Quality Site, Dissolved Oxygen (mg/l) from January 1-December 31 any year.
5. Now create a two-line graph by choosing water temperature and dissolved oxygen on the same graph for the same year as before. To print the graphs, click on the four lines on the right side of the graph. You can save the image as a .png or .jpeg or print it there.
6. Let them draw a picture (maybe a fish or crab) using the two lines of the graph and color in their estuary animal graph art.

Materials Needed

- **How to Access SWMP data**
- **Discussion Questions**
- **Computer**
- **Printer**
- **Markers or colored pencils**

Extension

Students can spend some time learning about the various [water quality parameters](#) measured at each Reserve. In addition to learning about the parameters and how they are measured students could explore the various tools used in measuring. A Jigsaw is a great strategy for teachers to use to promote student experts. This should inspire students to ask questions about why these parameters are measured and how changes may change throughout the year. This activity is a great extension to move into critical thinking exercises as students begin to develop questions and ideas about the possible causes for water quality differences between Reserve estuaries and even within an estuary.

Discussion Questions with Answers:

Temperature Graph: This is a water temperature graph for a whole year. We measure water quality every 15 minutes all day, every day with a meter that stays out in the water all the time.

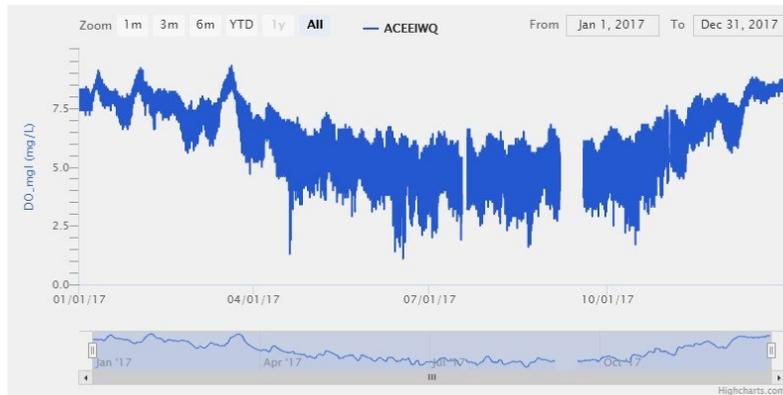
1. Look at the y-axis of the graph, what is the title? (Temperature)
2. What units are used to measure temperature in this graph? (Celsius)
3. Look at the x-axis of the graph, what does it say? (Date)
4. What is the time range on this graph? (January 1-December 31 one year)
5. When do you expect the coldest water temperatures to be? (winter) Does this graph show that? (yes) What was the coldest temperature this year? (varies depending on year)
6. What date had the highest water temperature for the year? (varies by year probably July or August) Does this make sense? (yes)
7. Did the temperature ever go up and then down again throughout the year? (yes, water temperature fluctuates with air temperature and weather)



Dissolved Oxygen Graph: This is a dissolved oxygen graph for a whole year. We measure water quality every 15 minutes all day, every day with a meter that stays out in the water all the time. Dissolved Oxygen is necessary for all animals with gills that live in the water, like fish, crabs, and shrimp.

1. Look at the y-axis of the graph, what is the title? (Dissolved Oxygen)
2. What units are used to show dissolved oxygen? (mg/l)
3. Look at the x-axis of the graph, what does it say? (Date)
4. What is the time frame shown in this graph? (Jan. 1-Dec. 31, one year)
5. During what time of year does this graph show the lowest dissolved oxygen? (Summer) What is the lowest level of dissolved oxygen? (varies with year)
6. During what time of year does this graph show the highest dissolved oxygen? (winter) What is the highest level of dissolved oxygen? (varies with year)
7. Did the dissolved oxygen ever go up and then down again throughout the year? (yes, dissolved oxygen fluctuates throughout the year with the weather, especially the water temperature)
8. Animals get stressed when dissolved oxygen going below 4 mg/l for too long. Did the dissolved oxygen level ever go below 4mg/l? On what dates?

9. What do you think estuary animals do during this time? (answers can vary) (they move or gulp air or use other adaptations)



Temperature and Dissolved Oxygen on one graph:

Now notice there are TWO y-axes!

1. On the x-axis, what is the graph showing? (date) What time frame is shown on this graph? (one whole year)
2. On the left, what water factor is the graph showing? (temperature) What color is the axis title and the line on the graph? (blue)
3. On the right, what water factor is the graph showing? (dissolved oxygen) What color is the axis title and the line on the graph? (green)
4. When the temperature is low, what happens to dissolved oxygen? (It is high)
5. When temperature is high, what happens to dissolved oxygen? (It is low)
6. What do you notice about the temperature and the dissolved oxygen lines in relation to each other? (they are inverse)
7. Remember that low dissolved oxygen levels are stressful for estuary animals, at what time of year could this happen? (Summer)
8. Why? (Because the water temperature is high and that causes the dissolved oxygen to decrease.)



Student Worksheets

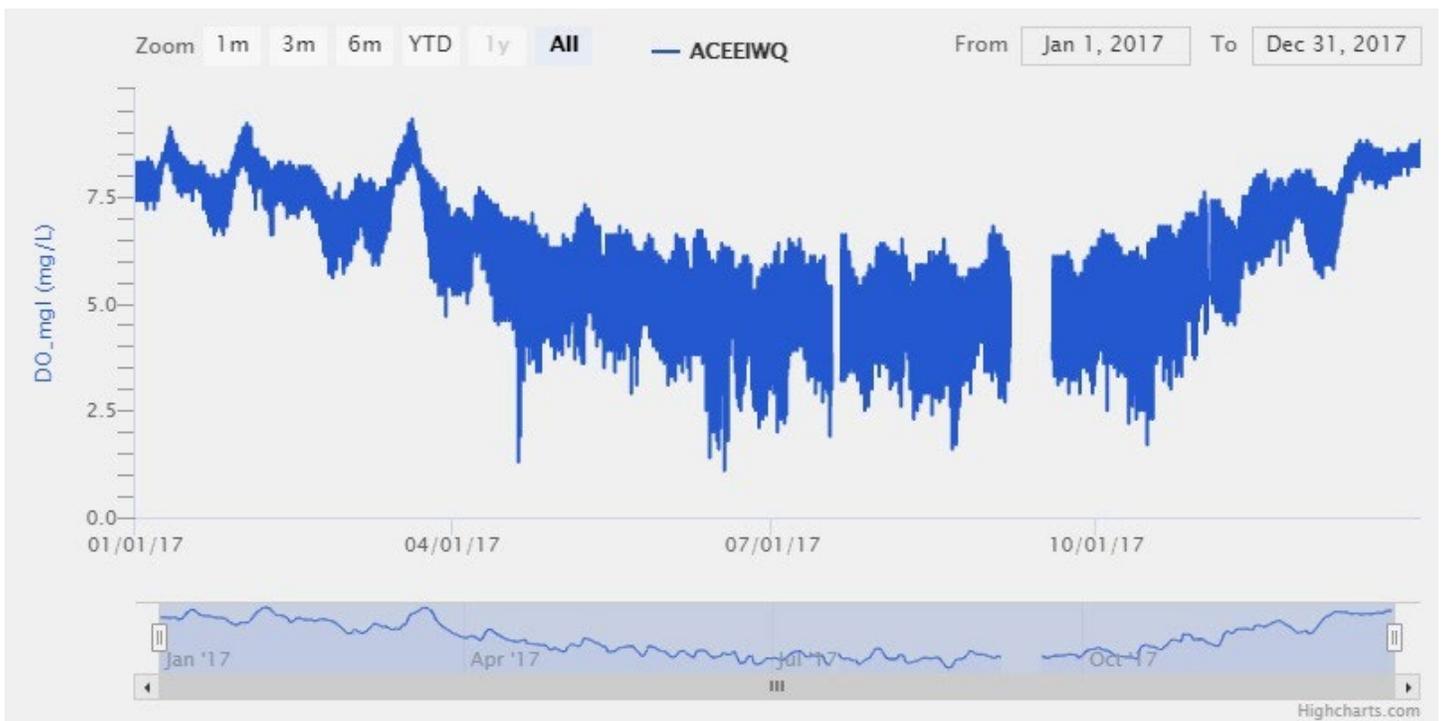
Temperature Graph: This is a water temperature graph for a whole year. We measure water quality every 15 minutes all day, every day with a meter that stays out in the water all the time.

1. Look at the y-axis of the graph, what is the title?
2. What units are used to measure temperature in this graph?
3. Look at the x-axis of the graph, what does it say?
4. What is the time range on this graph?
5. When do you expect the coldest water temperatures to be? Does this graph show that? What was the coldest temperature this year?
6. What date had the highest water temperature for the year? Does this make sense?
7. Did the temperature ever go up and then down again throughout the year?



Dissolved Oxygen Graph: This is a dissolved oxygen graph for a whole year. We measure water quality every 15 minutes all day, every day with a meter that stays out in the water all the time. Dissolved Oxygen is necessary for all animals with gills that live in the water, like fish, crabs, and shrimp.

1. Look at the y-axis of the graph, what is the title?
2. What units are used to show dissolved oxygen?
3. Look at the x-axis of the graph, what does it say?
4. What is the time frame shown in this graph?
5. During what time of year does this graph show the lowest dissolved oxygen? What is the lowest level of dissolved oxygen?
6. During what time of year does this graph show the highest dissolved oxygen? What is the highest level of dissolved oxygen?
7. Did the dissolved oxygen ever go up and then down again throughout the year?
8. Animals get stressed when dissolved oxygen going below 4 mg/l for too long. Did the dissolved oxygen level ever go below 4mg/l? On what dates?
9. What do you think estuary animals do during this time?



Temperature and Dissolved Oxygen on one graph:

Now notice there are TWO y-axes!

1. On the x-axis, what is the graph showing? What time frame is shown on this graph?
2. On the left, what water factor is the graph showing? What color is the axis title and the line on the graph?
3. On the right, what water factor is the graph showing? What color is the axis title and the line on the graph?
4. When the temperature is low, what happens to dissolved oxygen?
5. When temperature is high, what happens to dissolved oxygen?
6. What do you notice about the temperature and the dissolved oxygen lines in relation to each other?
7. Remember that low dissolved oxygen levels are stressful for estuary animals, at what time of year could this happen? Why?

