NATIONAL GEOGRAPHIC

RESOURCE LIBRARY
ACTIVITY : 2 HRS

Dissolved Oxygen and Water Temperature in the Chesapeake Bay

Students investigate the levels of dissolved oxygen at different sites in the Chesapeake Bay using FieldScope maps and data. They explore the relationship between dissolved oxygen and water temperature, and reflect on their decision to recommend a site for improving water quality in the bay.

GRADES

6 - 8

SUBJECTS

Biology, Ecology, Chemistry, Geography, Geographic Information Systems (GIS)

CONTENTS

4 PDFs

OVERVIEW

Students investigate the levels of dissolved oxygen at different sites in the Chesapeake Bay using FieldScope maps and data. They explore the relationship between dissolved oxygen and water temperature, and reflect on their decision to recommend a site for improving water quality in the bay.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/dissolved-oxygen-and-water-temperature-chesapeake-bay/

DIRECTIONS

1. Review indicators of the health of a body of water such as the Chesapeake Bay.

Discuss with students the value of a healthy watershed. Ask:

- *In what ways do you think the Chesapeake Bay watershed is important to humans?* (Student responses may include the seafood we eat, the water we drink from reservoirs, fishing, hunting, and other recreation in and around the waterways.)
- *How can we know if the Chesapeake Bay and other waterways in the watershed are healthy and safe?* (Answers may include that there is abundant wildlife, including birds, fish, crabs, and oysters, and that pollutants are not found in the water.)

Explain that scientists monitor the health of the bay and watershed by analyzing what is in the water, the populations of species that live in and around the bay, and other factors such as the acreage of farmland, acreage of impervious surfaces, and amount of non-point source pollution. In addition to these factors, scientists are continuously measuring the concentration of oxygen in the water and the water temperature to determine the water quality.

2. Have a class discussion about dissolved oxygen and the health of the Chesapeake Bay.

Ask students:

- *What do we need in order to survive?* (Student responses will probably include food, water, shelter, space, and oxygen.) Extend this discussion to include other organisms—such as fish and blue crabs—that live in the water and need those things to survive too. Explain that the focus of this activity is oxygen in the water.
- *How do you think oxygen gets into the water?* (Students may need some assistance in coming up with responses: oxygen from the atmosphere, photosynthesis from grasses in the bay, and from the mixing of ocean, river, and stream water. Oceans have more oxygen, and rivers are fast moving, which helps mix the oxygen from the air.)

Distribute a copy of the student worksheet, Analyzing Watershed Health: Dissolved Oxygen, to each student. Read the first paragraph with the students.

Ask:

- *Why is dissolved oxygen an important water quality measure to monitor?* (Almost all life found in the underwater habitats of the Chesapeake Bay depends on the availability of dissolved oxygen in the water.)
- *Why do you think dissolved oxygen levels change over time?* (Changes in air and water temperature naturally affect the concentration of dissolved oxygen in the water, but

human impacts from farming and urban development can lead to very low, unhealthy levels of dissolved oxygen in the bay.)
- *What do you think a dead zone is?* (Low dissolved oxygen levels can lead to areas where almost no life can survive due to lack of oxygen, referred to as dead zones.)

3. Have students analyze levels of dissolved oxygen in the Chesapeake Bay using FieldScope.

Tell students they will use FieldScope to examine the dissolved oxygen levels in the Chesapeake Bay. Have students work in their project groups at computers for this exercise. Following the worksheet, Analyzing Watershed Health: Dissolved Oxygen, students should complete:

- Part I: Explore levels of dissolved oxygen in the Chesapeake Bay.
- Part II: Examine data for dissolved oxygen at the six sites.

4. Discover the relationship between dissolved oxygen and water temperature.

Complete this activity as a demonstration or have students complete the activity in small groups. On their worksheet, Analyzing Watershed Health: Dissolved Oxygen, students should complete Part III: How does temperature affect dissolved oxygen? Discuss the relationship between water temperature and dissolved oxygen levels after students complete Part III. Students should be able to describe an inverse relationship: As temperatures rise, dissolved oxygen levels fall; and as temperatures fall, dissolved oxygen levels rise.

5. Have students make a connection to the Chesapeake Bay Action Plan decision.

Remind the students that the action plan for the Chesapeake Bay watershed is designed to improve water quality. An improvement in water quality will mean that the dissolved oxygen levels will be at a level to support an active and diverse ecosystem. Ask students to reflect on the importance of dissolved oxygen in the Chesapeake Bay ecosystem and to think about what sites would most benefit from this action plan. Have students refer to their Stakeholder Table from the first activity and add to it or revise any rows.

Based on their dissolved oxygen data, students should consider a site, or sites, for the action plan. Distribute the Project Data Tables and Decision Statement Planner worksheets to each group so they can complete Part IV: Chesapeake Bay Action Plan Connection of the worksheet, Analyzing Watershed Health: Dissolved Oxygen. It is important for students to keep these two worksheets for the entire project.

Modification

Step 2: Ask struggling readers to annotate the readings by circling new vocabulary and underlining important phrases or sentences. They can also be paired with more confident readers to help process the text.

Modification

Step 3: Some students may need fewer sites to compare. Consider reducing the number of focus sites to three or four.

Modification

When working with FieldScope, some students may work better in partners or small groups.

Informal Assessment

Students will construct a rough sketch of the relationship between water temperature and dissolved oxygen in Part III of their worksheets, Analyzing Watershed Health: Dissolved Oxygen. Students can be assessed on their understanding of this relationship throughout the class discussion. In class discussions, and responses on the worksheet, students will articulate the importance of dissolved oxygen as a measure of water quality.

Extending the Learning

Consider how dissolved oxygen levels might vary based on seasons. Students are looking at Chesapeake Bay Interpretive Buoy System (CBIBS) data from the most recent 2-3 weeks. Discuss how data might look different if they explored the CBIBS data in three months, six months, and nine months.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology
- Chemistry

Geography

- Geographic Information Systems (GIS)

Learning Objectives

Students will:

- describe the importance of oxygen to aquatic ecosystems and water quality overall
- analyze the relationship between dissolved oxygen levels and water temperatures
- identify levels of dissolved oxygen at different sites in the Chesapeake Bay watershed
- analyze and interpret data to investigate the relationship between dissolved oxygen, temperature, and health of the ecosystem

Teaching Approach

- Learning-for-use

Teaching Methods

- Discovery learning
- Multimedia instruction
- Reflection
- Research

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills

    - Information Literacy
    - Information, Communications, and Technology Literacy
    - Media Literacy
  - Learning and Innovation Skills
    - Critical Thinking and Problem Solving
- 21st Century Themes
  - Environmental Literacy
- Geographic Skills
  - Acquiring Geographic Information
  - Analyzing Geographic Information
- Science and Engineering Practices
  - Analyzing and interpreting data
  - Constructing explanations (for science) and designing solutions (for engineering)
  - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

NATIONAL COUNCIL FOR SOCIAL STUDIES CURRICULUM STANDARDS

• **Theme 3:**
People, Places, and Environments

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **Reading Standards for Informational Text 6-12:**
Key Ideas and Details, RI.6.2
• **Reading Standards for Informational Text 6-12:**
Key Ideas and Details, RI.7.2
• **Reading Standards for Informational Text 6-12:**
Key Ideas and Details, RI.8.2
• **Speaking and Listening Standards 6-12:**
Presentation of Knowledge and Ideas, SL.8.5
• **Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12:**
Research to Build and Present Knowledge, WHST.6-8.9

NEXT GENERATION SCIENCE STANDARDS

• **MS-ESS3: Earth and Human Activity:**
 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment
• **MS-LS1: From Molecules to Organisms: Structures and Processes:**
MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
• **MS-LS2: Ecosystems: Interactions, Energy, and Dynamics:**
MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem

THE COLLEGE, CAREER & CIVIC LIFE (C3) FRAMEWORK FOR SOCIAL STUDIES STATE STANDARDS

• **Geographic Representations: Spatial Views of the World: D2.Geo.2.6-8:**
Use maps, satellite images, photographs, and other representations to explain relationships between the locations of places and regions, and changes in their environmental characteristics.

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- 4, 1000 mL beakers
- Copies of Data Table (one per group of students)
- Copies of student worksheet (one per student): Analyzing Watershed Health: Dissolved Oxygen
- Dissolved oxygen probe or DO testing kit
- Pencils
- Ice (to make the water very cold)
- Stirring rod
- Thermometer or temperature probe
- Water of different temperatures (very cold, cold, room temperature, hot)

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per learner, 1 computer per small group, Interactive whiteboard, Presentation software

PHYSICAL SPACE

- Classroom
- Computer lab
- Laboratory space
- Media Center/Library

SETUP

Students either need to be at one computer independently or working in a small group. The space should have enough flexibility so groups can move between the computers and workstations easily.

GROUPING

- Heterogeneous grouping
- Homogeneous grouping
- Small-group instruction

BACKGROUND & VOCABULARY

Background Information

The amount of oxygen in water affects the life it can support. The warmer the water, the less dissolved oxygen it can hold. Some fish, such as trout, need cold water with high levels of dissolved oxygen. They cannot live in warmer water. Other fish, such as carp, thrive in warmer water with less dissolved oxygen. When thermal pollution warms water, some cold-water fish species cannot survive because they cannot breathe. Other fish species may take over habitats from cold-water fish if waters become too warm. The effect of these changes in fish populations can spread through the food web to organisms that eat or are eaten by the species that are directly affected.

Warmer water can also reduce the level of dissolved oxygen in water through a dramatic growth of algae called an “algal bloom.” Warm water provides a better environment for certain types of freshwater algae (tiny water plants) to grow. The algae thrive in warm water and their populations can grow rapidly. However, algae are short-lived. When they die, they sink to the lake bottom where they decompose. This decomposition uses up a great deal of dissolved oxygen, leaving even less in the water for fish to breathe. Some species of algae also produce toxins that are deadly to fish or other aquatic organisms. Widespread deaths of aquatic organisms often result from these algae blooms.

In summer months, warmer temperatures result in lower dissolved oxygen levels. Warm water can hold less oxygen than cooler water; so generally, Chesapeake Bay waters hold less oxygen in the summer than in winter. That is part of the reason why trees along a stream bank are so important to fish and insects that live in the water—the trees provide shade that lowers water temperature.

Prior Knowledge

["Living organisms, including aquatic organisms, need oxygen to survive.","Oxygen gets into the water from the air, from other waters that mix with the bay, and from underwater plants that undergo photosynthesis.","Food chains and food webs can get disrupted when one organism’s population declines."]

Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
dead zone	*noun*	area of low oxygen in a body of water.
dissolved oxygen	*noun*	measure of the amount of oxygen in a substance, usually water.
ecosystem	*noun*	community and interactions of living and nonliving things in an area.
photosynthesis	*noun*	process by which plants turn water, sunlight, and carbon dioxide into water, oxygen, and simple sugars.
stakeholder	*noun*	person or organization that has an interest or investment in a place, situation, or company.

Term	Part of Speech	Definition
water quality	*noun*	chemical, physical, and biological characteristics of water for a specific purpose such as drinking.
watershed	*noun*	entire river system or an area drained by a river and its tributaries.

For Further Exploration

Websites

- About the Chesapeake Bay Interpretive Buoy System (CBIBS)
- Current data from CBIBS

FUNDER

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