NATIONAL GEOGRAPHIC

RESOURCE LIBRARY I ACTIVITY : 55 MINS

Nitrates in the Chesapeake Bay

Students investigate nitrate levels at different sites in the Chesapeake Bay using FieldScope maps and data. Students review and reflect upon the decision they will make to choose a site to recommend for improving water quality in the bay.

GRADES

6, 7, 8

SUBJECTS

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

CONTENTS

8 PDFs, 1 Link

OVERVIEW

Students investigate nitrate levels at different sites in the Chesapeake Bay using FieldScope maps and data. Students review and reflect upon the decision they will make to choose a site to recommend for improving water quality in the bay.

For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/nitrates-chesapeake-bay/

DIRECTIONS

1. Motivate the need to explore nitrate levels in the Chesapeake Bay watershed.

Review the previous activity, where students explored why dissolved oxygen is an important water quality measure to monitor. (Because almost all life found in the underwater habitats of the Chesapeake Bay depend on the availability of dissolved oxygen in the water.) Remind students that the letter from Mr. Klene mentioned that algae blooms were becoming more

frequent in areas, indicating that levels of dissolved oxygen were decreasing. One possibility for the decrease in levels of dissolved oxygen is an increase in nutrient pollution. Distribute the worksheet, Analyzing Watershed Health: Nitrates to students. Read with students the section titled, "What is Nutrient Pollution?"

2. Have students analyze nitrate levels in the Chesapeake Bay using FieldScope.

Tell students they will use FieldScope to examine nitrate levels in the Chesapeake Bay. Have students work in their project groups at computers for this exercise. Before students start exploring FieldScope, it is important to discuss that citizen scientists have collected the type of data they will analyze. Discuss how this data may be less reliable and more uncertain than the CBIBS data used for the dissolved oxygen activity, but that it can still be useful. Students should complete the worksheet, Analyzing Watershed Health:

Part I: Explore nitrate levels in the Chesapeake Bay.

Part II: Examine data for nitrates at the selected sites.

3. Have students explore water flow paths at the selected sites in the Chesapeake Bay using FieldScope.

Nutrients that enter the watershed upstream can make their way downstream, eventually entering the Chesapeake Bay. Complete this activity as a demonstration or have students complete the activity in small groups. On their worksheet, Analyzing Watershed Health: Nitrates, students should complete Part III: Water Flow to the Chesapeake.

4. 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 nitrate levels will need to be brought to a safe level and maintained to support a healthy ecosystem. Ask students to reflect on the importance of lowering the amount of nitrates in the Chesapeake

Bay ecosystem, and to think about what sites would benefit most from this action plan. Have students refer to their Stakeholder Table from the first activity in this lesson and add to it or revise any rows.

Based on their nitrate data and Stakeholder Table, students should consider a site, or sites, for the action plan. Have students work on their Project Data Tables and Decision Statement Planner worksheets so they can complete Part IV: Chesapeake Bay Action Plan Connection, Analyzing Watershed Health: Nitrates. Students may decide that they would rather restore a site that has a lot of nitrogen input, or they may decide that they would rather restore a site that has less nitrogen input. The important thing is for students to justify their decision. It is important for students to keep these data tables and planner worksheets for the entire project.

Modification

Step 1: Ask struggling readers to annotate the reading by circling new vocabulary and underlining important phrases or sentences. They can also be paired with more confident readers to help them understand the text.

Tip

Step 2: Provide some support in interpreting the FieldScope maps by reviewing the legend and discussing that each circle represents *average* nitrate levels. Discuss how *averages* are obtained.

Modification

Steps 2 and 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

Through discussion and responses on student worksheets, Analyzing Watershed Health: Nitrates, student understanding of the inverse relationship between levels of nitrates and water quality can be assessed.

Extending the Learning

Extension: Understand Physiographic Regions

Direct students to turn on the Physiographic Provinces layer. Physiographic regions are defined by geology and terrain. Maps of physiographic regions can give you an overview of where mountains are versus where areas of flat terrain might be. Students can look at the water flow path to consider how it follows boundaries of the physiographic regions. Since water always wants to flow downhill, it often skirts around features in the terrain, like mountains or ridges, searching for the path of least resistance. Ask students to read the layer description of the physiographic regions and use the Query tool to click on different physiographic regions and learn more about them. Identify the physiographic region for each of the selected sites.

Extension: Upstream Area Tool

Understanding where water is coming from is just as important as knowing where it is going. Nutrient levels reported at one site may have entered the waterway at upstream locations. In the left toolbar, click on *Data Query Tool,* and select *Query by Upstream Area*. Return to the map and click a spot near a study site to select an outlet for the upstream area. Depending on the site, students may see a large or small area highlighted as the upstream area. If nitrate data is available, observe the levels upstream from each site. Are they higher or lower than the levels at the site? Why might they be different?

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology
- Chemistry

Geography

- Geographic Information Systems (GIS)

Learning Objectives

Students will:

- describe the effects of an overabundance of nitrates on water quality
- identify nitrate levels at different sites in the Chesapeake Bay watershed and understand some possible causes for high nitrate levels in urban and rural areas
- identify water flow paths from different sites to the Chesapeake Bay
- reflect on their decision to recommend a site to implement an action plan for improving water quality in the Chesapeake Bay watershed

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

- Critical Thinking Skills
  - Analyzing
  - Understanding
- 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

NATIONAL GEOGRAPHY STANDARDS

• **Standard 1:**
How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information
• **Standard 8:**
The characteristics and spatial distribution of ecosystems and biomes on Earth's surface

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

• **Reading Standards for Informational Text 6-12:**
Key Ideas and Details, RI.8.2
• **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.6.2
• **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:**
MS-ESS3-3: 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

- Copies of Data Table (one per group of students)
- Copies of Stakeholder Table (from previous activity) (one per group of students)
- Copies of student worksheet (one per student): Analyzing Watershed Health: Nitrates
- Pencils

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

RESOURCES PROVIDED: HANDOUTS & WORKSHEETS

- Analyzing Watershed Health: Nitrates Worksheet
- Project Data Table
- Decision Statement Planner
- Water Stakeholder Table
- Analyzing Watershed Health: Nitrates Worksheet Teacher Version
- Project Data Table Teacher Version
- Decision Statement Planner Teacher Version
- Water Stakeholder Table Teacher Version

RESOURCES PROVIDED: UNDEFINED

- FieldScope Map: Nitrates in the Watershed

Background Information

An overabundance of nitrates in the water can promote the growth of algae. This growth limits the amount of sunlight that can reach bay grasses, thereby reducing their ability to engage in photosynthesis to put oxygen into the water. Additionally, when algae 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 and other aquatic organisms.

Nitrate levels are often higher near agricultural areas because of animal waste and fertilizer use. Urban centers can have high nitrate levels from runoff.

Prior Knowledge

["Too much nitrogen in a waterway can cause an algal bloom","Why we use nitrogen and where we use it","Airborne sources of nitrogen"]

Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
air pollution	*noun*	harmful chemicals in the atmosphere.
citizen science	*noun*	science project or program where volunteers who are not scientists conduct surveys, take measurements, or record observations.
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.
fertilizer	*noun*	nutrient-rich chemical substance (natural or manmade) applied to soil to encourage plant growth.

Term	Part of Speech	Definition
nitrate	*noun*	type of salt used as fertilizer. Excess nitrates can choke freshwater ecosystems.
nitrogen	*noun*	chemical element with the symbol N, whose gas form is 78% of the Earth's atmosphere.
nutrient pollution	*noun*	water pollution caused by overabundance of nutrients, mostly nitrogen and phosphorus.
stakeholder	*noun*	person or organization that has an interest or investment in a place, situation or company.
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

Maps

- National Geographic Education: Citizen Scientists Across the U.S.