

Seminole County Water Atlas Learning Kit

Measuring Lake Quality *Teacher's Guide*

Students practice their skills while learning about lake quality and how humans impact it.

Water Atlas Curriculum Lesson 27

Grade Level: Middle

Subject Area/Course: Reading, Writing (Language Arts) and Math

Performance Objectives:

References are to the Next Generation Sunshine State Standards (2007).

Language Arts

- LA.7.1.7.3 Determine the main idea or essential message in grade-level or higher texts through inferring, paraphrasing, summarizing, and identifying relevant details.
- LA.7.2.2.3 Organize information to show understanding (e.g., representing main ideas within text through charting, mapping, paraphrasing, summarizing, or comparing/contrasting).
- LA.7.3.3.1 The student will revise by evaluating the draft for development of ideas and content, logical organization, voice, point of view, word choice, and sentence variation.

Math

- MA.A.3.3.3 The student adds, subtracts, multiplies, and divides whole numbers, decimals, and fractions, including mixed numbers, to solve real-world problems, using appropriate methods of computing, such as mental mathematics, paper and pencil, and calculator.

ACADEMIC OUTCOMES/LESSON OBJECTIVES:

- Students will read a selection introducing them to methods for measuring lake quality.
- Students will respond to questions or prompts in Reading, Writing, and Math.

DURATION: One Instructional period

TEACHER BACKGROUND INFORMATION:

The Trophic State Index (TSI) is one factor used in determining lake water quality. Scientists also investigate a lake's dissolved oxygen and biotic factors, such as bacteria, plant, and animal species, to determine water quality. This activity focuses on TSI because there is a high correlation between water quality and the plant nutrients measured by the TSI. The following information from the Seminole Water Atlas illustrates the relationships of nutrient scores and water quality.

WHAT IS "TROPIC STATE?"

"Trophic" means "relating to nutrition." To determine a waterbody's trophic state, the Trophic State Index (TSI) takes into account measurements of chlorophyll, nitrogen, and phosphorous,

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which are nutrients required by plant life. Florida waterbodies are classified into four trophic states: oligotrophic (lacking plant nutrients, the TSI is 0-49), mesotrophic (having a medium amount of plant nutrients, the TSI is 50-60), eutrophic (rich in plant nutrients, but often at the expense of dissolved oxygen; the TSI is 61-69), and hypereutrophic (extremely rich in plant nutrients, the TSI is greater than 69). The Florida Department of Environmental Protection (FDEP) uses this information to determine a good, fair or poor rating for the waterbody.

Ratio	TSI Range	Use
GOOD	0-59	Fully supports designated use.
FAIR	60-69	Partially supports designated use.
POOR	70-100	Does not support designated use. (end quote)

High levels of nutrients in lake water cause increased plant growth (hence greater levels of chlorophyll). As the levels of nutrients and chlorophyll increase, the TSI score also increases. Therefore, high TSI scores reflect poor lake quality. Yard fertilizers are one contributor to poor TSI. When these nutrients wash into lake water, they cause algae to grow at higher-than-normal rates. Algae adds oxygen to lake water during photosynthesis, but it also uses oxygen during respiration. When the algae dies, it is decomposed by bacteria that also use up oxygen. Between the algae growth and the bacteria, the oxygen level in poor quality lakes decreases. Very low oxygen levels can even lead to fish kills.

The Water Atlas website provides data that helps assess lake health. For example, the TSI Historic Range demonstrates how water quality has changed over the years. Lake managers can use this and other information to track down causes for and find solutions to water quality problems. On the Atlas, nutrients like nitrogen and phosphorous are measured in micrograms per liter of lake water (ug / liter). One gram equals one million (1,000,000) micrograms. Tracking nutrient levels can help scientists determine which nutrients affect plant growth and lake quality. In many Seminole County lakes, phosphorous is listed as a "Limiting Nutrient." This means that if the amount of phosphorous were decreased, the number of problem plants in the lake would also decrease. As a result, some lake managers, wishing to restrict plant growth and improve lake quality, work to decrease lake phosphorous levels. Other lakes in Seminole County have nitrogen listed as a limiting nutrient. If a lake is listed as "balanced," neither phosphorous nor nitrogen are limiting factors, but equal in their effect on plant growth.

The Seminole Watershed Atlas Website general pages for individual lakes, and Learn More about Trophic State Index (TSI) found at www.Seminole.WaterAtlas.org > Water Resource Search Box > Type in or select the Lake Name > Trophic State Index.

TEACHER WEBSITE RESOURCES:

- Sunshine State Standards can be found at <http://www.floridastandards.org/>

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MATERIALS NEEDED:

- Internet access with www.Seminole.WaterAtlas.org book-marked
- Student pages for "Measuring Water Quality"

SAFETY: N/A

VOCABULARY:

Alga

A simple, rootless plant that grows in sunlit water, giving the water a highly colored appearance, often green. *Plural: algae*

Chlorophyll

Any of a group of green pigments that are found in the chloroplasts of plants and in other photosynthetic organisms. Chlorophyll a is a specific form that is used by plants to carry out photosynthesis.

Data

Information (either facts or figures) from which conclusions can be drawn.

Habitat

The place where an organism, population, or community of animals, plants, or microorganisms lives, as well as its surroundings, both living and nonliving.

Microgram

One one-millionth (0.000001) of a gram. (May be abbreviated as μg or ug.)

Nitrogen

A chemical element that is also a biologically important nutrient essential to plant growth.

Nutrient

An element or compound essential as raw material for organism growth and development, such as carbon, nitrogen, or phosphorus. Nutrient pollution is primarily caused by urban or agricultural stormwater runoff containing fertilizers, or by runoff that contains animal manure.

Phosphorous

A chemical element that is also a biologically important nutrient essential to plant growth.

Trophic State

A measure of a lake's fertility, as determined by the quantities of the nutrients nitrogen and phosphorus in its water.

Trophic

Relating to nutrition.

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KEY:

Reading

1. b) LA.6.1.6.3, Bloom's Taxonomy Level One
2. Use the rubric for Extended Response Reading Questions – 4 points
LA.6.1.7.2, Bloom's Taxonomy Level Two

Example of a Top-Score Response:

Human choices can impact lake quality both negatively and positively. When people choose to add extra nutrients to a lake, either by using too much fertilizer or by allowing pet waste to wash into them, this decreases the lake's quality. On the other hand, people can choose to measure lake quality and make decisions to help keep these water bodies healthy. They can choose to restrict the use of fertilizers and scoop up pet waste. In this way, human choices can both improve and decrease lake quality.

3. b) LA.6.1.7.3, Bloom's Taxonomy Level One
4. Use the rubric for Extended Response Reading Questions – 4 points
LA.6.1.7.3, Bloom's Taxonomy Level One

Example of a Top-Score Response:

Lake Jesup is a poor quality lake. Its TSI of 73 is greater than the TSI of the fair quality Lake of the Woods (TSI 59). The fair quality lake, in turn, has a greater TSI than good quality Bear Lake (TSI 36). In each case, the TSI increases as the phosphorus and nitrogen levels increase. This means that poor water quality often goes hand in hand with high nutrient levels (high TSI). Good water quality often goes along with low levels of nutrients (low TSI).

Writing

For All – Use the rubric for Florida Writes! – 6 points

1. LA.6.4.2.1
2. LA.6.4.2.1
3. LA.6.4.2.1
4. LA.6.4.2.1

Math

1. Use the rubric for Short Response Math Questions – 2 points MA.7.A.3.2

Example of a Top-Score Response:

Bear Lake, Lake Kathryn, Lake Harney, and Lake Jesup have TSI values closer to the low quality end of their range.

For each lake, subtract the current value from the low quality end of the range. Then subtract the high quality value from the current TSI. If the difference is smaller between

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the current TSI and the low quality value, the Lake is included on the list of answers above.

For example, a top score response will include the following computations for each lake in the table.

Bear Lake: $46.8 - 36 = 10.8$ $36 - 22.4 = 13.6$ $10.8 < 13.6$ Closer to Lower Quality End

2. d) MA.7.A.3.2
3. a) MA.8.A.6.1
4. b) MA.7.A.3.2

PROCEDURE:

1. Preview this activity. Print copies for your students.
2. Preview the Seminole Water Atlas.
Go to www.Seminole.WaterAtlas.org > Water Resource Search Box > Type in or select the Lake Name > then look over the lake's Overview/Current Conditions page.
 - a. Click on Water Quality and review the data on nitrogen and phosphorous levels and TSI. Review the information in "Learn More About" Trophic State Index.
 - b. In the event that your lake does not provide this data, choose one of the lakes in Table 2 of the student reading assignment.
3. Using the information learned in the practice and the Water Atlas, compare the nutrient levels and water quality in a lake near you with those in Table 2. Visit a local lake. Does it look like a clear, good quality lake? Or is it filled with algae? Explore the schoolyard or have students search their neighborhoods looking for potential water quality influences, including excess use of fertilizers and un-scooped pet waste.

AUTHOR: Kelley G. Weitzel