Measuring Lake Quality *Handout*

Students practice for the FCAT while learning about lake quality and how humans impact it.

Water Quality and the TSI

How do scientists measure a lake's quality? Some test a lake's water for plant nutrients, like nitrogen and phosphorus. The data collected helps to determine how many plants a lake will support. A low to moderate amount of nutrients will support a healthy number of plants. If nutrient levels get too high, plants like algae can grow out of control. These algae blooms can block out sunlight and decrease the amount of oxygen in the water. As a result, high nutrients often indicate poor lake quality. Scientists describe this effect with the **Trophic State Index** (TSI). Table 1 defines each rating in the Trophic State Index.

Table 1. Trophic State Index (TSI)

Description	Trophic State Index (TSI score)	Florida Lake Rating
Lacking nutrients	0-49	Good
Some nutrients	50-60	Good
Rich in nutrients	61-69	Fair
Extremely rich in nutrients	70-100	Poor

Scientists calculate these TSI numbers by testing lake water for levels of nitrogen, phosphorous, and chlorophyll (a chemical made by green plants). The table on the next page, titled "Lake Quality and Nutrient Values," displays water quality information for six lakes located throughout Orange County. In addition to the TSI score, this table includes the TSI Historic Range. This range demonstrates how water quality has changed over the years, showing the highest and lowest values. For example, at this testing, Lake Cherokee has a rating of Good (57). In the past, however, its TSI has been as high as 81 (Poor) and as low as 40 (Good). A lake's quality varies depending on the condition of the habitat around the lake. If too many fertilizers are applied near the lake, rainwater will wash these nutrients into the water body. This increases the nitrogen and phosphorous amounts, causing the lake's quality to decrease (and the TSI number to increase).

Because they are so important to water quality, nitrogen and phosphorous amounts are also recorded in the table. Both nutrients are measured in micrograms per liter of lake water (μg / liter). A microgram – as you might guess – is very small. There are one million (1,000,000) micrograms in a single gram.

The nitrogen reading for Lake Cherokee (rated Good) is 736.7 μg / liter while Lake Poinsett (rated Poor) has 2786.7 μg / liter. Greater amounts of nitrogen and phosphorus in the water provide nutrients for more plant growth, particularly algae, decreasing the water quality of the lake. You can find out how a lakes' quality has changed over time by looking at each nutrient's historic range.

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The final category included in this table is "Limiting Nutrients." Plants need specific amounts of each nutrient for healthy growth. A "limiting nutrient" is something that restricts the amount of plant growth. In most of these water bodies, phosphorous is listed as a limiting factor. Because phosphorous is required for plant growth, decreasing the amount of phosphorous in a lake means that fewer problem plants (like algae) will be able to grow. This is one method lake managers use to improve lake quality.

If you live in Orange County and would like to investigate the quality of a lake near you, visit the county's Water Atlas Website, http://www.Orange.WaterAtlas.org. Type in the name of your lake to find the TSI score, the amount of nutrients in the water, and graphs showing how these levels have changed over the last two years, the last ten years, or how they typically change from month to month. If you would like to improve the water quality in a lake near you, focus on the habitat around the lake. Make sure that you are not over-fertilizing your yard. And always scoop the poop; pet waste is a major source of plant nutrients when it washes down into the lake. Gross, but true!

Table 2. Lake Quality and Nutrient Values

Lake Name	Trophic State Index (TSI) Score	TSI Historic Range	Amount of Nitrogen µg / Liter	Historic Range of Nitrogen µg / Liter	Amount of Phosphorous µg / Liter	Historic Range of Phosphorous µg / Liter	Limiting Nutrient
Beauclair	64 / Fair	42 – 99	1689.6	55.0 – 8631.1	36.6	3.0 – 3790.0	Phosphorus
Cherokee	57 / Good	40 – 81	736.7	300.0 – 2813.3	42.3	30.0 – 140.0	Balanced
Condel	70 / Poor	64 – 93	2030.0	630.0 – 5.570.0	46.0	7.0 – 431.0	Phosphorus
Dwarf	63 / Fair	45 – 92	1110.0	530.0 – 4790.9	65.0	33.0 – 708.0	Balanced
Palm	13 / Good	7 – 23	70.0	70.0 – 960.0	10.0	2.0 – 12.0	Nitrogen
Poinsett	80 / Poor	40 – 87	2786.7	692 – 4543.3	177.7	29.2 – 355.3	Balanced

FCAT-Friendly Reading Questions:

1. The following statements are included in this article: "If nutrient levels get too high, plants like algae can grow out of control. These algae blooms can block out sunlight and decrease the amount of oxygen in the water."

   Based on context clues, what is the meaning of the word "bloom" in these statements?

   a. Freshly opened flowers
   b. Sudden plant growth
   c. Mats of dead leaves
   d. Toxins released by algae

2. Based on your reading of the article, defend the following statement: "Human choices can impact lake quality positively or negatively." Use details and information from the article to support your answer.

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3. Which of the following statements is accurate for lakes included in the Table 2?

   a. High quality lakes generally have balanced nutrient levels.
   b. Higher nitrogen levels are generally found with higher phosphorous levels.
   c. Lakes with "Good" ratings generally have high TSI scores.
   d. Lakes with "Poor" ratings generally have high nitrogen levels.

4. Table 2 provides water quality data for six Orange County Lakes. Choose three of these lakes, one with "Good" water quality, one with "Fair" water quality, and one with "Poor" water quality. Explain the water quality relationships among these lakes by comparing their TSI scores, nitrogen levels, and phosphorous levels.

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FCAT-Friendly Writing Prompts

1. Fertilizers that wash into lakes decrease lake quality by causing too much algae to grow. Imagine that your neighborhood group is arguing over whether they should use fertilizers to promote green grass or ban fertilizers to improve the lake's health. Write to persuade your neighborhood group that with careful planning, the neighborhood can achieve both green grass and clear, healthy lake water.

2. High-nutrient lake water is often filled with algae, creating a low-oxygen environment that's unhealthy for fish. Imagine that your neighborhood fishing lake is becoming choked with excess algae. Write to persuade them to find other ways of improving the lake's water quality OR to use chemicals in altering the lake.

3. When buying lakefront property, many people do not realize that their daily activities affect the health of the entire lake. Imagine that your homeowner's association passes a rule requiring lake-front owners to scoop up pet waste and limit their use of fertilizers. Write to explain your response to the association's efforts to preserve the lake quality.

4. Because lakes are generally lower than the surrounding ground, a variety of trash and pollutants wash down storm drains into these water bodies. Think about a time in your life when you added trash or pollutants to a roadway or natural area. Write to explain two ways that you can change your personal practices to reduce the trash or pollutants that flow into nearby water bodies.

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FCAT-Friendly Math Questions

Refer to Table 2 to answer the following questions.

1. As a regional lake manager, you are interested in how each lake's current water quality score (TSI) compares to its historic range. How many of the current TSI scores in this table are closer to their LOWER QUALITY score? Write their names below, and be sure to show your calculations. Remember, high TSI=low quality.

2. Which of the following shows the lake with the largest TSI range paired with the lake with the smallest TSI range?

   a. Dwarf, Poinsett
   b. Cherokee, Poinsett
   c. Condel, Palm
   d. Beauclair, Palm

3. One gram equals one million (1,000,000) micrograms. Lake Katherine has 2177 micrograms per liter. Which of the following represents the amount in grams per liter?

   a. 2.177×10^3 grams per liter
   b. 2.177×10^4 grams per liter
   c. 2.177×10^3 grams per liter
   d. 2.177×10^4 grams per liter

4. In the Table 2 column titled "Limiting Nutrient," two lakes have a balanced combination of nutrients. According to the table, which of the following represents a ratio of nitrogen to phosphorous in a <u>balanced</u> lake?

   a. 1 nitrogen: 24 phosphorous
   b. 17 nitrogen: 1 phosphorous
   c. 1 nitrogen: 17 phosphorous
   d. 35 nitrogen: 1 phosphorous