# A Water Table's Story *Lesson Plan*

*Students will compile and use a statistical table using water quality data.*



**Topic:** Statistical tables are used to show trends and patterns. They organize and categorize information under specific headings. Students will explore the Water Atlas and record information about different bodies of water in a table. They will then use the information in their table to make some decisions and create a hypothesis about the health of the waters in Orange County.

**Grade Level:** 6th – 7th

**Time Allotted:** One class period (approximately 50 minutes)

## Performance Objectives

**6th Grade Science**

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| SC.6.N.1.2 | Explain why scientific investigations should be replicable. |
| SC.6.N.1.4 | Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigations. |
| SC.6.N.2.2 | Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered. |

**6th Grade Math**

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| MA.6.S.6.1 | Determine the measures of central tendency (mean, median, mode) and variability (range) for a given set of data. |

**6th Grade Language Arts**

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| LA.6.2.2.1 | The student will locate, use, and analyze specific information from organizational text features. |
| LA.6.2.2.3 | The student will organize information to show understanding. |
| LA.6.4.2.2 | The student will record information related to a topic, including visual aids to organize and record information and include a list of sources used. |

**7th Grade Science**

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| SC.7.N.1.2 | Differentiate replication (by others) from repetition (multiple trials). |
| SC.7.N.1.3 | Distinguish between an experiment (which must involve the identification and control of variables) and other forms of scientific investigation and explain that not all scientific knowledge is derived from experimentation. |
| SC.7.N.1.7 | Explain that scientific knowledge is the result of a great deal of debate and confirmation within the science community. |
| SC.7.N.3.1 | Recognize and explain the difference between theories and laws and give several examples of scientific theories and the evidence that supports them. |

## Prior Knowledge

- Students should understand what a hypothesis is, and how to create one.

## Overview

Statistical tables are used to show trends and patterns. They organize and categorize information under specific headings. Horizontal lines are called rows and vertical lines of information are called columns. To read a statistical table, look at the title, and then look at the headings. Using the categories at the top and left side of the table, read across a row and down a column to locate specific information.

Students will explore the Water Atlas and record information about different bodies of water in Orange County in a table. They will then use the information in their table to create a hypothesis about water quality and suggest methods of testing it.

## Key Vocabulary

**Algae**
Simple, rootless plants that grow in sunlit water, giving the water a highly colored appearance, often green.

**Chlorophyll-a**
A pigment that plants use in a process called photosynthesis that makes food from water and carbon dioxide, using energy from sunlight.

**Data table**
A tool to organize and display information so that it is more easily read and interpreted. Data are typically arranged in rows and columns, with each cell of the matrix containing a piece of data; rows and columns are labeled so that the reader knows what the data in each cell represent.

**Hypothesis**
A testable explanation for observed phenomenon. A scientific hypothesis should be testable and measurable; if a hypothesis states "If A happens, then B will occur," then you will need a way to quantify A, and a way to measure B as it happens.

**Liter**
A liter is a unit of volume; it is slightly more than a quart.

**Milligram**
One one-thousandth (0.001) of a gram, abbreviated mg. A gram is a unit of mass.

**Nitrogen**
A chemical element used as a nutrient by plants.

**Phosphorus**
A chemical element used as a nutrient by plants.

**Trophic state**
A measure of a lake's fertility, derived by measuring the concentrations of nitrogen, phosphorus, and chlorophyll-a in its water.

## Materials

- Computer with internet access.

## References

*The following references are available on the Orange County Water Atlas:*

Learn More: Overall Trophic State Index.

A Beginner's Guide to Water Management—The ABCs. 2000. Florida LAKEWATCH, University of Florida Institute of Food and Agricultural Sciences.

A Beginner's Guide to Water Management—Nutrients. 2004. Florida LAKEWATCH, University of Florida Institute of Food and Agricultural Sciences.

*Other references:*

Prince, Robert. Plant Nutrients. Undated. North Carolina Dept. of Agriculture and Consumer Services. (Retrieved from http://www.ncagr.gov/)

## Procedure

### Engage/Elicit

Present students with this problem: How exactly do we know if a lake or other body of water is polluted? What exactly is "pollution" anyway? Is it just toxic waste or oil spills in the water? Or can other things pollute water?

Get them to discuss and brainstorm ideas about pollution in small groups. Have them write down their ideas and circulate among the groups asking leading questions. With your questions, steer them toward the idea that even naturally-occurring substances can be harmful to a body of water if they are present in too great a quantity. In particular, if water receives too many nutrients, algae and other plants can grow out of control, causing an ecological imbalance.

### Explore

After brainstorming ideas and sharing what they have with the other groups, give the students the handout. (If you wish, you can give them the electronic copy and have them complete it using Microsoft Word.) Ask them if they have heard of "algae blooms" before and if they know anything about them. Let the students read the worksheet and specifically call their attention to the "Trophic State" and "Impaired/Okay" columns; let them know that waters undergoing algae blooms will have a very high trophic state and may be impaired. If you have never covered anything like algae blooms or measures like Trophic State Index (TSI) before, you may wish to have your students read the Learn More about Overall Trophic State Index on the Water Atlas, as well as A Beginner's Guide to Water Management—Nutrients.

Their object at the moment is to search through www.orange.wateratlas.org and find the information need to complete the table. Give the students about 20 minutes to do this; if they haven't used the Water Atlas before, you may need to show them how they can use the Search box to look up specific bodies of water.

### Explain

Once they have filled out the table, ask the students to look at their table: Is there any relationship between trophic state and whether or not the body of water is impaired? Is there any relationship between the size/depth of the lake and the trophic state? Is there any relationship between the size and amount of dissolved oxygen (DO) in the water? Is there any relationship between the DO and the trophic state?

You do not need to necessarily ask the students all these questions; simply get them to start looking at their data table and they may begin to ask these questions (or similar ones) on their own. However if students are not noticing any patterns on their own, you may prompt them with these types of

questions to get them on the right path. Also, it may be beneficial to have the students work in small groups (2-5) for this part so that they can discuss the tables and generate ideas together.

Once they have had about 10 minutes or so to discuss their tables, instruct them that they need to construct a testable hypothesis regarding the health of the waters in Orange County. This is very open ended and may confuse some of the students, especially if they have not had much experience creating hypotheses before, so may wish to give them an examples: For example, if you think that lake size influences trophic index, you might design a hypothesis that says "If a body of water is larger than 40 acres at the surface and is less than 25 deep, then trophic index is going to be high (> 46)." This hypothesis may or may not turn out to be correct with further research and information, but it is a hypothesis that he students could test either by gathering more information from the Water Atlas or by making their own measurements of the lakes and streams.

The students must record their hypothesis and how they might test it below the table. Then they need to save the document and/or print it to hand in for grading.

Finish the lesson by asking the students what role their table played in helping them form their hypothesis? Did it help them? Could they have designed their hypothesis without the table? If not, why not? Emphasize the importance of data organization and how tables present a lot of information in a form that can be easily read and compared; if they would have simply looked at each individual lake on the Atlas and tried to draw connections between their characteristics, that would have been very confusing and time consuming with a lot of back tracking and re-checking.

**Extend**

If you wish to expand upon this lesson, have the students design experiments that will actually test their hypothesis. They may design an experiment that relies completely on information contained within the Water Atlas or, if you are able, you can even plan a field trip to a nearby body of water to let the students collect real data in the field.

Ideally, the experiments will be designed by the students themselves from their own hypotheses, but if you are worried about time/resource constraints, you might select one or two hypotheses that seem the most promising or interesting and allow the students to all design their experiments based around these same hypotheses. Also, students should work in at least pairs if not groups of 4 or 5 so that they can share data and brainstorm experiment ideas.

**Exchange/Evaluate**

Collect the papers or access the saved files. Check the table for accuracy (see the key below, note that current values may have changed so they key may not be accurate for DO, TSI, and Impaired/OK) and verify that the hypothesis is testable and the students' methods for testing it are reasonable.

## Answer Key:

*(Data correct as of June 2011)*

| Lake Name | Surface Area in Acres | Mean Depth in Feet | Dissolved Oxygen mg/l | Trophic State Index | Impaired or OK? |
|---|---|---|---|---|---|
| **Lake Apopka** | 30,862 | 7.0 | 9.0 | 71 | IMP |
| **Bay Lake** | 35.93 | 7.7 | 8.5 | 69 | IMP |
| **Lake Beauclair** | 1,134 | 9.8 | 10.0 | 74 | IMP |
| **Big Sand Lake** | 1,040 | 23.0 | 7.5 | 12 | IMP |
| **Lake Cypress** | 62.17 | 13.8 | 8.6 | 48 | IMP |
| **Lake George** | 79.79 | 13.3 | 8.6 | 29 | OK |
| **Lake June** | 3.56 | 8.2 | 5.5 | 52 | OK |
| **Little Sand Lake** | 160.91 | 23.0 | 9.3 | 12 | OK |
| **Palm Lake** | 24.63 | 24.8 | 8.7 | 13 | OK |
| **Wauseon Bay** | 1,685 | 24.6 | 7.7 | 21 | OK |

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