# Estimate or Actual? *Lesson Plan*

*Students survey water quality and hydrology tests, classify them and justify their reasoning.*



**Grade Level:** 5th

**Subject Area/Course:** Science/ Language Arts/ Math

**Lesson Summary:** Students survey water quality and hydrology tests, consider if they are estimates or actual data, and justify their reasoning.

## Performance Objectives

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

**Science**

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| SC.5.N.1.5 | Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method." |
| SC.5.N.1.6 | Recognize and explain the difference between personal opinion/interpretation and verified observation. |
| SC.5.N.2.1 | Recognize and explain that science is grounded in empirical observations that are testable; explanation must always be linked with evidence. |

**Language Arts**

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| LA.5.1.6.1 | The student will use new vocabulary that is introduced and taught directly; |
| LA.5.4.2.2 | The student will record information (e.g., observations, notes, lists, charts, map labels, legends) related to a topic, including visual aids to organize and record information on charts, data tables, maps and graphs, as appropriate; |

**Math**

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| MA.5.A.1.4 | Divide multi-digit whole numbers fluently, including solving real-world problems, demonstrating understanding of the standard algorithm and checking the reasonableness of results. |
| MA.5.S.7.2 | Differentiate between continuous and discrete data, and determine ways to represent those using graphs and diagrams. |
| MA.5.A.2.3 | Make reasonable estimates of fraction and decimal sums and differences, and use techniques for rounding. |

**Social Studies**

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| SS.5.G.4.2 | Use geography concepts and skills such as recognizing patterns, mapping, graphing to find solutions for local, state, or national problems. |

## Prior Knowledge

None.

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## Topic Overview

Adults use rounding and estimation all the time. They approximate the temperature, the cost of items, the time, and even their age. Even though rounding and estimating are related, there is a significant difference. Rounding involves converting a known number into a number that is easier to use. Estimation is an educated guess of what a number should be without knowing the actual number. Estimation should be thought of as a tool to quickly determine whether an answer is reasonable or not. The students will learn when direct, accurate observations are important in conducting measurements, and when estimation is necessary. They will then examine real data, decide which is which, and justify their decisions.

## Key Vocabulary

**Actual data**
Observed data, taken directly from measurement instruments or people.

**Estimated data**
Information that is a "best guess," used when information is not available.

**Hydrology**
The scientific study of water on earth and in the atmosphere in all its forms.

**Secchi disk**
A device for measuring the clarity of water which consists of a black-and-white disk attached to a rope (see illustration above). It is lowered into the water, and the shallowest depth at which the disk can no longer be seen is recorded as the "Secchi depth."

**TIME ALLOTTED:** Two class periods of approximately 50 minutes each.

**MATERIALS**

- Computer with internet access
- Student handout (printed or computer version)
- Graduated cylinders and measuring cups for the rainfall measuring extension

**REFERENCES**

*These references may be found in the Seminole County Water Atlas Digital Library:*

Carriker, Roy R. 2001. Florida's Water Resources. University of Florida Institute of Food and Agricultural Sciences.

How to Make a Secchi Disk. 2001. New Hampshire Department of Environmental Services.

*Other references.*

National Weather Service. Website accessed July 2011.

Florida Automated Weather Network (FAWN). Website accessed July 2011. University of Florida Institute of Food and Agricultural Sciences.

## Procedure

### Engage/Elicit

Show students an image of rainfall from the last storm to hit the area, or some other significant event (this can be collected shortly after it happens with a screen grab from the National Weather Service – use the Radar & Satellite storm total image, or gather one from another source). Ask students to consider:

1. Are the numbers or patterns that they see estimates or actual measurements?
2. What is the difference?
3. Which is better?
4. Why might we use both?

### Explore

Provide students with the handout in printed or computer form. It will direct them to the ***Seminole County Water Atlas*** site where they should choose a lake from the Water Resources Search list, click on the Water Quality tab, and then the Water Levels & Flows tab to locate water quality and hydrology information.

Using data from the Water Atlas, have students complete the table for each lake. They should then be grouped (3-4 per group) to discuss the tests. Students are to decide if each measurement is actual or estimated, and to justify their reasons.

### Explain

Go over the **Key Vocabulary** definitions with the class, then follow with a class discussion. Students can share decisions and challenge each other's decisions, when appropriate. Share the following information with them in the discussion:

The data presented on the Water Atlas website has passed stringent quality control measures and is scientifically accurate. Each data point found in the Data Download section (at the bottom of Hydrology or Water Quality tab pages or under the Research tab) is accurate. However, every possible point in the lake has not been tested. It is estimated that the readings would be very close. There may be several data gathering stations on the same lake or river.

Go to the "Data & Mapping" tab found at the top of every page and select the Real-time Data. Data is taken at regular intervals, recorded, and available on the Water Atlas website at near-real time frequency. For example, the average rainfall is the average of rainfall reported over a wide range of stations. Each station will have actual measurement. However, rainfall would be estimated for a point part way between two stations.

Some other examples include:

- Contour lines on a bathymetric/topographic map are estimated. While many data points have been collected, the lines between data points are interpolated.
- The Secchi disk test for water clarity depends on the judgment and eyesight of the person deciding when the pattern is seen.
- On a calm day, the level of a lake will be the same everywhere due to gravity and a lake surface elevation reading would be accurate even in a spot far distant from the measuring device. However, in a very long lake such as Lake Alpharetta, a strong wind can cause water to be pushed toward one end of the lake, causing a slightly higher reading on the end toward which the wind is blowing. In that case, an elevation reading would provide an estimate of the overall lake level its accuracy would depend on the position of the sensor.

**Extension 1 – Simulated Rainfall**

To illustrate this concept, distribute measuring cups or graduated cylinders with varied amounts of water randomly to students around the room, simulating scattered showers. Record the amounts of "rainfall." For students who do not receive cups, record the actual measurements around them and estimate their rainfall.

Pour all of the water into a larger graduated cylinder or measuring cup and divide the amount by the number of cup stations to find the average rainfall. Discuss which ones were actual measurements and which are estimates – accurate, but not actually measured. Have students create a rainfall diagram of the classroom, showing which areas were wetter and dryer.

This is also a good time to remind the students of the difference between scientific observations (the measurements) and inferences (the estimates).

**Extension 2 – Real Rainfall**

If the weather cooperates, a similar activity can include putting out rain gauges in various locations around the school grounds before a rainfall. Students can track an approaching system online (using the ***National Weather Service*** forecasts and radar), then gather the containers and record the amounts after it passes.

The data they collect can be compared (did the parking lot get as much as the sports field?), and can also be compared with real time weather data on various sites including the ***Seminole County Water Atlas*** real time rainfall. Have students record their observations in a science notebook, and create a rainfall diagram of the school grounds, showing which areas were wetter for the storm. This will help stimulate discussion about observed and estimated data, as well as the potential variability of storm rainfall. It can also lead to discussions about where all the rain goes after it lands on the school yards, and how the grounds have been designed to deal with too much rain.

**Exchange/Evaluate**

To assess whether the students are getting the concepts, consider their work on the handout, as well as the class discussions and their work in the extensions.