

Filling the Lakes and Rivers Lesson Plan

Students will examine rainfall, water levels and the likely impact of climate change on rainfall.

Lesson Summary: The students will learn of the relationship between rainfall and the water level of water bodies. Additionally, the students will discuss the impact of climate change on rainfall. Finally, students will learn to use the basic functions of spreadsheet and word processing software by using it to create documents to record their findings and write reports.

Grade Level: Middle School (Grades 7 – 8)

Time Allotted: 2 class period (approximately 50 minutes each)

Performance Objectives

References are to the Next Generation Sunshine State Standards.

7th Grade Science

- SC.7.N.1.1 Define a problem from the seventh grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.
- SC.7.N.1.5 Describe the methods used in the pursuit of a scientific explanation as seen in different fields of science such as biology, geology, and physics.
- 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.
- SC.7.E.6.6 Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.

7th Grade Math

- MA.7.P.7.1 Determine the outcome of an experiment and predict which events are likely or unlikely, and if the experiment is fair or unfair.
- MA.7.P.7.2 Determine, compare, and make predictions based on experimental or theoretical probability of independent or dependent events.

8th Grade Science

- SC.8.N.1.1 Define a problem from the eighth grade curriculum using appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

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- SC.8.N.1.4 Explain how hypotheses are valuable if they lead to further investigations, even if they turn out not to be supported by the data.
- SC.8.N.1.6 Understand that scientific investigations involve the collection of relevant empirical evidence, the use of logical reasoning, and the application of imagination in devising hypotheses, predictions, explanations and models to make sense of the collected evidence.

8th Grade Math

- MA.8.A.1.1 Create and interpret tables, graphs, and models to represent, analyze, and solve problems related to linear equations, including analysis of domain, range, and the difference between discrete and continuous data.
- MA.8.A.1.3 Use tables, graphs, and models to represent, analyze, and solve real-world problems related to systems of linear equations.
- MA.8.S.3.1 Select, organize and construct appropriate data displays, including box and whisker plots, scatter plots, and lines of best fit to convey information and make conjectures about possible relationships.

Prior Knowledge

None required. If the students already know how to use spreadsheet (Microsoft Excel) and word processing (Microsoft Word) software, they will be able to help their classmates with the assignments.

Topic Overview

Water levels in Florida Lakes are significantly influenced by rainfall. Rain may go directly into a lake or river through storm drains, or indirectly from infiltration and percolation through the soil into the water table. Retention ponds hold excess rain, giving it time to seep into the ground. The groundwater seeps into lakes and rivers. During times of drought, lake levels fall and during times of heavy rainfall, lake levels rise. The data students find will show water above average, dipping down below average during the droughts, and then back up again. Students can research local news media for reports and personal stories of rainfall and water levels during times of drought and flood.

Key Vocabulary

Data table

A method to organize and display data so that it is more easily read and interpreted. Typically arranged in a matrix-like format with rows and columns, each cell of the matrix contains a piece of data and the rows and columns are labeled so that the reader knows what the data in each cell represents.

Graph

A visual representation of data. Typically containing a X and a Y axis, a graph will represent data

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as points, lines, bars, or other easily distinguished character along some kind of continuum in relation to other pieces of data. Graphs can represent data collected during a certain time period, over a certain distance, or during any other interval where the observer might wish to observe. The highly visual nature of graphs allows for easy recognition of changes or similarities in the data patterns.

Hydrology

The science that deals with water as it occurs in the atmosphere, on the surface of the ground, and underground.

Hypothesis

A testable explanation for an 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 some way to quantify A and to measure B as it happens.

Materials

- Computer with internet access
- Microsoft Word and Excel or equivalent programs. (LibreOffice is a free, open-source suite of similar software that can be downloaded from the internet.)

Resources

These resources are found in the [Digital Library](#) of the Orange County Water Atlas:

[Fluctuating Lake Levels](#). 2006. St. Johns River Water Management District.

Schiffer, Donna M. 1998. [Hydrology of Central Florida Lakes: A Primer](#). U.S. Geological Survey.

[Climate Change and Water: Perspectives from the Forest Service](#). 2008. Forest Service, U.S. Department of Agriculture.

[Climate Change Basics for the Southeast U.S.A.](#) 2008. [AgroClimate](#).

Other resources:

[Climate Change Impacts: Changes in Precipitation](#). The Climate Change Clearinghouse, by the Water Research Foundation. (Retrieved June 2011).

[Learn More: Lake Water Levels](#). Orange County Water Atlas.

Stanton, Elizabeth A., and Frank Ackerman. 2007. [Florida and Climate Change: The Cost of Inaction](#). Tufts University. (Retrieved June 2011)

Winsberg, Morton D. Undated. [Anticipating Heavy Rain in Florida](#). Florida Climate Center. (Retrieved June 2011)

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Procedure - Day 1

Engage/Elicit

Present students with the following problem: if global temperatures keep increasing, the rising temperatures will alter the weather patterns around the world, including here in Florida. We can't say for certain if it will cause more or less rainfall (although certain indicators do lean towards less), but either change can have a profound impact on the state's ecology and its waters. But how can we know the amount of rain really does change? How much rain falls and enters our waters? And does the amount constantly change from season to season, or has the amount of rainfall remained steady over time?

This discussion is a framework for teaching students: 1) how to use spreadsheet and word processing software to collect, organize and present their work, and 2) how rainfall impacts the local environment. Run through a description of basic data organization techniques (examples below) and ask the students to interpret some of these examples. Then allow the students to investigate rainfall levels in local water resources using the data download tool found on the [Orange County Water Atlas](#).

You should designate a folder on your computer system in which students can save their work.

Explore

Begin by showing your students some of the features of the [Orange County Water Atlas Data Download tool](#).

1. Choose a lake that has water level data by doing the following:
 - a. Select **Water Levels and Flows** from the Topics menu in the navigation bar.
 - b. Click on the **Water Levels** link and a list of lakes with water level data will appear.
 - c. Click on the name of a lake to get the **Water Levels & Flows** page for that lake.
2. Click on the
Water Levels link to get current and historic data on the lake's water level.
Record the historic range of the lake's water level: _____
Record the average of these two numbers: _____
(This number will be important later when we create a data table and graph with our information.)
3. Click on the **Download this data** link to use the Data Download tool:
 - a. Select one or more stations. (Some bodies of water may have only one or they may have several; you can select them all if you like, but be aware that in some cases this may generate data sets with inconsistencies.)
 - b. Choose **Excel** for the file format and click **Generate File to Download**.
 - c. Click the **Download File** button to save the file on your computer.

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Allow the students (working in pairs or small groups) to now explore the Atlas on their own. They can choose their own body of water using the Water Resource Search menu and they can check the different tabs and pages for their chosen body of water. Give them several minutes to simply play around and get used to working with the Water Atlas if they haven't had a chance to do so before. They can select a different body of water if they don't like the one they initially chose.

Once they have had some time to explore, direct them to collect the water level data for their chosen body of water, as you have just demonstrated. If they don't remember how to do that, you can assist them, but allow them to do the work themselves.

After the students have downloaded their data, show them how to create a data table and then create a graph from the data. Demonstrate by using the file you downloaded earlier:

1. Open the Excel document you saved to your folder. Save a copy and title it Water Level Graph.
2. Change the name of the column heading "level_ft." to "Lake Level (ft)"
3. Insert a column after "Lake Level" and title the column "Historic Level (ft)."
4. Copy the average value that you calculated earlier into each of the cells in the new "Historic Level (ft)" column, down to the last row containing data.
5. Select three columns: "Sample Date," "Lake Level (ft)" and "Historic Level (ft)".
6. With the columns selected, use the "Insert Graph" command to make a line graph showing the water level trend over time.

Now allow the students to experiment with Excel. If they have never used the program before, there will likely be many questions and this could take quite some time so plan on this being the last activity for today's lesson. If you still run out of time, that is okay; you can continue on into the next day.

Ideally the students will complete a graph before the end of the lesson today. If they finish with time to spare, ask them to assist the other students.

Explain

Once the students have prepared their graphs, ask them why it is useful to include the historic average data in their graphs? Allow them to discuss this with each other. Tell them that they do not need to answer immediately, but to consider the question and be prepared with an answer for their final report the next day.

Extend

No extension for this lesson. Between covering the example and the collection of the data, this day will be very full.

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Exchange/Evaluate

No specific assignment to grade today. Award points based on participation, ability to listen and follow instructions, and time on task.

Procedure – Day 2

Engage/Elicit

Begin the lesson by reminding the students what happened on Day 1. If some students were unable to finish their graphs on Day 1, allow them time to complete them.

Ask the students if they have an answer for the question you asked yesterday: why were they supposed to include the historical average water level in their graph? Answer: The historical average level is being used as a point of comparison.

Explore

Have the students open Microsoft Word (or equivalent). They can then copy and paste their graph and pictures from their folder into the Word document. Have them save the document into a designated folder.

Ask the students to take a close look at their graphs. Specifically, ask them to look at the times when the water levels are lowest: at what time of year does this seem to happen? In most (probably all) of their graphs, the lowest points will occur during winter (around January and February). Now ask them to look at the time when the levels are the highest: at what time of year does that seem to happen? In most cases, the high points should be sometime in the summer (around June and July).

Now ask the students if they have any idea why the water levels are at their highest and lowest at those times? Give them a few minutes to discuss the idea in their pairs or groups before they answer the question. Eventually lead the discussion to rainfall if they do not suggest this themselves: rainfall is lightest in the winter and heaviest in the summer—and more rain results in higher water levels.

With the students working in pairs or small groups, direct them to form a hypothesis that might explain the connection between rainfall and lake water levels. While they won't actually test their hypothesis, it does need to be testable/reasonable ("I will fly up into space to look at all the clouds over Florida" is not a valid response). If the students do not know what a hypothesis is, take some time to explain the term (see vocabulary). Each group will develop its own hypothesis and test/experiment, but since they will all be measuring rainfall in some way or another, they likely will be similar.

Explain

After the students have discussed their hypothesis, have them use Word to record their hypothesis and write a brief description of an experiment they could do to test it. Ideally, these descriptions will

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include something about measuring the amount of rainfall at various times during the year and comparing the amount of rainfall to the water level of their body of water.

This explanation of their hypothesis and experiment does not need to be very long, but it should explain what their hypothesis has to do with their graph. It should show that they understand why the class is discussing water levels in lakes and rainfall at the same time.

Extend

Ask students to consider what impact climate change and warming of the local environment might have on rainfall. Many factors influence the amount of rain that falls during each season, but average temperature is a significant contributor to weather patterns. If the average global temperature is raised even a couple degrees, massive changes in weather patterns can occur. For example, some models predict that Florida and other locations in the southern United States will likely receive much less precipitation on average, especially during winter months.

If you have not discussed climate change in detail with your class before, have them read the document [Climate Change and Water: Perspectives from the Forest Service](#) (see Resources) to provide some context for this part of the lesson (you may wish to assign this reading for homework following Day 1, so that they are better prepared for this discussion) or have them visit [The Climate Change Clearinghouse](#) website as homework).

Ask the students to consider their data tables now within the context of climate change. While it is uncertain exactly what will happen to precipitation here in Florida if the climate continues to warm, can they predict what might happen to the rainfall and water levels in their community based on their reading/past class discussion of climate change? What might their data tables and graphs look like in the future? Would they remain the same? Would they change? If they change, would they predict a uniform change (e.g. would the levels just decrease by a fixed amount across all time points and all locations?) or would certain locations and/or seasons be affected more dramatically than others?

Have the students record their predictions, with an explanation why they think the predictions might happen, in their Word documents. Have them save the documents and print off the documents to hand in as their final assignment for this lesson.

Exchange/Evaluate

If enough time remains in the lesson, have a spokesperson from each group briefly present to the rest of the class their predictions and their reasons for them. Ask questions, and allow other students to ask questions, if the predictions/justifications are not clear.

Collect the Word documents the students created. Grade the graphs for completeness (paying particular attention to labels and titles). Also grade their hypotheses, looking for three key factors:

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1. the hypothesis is testable, and not just a problem statement;
2. the proposed experiment/test is reasonable/achievable;
3. the hypothesis is related to the link between rainfall and water levels.

Finally, make sure they provided a justification for their global warming predictions; there are no right or wrong predictions, but they do need to offer some justification and support for their predictions.

Curriculum developed for Orange County Environmental Protection Division by USF's Florida Center for Community Design & Research. This material is based upon work supported by the Department of Energy under Award Number DE-EE0000791.

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