Shape Shifters *Lesson Plan*

How and why does the shape of a lake change?

Lesson Summary: Students use a variety of data and information sources to discover why some of Florida's lakes change shapes.

Grade Level: 5th

Time Allotted: 1-4 hours

Performance Objectives

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

Science

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.E.7.1	Create a model to explain the parts of the water cycle. Water can be a gas, a liquid, or a solid and can go back and forth from one state to another.
SC.5.E.7.4	Distinguish among the various forms of precipitation (rain, snow, sleet, and hail), making connections to the weather in a particular place and time.
SC.5.L.15.1	Describe how, when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.
SC.5.L.17.1	Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycles variations, animal behaviors and physical characteristics.

Math

MA.5.A.4.2	Construct and describe a graph showing continuous data, such as a graph of a quantity that changes over time.
MA.5.A.6.4	Compare, order, and graph integers, including integers shown on a number line.
MA.5.S.7.1	Construct and analyze line graphs and double bar graphs.

Language Arts

LA.5.1.6.1	The student will use new vocabulary that is introduced and taught directly.
LA.5.1.6.4	The student will categorize key vocabulary and identify salient features.
LA.5.1.6.5	The student will relate new vocabulary to familiar words.

LA.5.1.7.1 The student will explain the purpose of text features (e.g., format, graphics, diagrams, illustrations, charts, maps), use prior knowledge to make and confirm predictions, and establish a purpose for reading;

LA.5.6.4.2 The student will determine and use the appropriate digital tools (e.g., word processing, multimedia authoring, web tools, graphic organizers) for publishing and presenting a topic.

Prior Knowledge: None.

Topic Overview

Bathymetric maps are the underwater equivalent of a detailed topographic map. While the contours of a lake bottom remain relatively constant, the depth of water in the lake can vary considerably from year to year and season to season, affected by the amount of rainfall, nearby groundwater extraction by people, and the hydrology of the soil surrounding the lake. If a lake's sides were perfectly vertical, its shape would not change as water levels fluctuate but that is rarely the case. Instead, a lake's outline will change as water levels rise and fall, its shape determined by the degree to which its sides are sloped.

Key Vocabulary

Aquifer, confined
A source of underground water that is cut off from the surface above it by an impermeable layer.

Aquifer, perched
A source of underground water that is trapped above the water table by an impermeable layer.

Aquifer, unconfined
A source of underground water in permeable rock that connects directly to the surface. The top of it is called the water table.

Bathymetry
The measurement of depth of water in oceans, seas, or lakes.

Evaporation
The transformation of liquid water to water vapor (gas).

Irrigation
The transportation and distribution of water to an area for the benefit of plants or for other agricultural purposes.

Permeable
Allowing liquids or gases to pass through.

Precipitation
Any or all forms of water that falls from the atmosphere, such as rain, snow, hail, and sleet.

Sinkhole
An area where the erosion of underground limestone has allowed a depression to form.

Materials

- Computers with internet access
- Spreadsheet/graphing software (Microsoft Excel or equivalent)
- Clay or firm sand in small trays (optional)
- Science notebook for recording observations

References

The following documents are available in the *Water Atlas Digital Library*:

Fluctuating Lake Levels (Fact Sheet)
Source: St. Johns River Water Management District. 2006.

Lake Water Levels (Water Atlas Learn More)

The ABC of Aquifers. 2003. American Ground Water Trust.

Hydrologic Data (Southwest Florida WMD)

Southwest Florida Water Management District (SWFWMD) Education (Web Page Group)

Procedure

Engage/Elicit

Tell students that some of Florida's lakes are able to change their shape – they are shape shifters. Ask them to imagine different ways that lakes could change shape, and write them down.

Put students in groups of 3 or 4 and have them discuss their lists of possibilities. Have each group choose two possible reasons from their lists, and consider ways that the two ideas might be checked. Are they testable? (Not all of them will be.)

Explore

Have students examine several large lakes on the Seminole County Water Atlas website. To find large lakes, choose Explore>Water Resources from the menu bar at top left. A list of water resources will appear. Choose the Lake button and click Search. You can click the column heading for Surface Area to sort the lakes by size. For each lake, choose the Water Levels and Flows tab and check for the presence of bathymetric contour maps. Open several of these maps so students can see the bathymetric lines. Ask them what these lines represent.

Have students divide a paper into 4 parts. In the top left, have them sketch the shape of the lake, using the bathymetric map. In the top right, have them sketch the shape if the lake were to drop 2 feet – what would it look like? Continue this for 4 feet and 6 feet in the other squares. Choose a lake like Lake Ada, which has an unusual shape and several deep spots, and will separate into smaller lakes at lower levels.

Optional: use clay or firm sand in a tray to model the bottom of one of the lakes. You may do this as a demonstration, or help the students to do it in groups. This may help forge the link between the two dimensional bathymetry and the actual bottom of the lake. Adding/subtracting water to your model can make this even more effective.

Have students download the ten-year level data for several lakes for comparison. Choose lakes that are in the same watershed. Put this data into a spreadsheet and graph the level of each lake as a separate line on the graph (about five lakes on one graph works well). Is there a trend? (Many lake levels fell during the drought years in the first half of the decade, and have since recovered).

Example Lakes	Area (acres)	Mean Depth (feet)	Approx. Vol. (gals.)
Lake Brantley	288	12.1	1,023,051,032
Bear Lake	311	12.4	1,191,673,580
Deep Lake	42.88	9.5	131,624,702

As an extension, you can download the rainfall data for the watershed of the lakes you are using. For example, the SWFWMD Hydrologic Data link in resources. You may do this first yourself, or direct the

students to do it, depending on time, computer availability and web skills. This will provide extra practice with data and graphing. Use this data to demonstrate that the rainfall data correlates with the lake levels for your watershed.

Now that students have had some experience with data related to lake levels, ask them to make another list of reasons why lakes might change shape. The following clues will help stimulate thought:

- really cold weather
- really hot weather
- bulldozers
- wildlife
- too many lawns

Explain

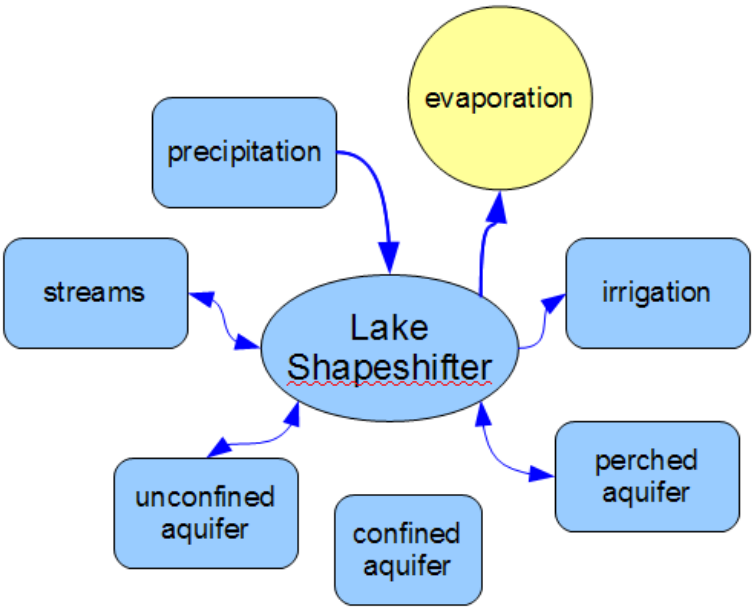
Review the water cycle with students using at least one model (computer, physical, mental). Remember that computer or physical models of the water cycle may be available through the local water management district, for example the SWFWMD Education site. Be sure students understand the idea of water under the ground.

Have students read the ***Fluctuating Lake Levels*** document, either online or as a handout. Discuss the following reasons that lakes change size, and evaluate any other reasons they included in their lists.

1. evaporation/precipitation balance
2. drought
3. withdrawal of ground water for human use (for example: lawn irrigation, agricultural irrigation, drinking water)
4. flood control—i.e., dams, canals, stormwater control structures
5. topographical changes that affect surface flow – these can be natural (like a hurricane) or through development
6. whether or not the lake is connected to the aquifer
7. aquatic weeds – which can change the perception of lake depth, especially for recreational users, when they become too thick for swimming or boating
8. beavers (although they once lived as far south as Orange County, they are now in North Florida only, but worth mentioning for their ecosystem engineering feats, and a discussion of extirpated wildlife)

This would also be a good time to discuss the implications of climate change for Florida's lakes. Have half the class write a paragraph or two on why Florida's lakes will grow bigger due to climate change, and the other half explain why they will shrink. Use the various ideas to discuss the notion that the implications of climate change can be complex and potentially conflicting. This makes things challenging for the people, wildlife and plants that depend on them, as well as the managers who try to mitigate the effects.

Using the logic model (below) on screen or as a handout, have students consider the different ways water moves into and out of a lake. The ***ABC's of Aquifers*** resource provides helpful background information. Note that many of central Florida's lakes are essentially landlocked.



Extend

Discuss some of the potential issues plants and animals might have with lakes that change sizes – note the ecosystem benefits at the end of the ***Fluctuating Lake Levels*** document. Have the students write a story about a local lake using four characters. The characters are a fish, a wading egret, a person living next to the lake, and one more that they can choose (any animal, plant or person). What happens to these characters as the lake changes shape?

This activity would be much richer if students were able to go on a watershed excursion to a nearby lake. If possible, visit a lake twice, first during the rainy season (June-October) when it is high, and again during the dry season (November-May) when it is low. This will help students to appreciate the difference between the levels and the rich habitat that exists between high and low water.

Another watershed excursion activity involves examining trees at the edges of lakes. Depending on the lake and the topography, students may be able to tell what areas regularly flood by the presence of flood-tolerant species of trees (such as cypress, gum, maple, willow and some bays), and what areas rarely flood by the presence of upland species (such as live oak or slash pine). It also may be possible to tell the range of seasonal water levels by examining flood marks on the trunks of the trees.

Exchange/Evaluate

Evaluate student understanding by collecting or checking:

- their initial ideas about why lakes might be able to change shape;
- their group work on how such ideas could be tested;
- their 4 sketches of lake shapes from the bathymetry
- their lake models (optional);
- their 10 year data graphs;
- their rainfall graphs (optional);
- their second list of reasons why lakes might change shape (using the clues);
- their stories (optional first extension);
- their watershed excursion notes (optional).