

Jeanette T. Costanza
Spring, 2001

Lake Effect

Abstract:

The following activity explores some of the effects Great Salt Lake has on Utah's local weather/temperature moderation, lake effect storms, and temperature inversions. Specifically, students will observe the differences of specific heat between soil and water and make a relationship to the "lake effect" phenomenon.

Grade Level: 4th

Utah Elementary Core Curriculum Standards

Standard 3040-06: Students will observe, record, analyze, and predict weather

Objective 3040-0601: Identify the elements of weather.

- Relate air and air movement to weather.
- Describe some effects of geographical factors on weather.

Objective 3040-0603: Predict weather based on qualitative and quantitative observations

- Demonstrate the relationship between weather observations and seasonal weather patterns.

In class instructional time: 60 minutes

Terminology:

Absorption - The uptake of liquid into the fibers of a substance.

Retention - The act of retaining something or the condition of being retained.

Specific heat - the amount of heat needed to raise the temperature of one gram of a substance by one degree, usually measured in joules per kilogram per Kelvin.

Intended Learning Outcomes:

Students will be able to explain how Great Salt Lake affects the air temperatures of the surrounding region.

Background:

Land and water both absorb solar energy and give off heat; however, water absorbs energy more slowly and gives off heat more slowly. Water has the highest heat capacity of any natural substance (with the exception of ammonia). In other words, a given weight of water can contain more heat energy than the same weight of any other substance.

Specific Heat is the amount of heat energy that can be contained by a given weight of a substance compared to the amount of heat energy that can be contained by the same weight of water. Therefore, the specific heat of water is one (1). In practical terms, this means that a bottle containing a pound of 100 degrees Fahrenheit water will keep your hands warm longer than a one pound rock that has been heated to 100 degrees Fahrenheit.

The large surface area of the Great Salt Lake can absorb a great deal of solar energy during the hot summer days. During the nights, and during colder periods of the year, the surrounding land areas cool rapidly, but the heat stored in the lake water is given off slowly, keeping the temperatures in the area warmer than they would otherwise be. These differences in heating and cooling between land and water give rise to breezes. These breezes can lower afternoon temperatures in areas near the lake by as much as two to four degrees Fahrenheit during the late spring and early summer.

Materials:

2 small plastic cups or containers of equal size

2 thermometers

Spotlight or heat lamp

Soil

Water

Graph paper

Pencils or pens

Assessment of Prior Knowledge: The KWL Process (assessing what they know, what they want to know, and eventually what they learned) should be used to assess the students' prior knowledge of the lake. Use this opportunity to build on what they know and to fill in the gaps on what they do not.

Instructional Procedures:

Ask the students to predict whether the Great Salt Lake or the nearby land heats up faster when exposed to the sun's energy. Which one cools down faster? Engage the students in a discussion and then set up experiment:

- Fill one container with soil to a depth of 2 inches, and the other with water to the same depth. Both the soil and the water should be at room temperature.
- Place one thermometer in the center of the soil container. The bulb of the thermometer should be about 1 inch below the surface of the soil.
- Experiment to find a way to suspend the other thermometer in the center of the container of water, also 1 inch below the surface. (How you do this will depend upon what kind of thermometer you use - you may be able to suspend it from a string.) It is important to have the same volume of soil and water, and to have both thermometers the same distance below the surface.
- Read and record the temperatures on both thermometers.
- Place a spotlight or heat lamp so that both containers receive an equal amount of energy. Check and record the temperatures at 10 minutes intervals for another 30 minutes. **Safety note:** Be careful that students do not burn themselves on the lamp or heat source.

- After the experiment is completed, have the students graph their results and compare them (plot them as temperature versus time). As a group, share the results and discuss them.

Discussion Questions:

- Which container heated up faster? (the soil) Which one cooled down faster (again, the soil) Why? (it takes more energy to heat the same volume of water, but the water is better at storing heat)
- Since heat is energy, and energy cannot be created or destroyed, where does the heat go when the water of soil cools? (into surrounding air)
- What happens to air when it is heated? (it expands and rises)
- What effect would a slow release of heat into the air around the Great Salt Lake have on temperatures in the valley during the night or during the winter? (keep the temperatures in the valley from getting as cold as they would if there was no heat storage)
- Have each student complete paragraph about what they learned from the experiment of temperature of water and soil and how this relates to the “lake effect.”

Assessment Strategies:

- Complete graph of temperatures of water and soil.
- Written paragraph.
Criteria for rubric: Complete sentences for paragraph.
Paragraph must contain one of the vocabulary words listed,
Must be specific learning example, not just it was fun.