

III. Sheds and Cycles: Great Salt Lake, Past & Present

Description: A story of the water and hydrology of the Great Salt Lake Ecosystem

Purpose: Explore how Great Salt Lake receives water from its watershed
Investigate some important landforms surrounding Great Salt Lake
Examine relationships between volume, surface area, and depth as it relates to the Salt Lake Basin
Relate the size of Great Salt Lake to precipitation, runoff, evaporation
Identify some evidence and causes of erosion
Reveal the ancestry of Great Salt Lake through a study of Lake Bonneville
Explain where water comes from and where it goes (the water cycle)

Related Utah Core Objective(s)

Standard: Students will explain the water cycle

3040-0302 CONSTRUCT A CHART OR DRAWING OF THE WATER CYCLE.

- *Make a model of the water cycle (e.g., drawing, computer simulation, physical model)*
- *Explain in their own words what "cycle" in water cycle means*
- *Explain how a change in one part of the cycle would affect other parts*
- *Create a story taking a drop of water through the water cycle*

Related SLICE Objective(s)

Appropriate elements of Essential Questioning and Analysis Skills, plus...

FOCUS I: Great Salt Lake As A Physical System

Element 1: Processes that Shape the Earth

- *Identify some of the forces that cause erosion at or near Great Salt Lake, pointing out factors such as freezing and thawing, wind, waves, soil building processes and gravity*

Element 2: Changes in Matter

- *Describe and demonstrate the basic elements of the hydrologic cycle (including condensation, precipitation, melting, evaporation and percolation) and geologic processes (including erosion, transportation and deposition). Locate past and present examples of these in and around Great Salt Lake.*

Duration: TBA

Other References

The Great Salt Lake Story (Utah Museum of Natural History, 1997)

Project WET Curriculum & Activity Guide (Western Region Environmental Education Council, 1995)

Geology & Antelope Island State Park, Utah (State of Utah Dept. of Natural Resources, UT Geological and Mineral Survey, 1988)

"What About This Great Salt Lake?" fact sheets (Friends of Great Salt Lake):
#1, "Resource List," and #2, "Physical Features"

Instructional Activities

- A. Downhill From Here (the Greater Great Salt Lake watershed)
- B. Far and Wide (characteristics of the Salt Lake Basin)
- C. Comings & Goings (inflow vs. evaporation at Great Salt Lake)
- D. Lake Bonneville, In Depth (constructing a story of a lake now gone)
- E. Endless Circle (the water cycle, via Great Salt Lake)
- F. Sheds & Cycles In Review (a diary of a drop)

Speaker Opportunities For Enrichment

A visit from the USGS about the monitoring of Great Salt Lake elevations and salinity

A visit from a geologist or geographer about Lake Bonneville

A visit from a quarry representative about lakeside sand and gravel mining

Field Trip Opportunities

Trip to a mine or quarry

Trip to visit various Bonneville shoreline sites around the Lake

Activity III.A. Downhill From Here

PURPOSE Explore how Great Salt Lake receives water from its watershed
Investigate important landforms surrounding Great Salt Lake

FORMAT Classroom discussions, demonstration and watershed worksheet

BACKGROUND *The Great Salt Lake Story*, text, pg. 1 (Utah Museum of Natural History, 1997)
Project WET: "Branching Out" pgs. 129–132 (Western Region Environmental Education Council, 1995)

STAGES Students will . . .

1. Examine branching patterns found in different systems;
2. Observe rainfall and flow patterns with a watershed model;
3. Use a map to interpret direction of flow and infer elevation differences in a watershed;
4. Label and identify Great Salt Lake watershed features on a map.

MATERIALS

- ✓ Overhead projector
- ✓ Overhead transparency or handout of Chart III.A.1. "Branching Out, Flowing In."
- ✓ Watershed demonstration materials
 - watershed model (see below)
 - 1–4 spray bottles filled with water
 - towels for clean-up
- ✓ Enlarged photographs that include snow-covered mountains, forested hillsides and drier valleys
- ✓ Map of Utah
- ✓ Map of the US or North America
- ✓ Map III.A.2. "Watercolors" Great Salt Lake Watershed worksheet
- ✓ Student Scrapbooks
- ✓ The evolving Classroom Mural (see Activity I.E.)

IN ADVANCE Construct a watershed demonstration model, choosing one of the options below:

- **OPTION 1**
Prepare a single-use crumpled paper model using newsprint paper (or similar light-colored, thick, unlined paper), blue food coloring, fine-mist spray bottles filled with water, and a large tray or suitable floor space, as follows:

In advance...

1. Crumple a large clean sheet of plain paper into a compact ball, and then open it so as to preserve a "landscape" of numerous peaks and valleys. (Paper 24" x 36" or larger create more dramatic results, but requires more water and space.)

2. Tape the edges of the paper to the bottom of a large tray, such as cookie sheet. (For larger demonstrations, use a floor that can get wet or one protected with garbage sacks taped together.) Be careful not to stretch the paper so that it overly flattens the “mountains.”

For the demonstration, distribute a thin line of blue concentrated food coloring along the edge of all the higher ridges of the paper “mountains.” Then, use one or more spray bottles held two feet or more above the display to distribute a continuous mist of “rain” across the paper surface. The water will soon accumulate and cause diluted blue coloring to flow down into concentrated streams in the various valleys.

- OPTION 2
Construct a more permanent paper maché model using the materials and directions specified in the activity, “Branching Out” on page 129 of the Project WET Curriculum & Activity Guide. Conduct the demonstration according to the directions provided.
- OPTION 3
Construct one or more models as described in Option 2 as a class art project.

DURATION TBA

SEQUENCE

ENGAGE BRANCHING OUT

1. Use an overhead projection or handout to show the students four illustrated examples of arteries: the human circulatory system, a tree's branching pattern, a road system and a watershed drainage. (Chart III.A.1.) For clarification, have students describe the different point of view for each (e.g., "from the side" or "from above").
2. Ask the students to describe what the lines represent for each illustration. What do all the combined lines do for each subject shown?
Clarify that our bodies' vessels carry blood, tubes inside trees carry water or sap, roads carry vehicles, and streams carry water.
3. Suggest to the students that while the drawings show different things, they are all alike in a way. How are they similar?
Confirm that the ends of all parts shown in each of these systems eventually connect and allow something to *flow* toward the same place. Also, the lines get bigger and carry a larger flow as additional smaller lines are joined.
4. Briefly explain that we stay alive, thanks to the blood vessels that flow through our bodies. In a similar way, a tree stays alive because of the vessels that pump water or food through its system. Roads are sometimes called "arteries," because they form a system that connects people in cars, trucks, busses or bicycles so they can meet, work, visit or get things they need. In this same way, the life of a pond or lake—including Great Salt Lake—depends on the connections it has with all the streams flowing into it. For this reason, in fact, America's rivers are often called "the bloodstream of the land." Tell the students that they are going to be discovering "the bloodstream" of Great Salt Lake.

EXPLORE THE FLOW OF A STREAM

1. While continuing to view the illustrations from the previous discussion, ask the students to suggest how what is happening in the watershed diagram is different from the other three.
[A stream flows only one way. The other illustrations involve flows that can go in both directions.]
2. Ask if students can tell the direction water is flowing in the watershed diagram. Have them describe their reasoning. [Student understanding here may vary. Rather than discuss this at length, proceed to the following demonstration.]
3. Instruct the students to move to the area you have prepared for the watershed demonstration. Be sure all students are able to see the water as it moves down the "slopes."
4. Explain to the students that you are about to give them a birds eye view to watch a rainstorm come and go over the mountains. Note that

the showers really took several hours, but they will see it happen in just two minutes.

5. Gently spray a continuous mist of water from above and across the model so that flows become visible in all the drainages. With larger models it is useful to enlist two or more reliable students to assist in the spraying. To add interest, tell a story that begins with clouds covering the sun, followed by a gentle rain that becomes an intense downpour and then stops.
6. As you produce and describe the “rainfall,” ask the students to describe what they see happening. Where is most of the rain going? What is causing the water to flow where it is? What patterns do they see? Why?
7. Stop the spraying. Ask a student to summarize the meaning of what just happened. Have the student point to specific areas where most of the water flowed.

EXPLAIN WHY STREAM DRAINAGES LOOK THE WAY THEY DO

1. Redirect student attention to the watershed drainage diagram of Chart III.A.1. used earlier. Ask the following questions, allowing various responses and discussion for each.
 - a. In which direction is the water is flowing?
 Ask several students to take turns tracing with a finger the flow of water, start to finish, from different places along the stream. Ask other students to help correct any misconceptions.
 - b. Based on the way the water is flowing, where is the lowest place shown on the diagram likely to be, and why?
 As necessary, explain that for this drainage the lowest place must be at the bottom. Here the stream has become wider and deeper, having combined the water from all the higher streams.
 - c. Which parts of the landscape must be highest? Ask one or more students to point to some likely high points on the diagram.
 Numerous answers are possible, but it should be made clear that where a stream begins will always be higher than anywhere else along its flow. The tips of each branch, or the space between them are the best choices for higher locations on the diagram. If necessary, refer back to the demonstration model.
 - d. To reinforce this principle, focus attention on the left center portion of the diagram. Here they can see three streams beginning to flow north and three other nearby streams flowing south. What would cause streams that close to flow in completely opposite directions?
 Explain as necessary that streams on a map give us important clues about where hills and valleys are located. Water will only flow downhill and must detour around hills and mountains. The six

streams are divided as they are because their headwaters must descend two sides of what is probably a very steep mountain.

- e. Why is a stream drainage called “a stream *drainage*?”

Explain as needed that similar to a sink or street drain, water in a stream drainage flows downward from different directions and collects in one place.

- f. What do all the streams in this diagram have in common?

Each of the streams carries water down toward the bottom. Explain that when all the water from an area eventually works its way down toward the same place, that area is called a *watershed*.

2. Explain that there are three main parts to a watershed. They saw all three parts as they watched the demonstration. Can anyone suggest what they are?

Explain as necessary that a watershed consists of mountains (or at least high ground), one or more rivers, and a lake or ocean.

3. Point out that when the spray stopped during the demonstration, so did the flow of water. However, in real mountains there are creeks and rivers that continue to flow all the time, even when it is not raining or snowing. Ask for explanations. To stimulate thinking, remind the students that streams can get water from other places than directly from the sky.

Explain as necessary that water that once fell as precipitation can trickle underground. This kind of flow is called *percolation*. It is what replenishes our underground water supplies, and it is what seeps out as *springs* to keep rivers and creeks flowing year-round.

4. Discuss some basic but important relationships between elevation and climate through the following discussion:

- a. Show the students pictures of snow-covered mountains, forested hillsides and drier valleys. Why does it sometimes rain in the valleys when it snows in the mountains?

Students should understand a basic relationship between elevation and temperature. Explain as necessary that, like people, air and clouds also become cooler as they go higher.

- b. Why is there often more precipitation at higher elevations than in surrounding valleys?

Students should understand a basic relationship between elevation and precipitation. The answer is related to why air around a glass of ice water condenses into liquid on the sides, or why the steam from a hot shower condenses as water droplets on the cooler surface of a mirror. Air crossing a valley can contain many tons of water in the gas phase, which we never see. But as this same air rises up a mountain and becomes cooler, it cannot hold as much

water. As a result, air moving up a mountain often means an increase in both clouds and precipitation.

5. Have different students identify the following watersheds on maps of Utah and the United States (or North America):
 - a. The Colorado River
 - b. The Mississippi River
 - c. A local watershed. Remind the students that every place on land is part of a watershed. Use a map to help students determine where water flows after it falls near their homes or at school.
6. Explain to the students that a watershed can be named for the main river that drains it, or for the place where the water ends up. For example, all of the drainages that go into the Colorado River make up what is called the Colorado River Watershed. All of the drainages that go into Great Salt Lake make up what is called the Great Salt Lake Watershed, sometimes also called the Great Salt Lake *Drainage Basin*.

ELABORATE WATER COLORS: A MAP OF THE GREAT SALT LAKE BASIN WATERSHED

1. Distribute a copy of the watershed map (Worksheet III.A.2.) to each student. Provide a brief map orientation by asking and discussing the following questions:
 - a. What does this map show?
 - b. What states are shown on the map? For clarification, correlate this map's location to a classroom map of Utah and of the US.
 - c. What is the purpose of the thick gray line surrounding all the other information?
 - d. Discuss any other questions the students might have about their maps.
2. Assign the following tasks to be completed individually:
 - a. What would be a good title for this map? Put your title on the line near the bottom.
 - b. Label the three main lakes shown on the map by writing the correct name next to or inside of each. Refer to other maps in the classroom if you need help.
 - c. Use the key near the top of the page to decide which river basin adds the most water to Great Salt Lake. Then, use a BLUE crayon or marker to carefully trace the flow from where this river enters Great Salt Lake back upstream as far as it goes. Use blue to also color any other streams or rivers that join this same river on its way to Great Salt Lake.
 - d. Use the key to decide which river adds the second most water to Great Salt Lake. Then, use a GREEN crayon or marker to carefully trace the flow from where this river enters Great Salt Lake back

upstream as far as it goes. Use green to also color any other streams or rivers that join this same river on its way to Great Salt Lake.

- e. Decide which river adds the third most water to Great Salt Lake. Then, use a RED crayon or marker to carefully trace a line from where this river enters Great Salt Lake back upstream as far as it goes. Use red to also color any other streams or rivers that join this same river on its way to Great Salt Lake.
- f. Complete the key on your map by filling in the color that matches the name for each of the three main rivers feeding Great Salt Lake.

As with other activities, students should insert their maps into their Great Salt Lake Scrapbook for evaluation and for future use.

EVALUATE Direct the students in making entries into their Great Salt Lake Scrapbooks, as appropriate.

Activity III.B. Far And Wide

PURPOSE Examine volume, surface area, depth as it relates to Salt Lake Basin

FORMAT Classroom demonstration and discussion
Adapted from "What's In A Basin?" *The Great Salt Lake Story*. Pgs. 7–10.
Utah Museum of Natural History, 1997.

BACKGROUND *The Great Salt Lake Story*, page 1. Utah Museum of Natural History, 1997.

STAGES Students will . . .

1. Compare two "lakes" of different dimensions (demonstration)
2. Graph the diameter and volume changes during the filling of two different "lakes" (student-assisted demonstration)
3. Interpret graphs for fundamental surface–volume relationships
4. Correlate graphs to the Salt Lake Basin

MATERIALS This activity is described here as a teacher-led classroom demonstration with student assistance. To conduct the activity with student groups, provide each group with the containers, measure, graduated cylinder, measuring cup and water listed below.

- ✓ 2 containers * of nearly the same volume. 500 ml (or 16 oz.) is a convenient size. You need two different shapes, as follows:
 - 1 bowl with steep sloping sides and an approximately 6 in. (15 cm) filled surface area (such as a Pyrex bowl)
 - 1 large shallow plate with very gradual but continually sloping sides and approximately 12 in. (30 cm) filled surface area
- ✓ overflow tray (optional, to control water spillage from plate)
- ✓ tape measure
- ✓ 500 ml (or 16 oz.) graduated cylinder or measure
- ✓ A large pitcher of water (or immediate access to a sink)
- ✓ A bucket for water disposal (optional)
- ✓ For each student: Worksheet III.B. (or graph paper), ruler, pencil
- ✓ Optional: Pictures of high Great Salt Lake water from the 1980's
- ✓ Student Scrapbooks

* IMPORTANT NOTES: Containers of larger volume will work as well. However, be particularly careful in your selection of the plate. Many plates are flat to the edges and then rise abruptly. These will not provide graphed results that differ appreciably from those of a bowl. This is because after the initial volumes of water are poured, further quantities merely rise up the steep edges of both containers. The ideal plate is one that rises gradually and continually from the center outward, with no steep edges.

For greatest impact, you should select containers nearly equal in filled capacity, but differing in filled diameter by a factor of 2 : 1 or more. The closer the total water volume comes to filling each container, the more impressive the effect.

IN ADVANCE Prepare the students with some preliminary graphing exercises, particularly if they have not had recent experience. They should also be aware that for both accuracy and mathematical convenience in science, metric units (milliliters) are the preferred measure for liquids. For these same reasons, you might also choose to use metric for linear measure.

Unless you prefer the students to create their graphs from scratch, prepare copies of the Far & Wide Worksheet III.B. that includes x and y axes lines with numbers and labels on a grid.

Gather and prepare materials. Set up a demonstration area where all students can see and assist with the activity.

DURATION TBA

SEQUENCE**ENGAGE FILLING UP A LAKE**

1. Show the students two empty containers: the deep, narrow bowl and the wide, shallow plate. Ask for descriptions that compare the two containers.
2. Slowly pour 500 ml water from the graduated cylinder into the bowl while asking the students to describe where the water is moving as it fills. [Up and outward]
3. Refill the graduated cylinder and slowly pour 500 ml water into the plate, asking the students to describe where most of the water is going as it fills. [Mostly outward or horizontally]
4. Remind the students that, surprisingly, each of the two containers contains exactly the same amount of water. Ask them to suggest how this can be. [Answers may vary.]
5. Ask the students to imagine these are two lakes. How would they describe the first “lake” (the bowl)? The second (the plate)? Which “lake” do they think is shaped more like Great Salt Lake? [The plate]
6. Ask the students if they have ever seen pictures or heard stories of how Great Salt Lake spread out to record size during the 1980’s (1983–87). Show pictures if you have some available. Inform the class that you are going to perform some experiments and make graphs to show why Great Salt Lake changes the way it does.

Empty the water from the bowl and the plate to prepare for the next step.

EXPLORE GRAPHING THE “LAKES” AS THEY FILL

1. Distribute Worksheet III.B. (or graph paper), rulers and pencils to each student.
2. Suggest to the students that they again imagine the bowl and plate as two lakes, A and B. Each has marshes and beaches right to their edges. But the lakes have become dry from a draught. Now the drought is over, and you are about to show how, over a period of time, these two “lakes” fill up once more. The students should imagine their jobs are to assist the Department of Natural Resources with measuring the “lakes” as they fill, and to prepare a graph that shows the difference between them.

If it has not been done previously, have the students prepare the x and y axes lines, numbers and labels for their graph.
3. Select two students to assist with the demonstration. One is to be the “rainmaker” and the other the researcher taking measurements. (Between intervals you might wish to perform the role of filling the graduate cylinder for each pouring.)

4. Have the rainmaker carefully pour 50 ml (or 10% of the final volume) of water into each of the two containers.
5. Have the researcher recall what a “diameter” is, and then carefully measure and announce the diameter of the surface of the water in each container. Assist the students in determining that this first data entry for the two “lakes” should be marked across from the appropriate ml line of the y axis to intersect the appropriate diameter. Both lakes will be graphed on the same plot for the sake of comparison. Be sure your assistants also enter the data on their graphs.
6. Select two new assistants to measure and add another 50 ml (or 10% of the total volume) of water to each container. Record these new data for the 100 ml volume. Proceed similarly, but now in increments of 100 ml (or 20% of the total volume). Measure successive diameters for each container until 500 ml (or your final volume) has been added to fill each “lake.”
7. Survey students who might be having difficulty with their graphing. Assist and encourage them to assist one another with making necessary adjustments.

NOTE: Diameter is converted to surface area with the formula $A = \pi r^2$. Graphing in this way is even more dramatic, but is too conceptually challenging for most fourth grade students.

EXPLAIN EXAMINING THE GRAPHS

1. Have the students examine their graphs. What do they see?
[They should notice that Lake B with the flat, shallow shape (the plate) started out wider and became even wider faster than Lake A with its deeper and steeper shape.]
2. Provide a simplified explanation of *surface area* to the students. Discuss how the changing diameters of the “lakes” they measured were also showing how the amount of surface space of each “lake” was changing. When a lake “spreads out” its surface as they observed, it is increasing its surface area.

ELABORATE RELATING THE ACTIVITY TO GREAT SALT LAKE

1. Ask the students to describe what this activity tells us about lakes like our own Great Salt Lake. Invite explanations from several students.

Student responses should acknowledge that the flatter a landscape is beneath a lake, the less water it takes for the lake to increase its size dramatically. The Salt Lake Basin is very broad and flat, so moderate amounts of water added to the lake will increase the surface area—cause it to widen—quite fast, without adding a lot of depth. This is what happened in the 1980’s.
2. Challenge the students to come up with other examples of something that spreads out to cover a lot of surface area? Have them imagine, for

example, what would happen if everyone in the classroom tried to lie down rather than sit upright in seats. Or what if shelved books were all placed flat instead of upright? In each case much more surface area would be needed.

[Other examples include milk spilled on the cafeteria floor, a gallon of paint spread out over the walls in a living room, frosting on a cake, rain falling onto a flat parking lot, or toppings spread out over a large pizza.]

EVALUATE Instruct the students to insert their graphs into their scrapbooks.

Activity III.C. Comings & Goings

PURPOSE Relate the size of Great Salt Lake to precipitation, runoff, evaporation

FORMAT Classroom discussions and graph interpretation activity

BACKGROUND *The Great Salt Lake*, by Hissibe and Keck. US Geological Survey. 1993.
Great Salt Lake, Past and Present, by D. E. Miller. Publishers Press, Salt Lake City. 1997.
 USGS Web site: <http://www.dutslc.wr.usgs.gov/greatsaltlake>

STAGES Students will . . .

1. Consider the relationship that exists between stream inflow and evaporation output at Great Salt Lake;
2. Relate lake level and size to precipitation, runoff and evaporation;
3. Examine seasonal and annual water fluctuations at Great Salt Lake using a graph depicting the lake's elevation changes since 1847.

MATERIALS

- ✓ Photographs and newspaper clippings showing high water of Great Salt Lake and surrounding streams during 1986–87.
- ✓ Board and marker
- ✓ Copies of graph showing Great Salt Lake elevations since 1847 (Activity Chart III.C.)
- ✓ Classroom graph, as above, enlarged or as an overhead transparency projection
- ✓ Student pencils and paper
- ✓ Student Great Salt Lake Scrapbooks

IN ADVANCE Gather and prepare materials listed above.

If necessary, download a recent graph from the USGS Great Salt Lake Web site.

Find out the year your school was built (for the activity in the Elaborate section).

DURATION TBA

SEQUENCE

ENGAGE RISE AND FALL

1. Ask if any students recall from “The Lake Affect” presentation the normal depth of Great Salt Lake. [Maximum 33 feet, average 13 feet]
2. Remind the students that Great Salt Lake has sometimes become much shallower, and has at other times become a lot deeper than its average. Mention that during the lifetimes of many adult Utah residents, including some of their own relatives, the lake reached both all time record high and low levels.
3. Ask if any have seen pictures or heard stories of how between 1983 and 1987 many Utah rivers carried huge amounts of water, causing flooding in many areas. Did they know that Great Salt Lake enlarged and spread out to a record size during that time? Show the students some pictures from the high water years.
4. Inform the students that part of the way people are discovering the importance of Great Salt Lake and how it works is by understanding the way it changes, or fluctuates over time.

EXPLORE A INPUT VS. OUTPUT

1. Remind the students, as noted in an earlier activity, that an average of 2.6 billion (2,600,000,000) gallons of water escapes from Great Salt Lake every 24 hours. That’s more than 108 million (108,000,000) gallons per hour! Write these two numbers on the board for students to see.
2. Next, ask the students to recall that there are no rivers flowing out of the lake. Invite students to explain how, then, all this water manages to leave the lake.
[The students should recall that evaporation is the only significant way that Great Salt Lake water escapes.]
3. Ask the students why, with all this water leaving Great Salt Lake, the lake is still there. Where does Great Salt Lake get all the water to keep it filled?
[Appropriate answers include: any or all of the three rivers, rain and snow, and flow from higher elevations, such as mountains.]
4. Point to the evaporation numbers written on the board and ask the following question: If the lake stays the same size from one day to the next, and we know that this is how much water has evaporated, how much water entered the lake during that same time? Repeat the question slowly, if necessary, to allow appropriate time for students to process the question.
[Students should arrive at the conclusion that in order for the lake to remain at a steady level, all that evaporates from it must be replaced by an equivalent amount flowing or precipitating into it.]

5. Next, ask students to describe what must be happening when the lake level *goes down* over time. Continue accepting responses until an appropriate explanation has been offered. [More water has left from evaporation than has been replaced by inflow during the same period.]
6. Ask other students to describe what would cause the lake level to *rise* over time. [More water has flowed into the lake than has evaporated out of it during the same period.]
7. Ask one or more students to suggest up to four ways that our weather and climate affects all of these changes.

[As the students have discovered in a variety of earlier activities, precipitation, sunlight, wind and temperature affect either or both the amount of water available to flow into the lake and the amount of evaporation removing water from it.]

EXPLAIN A THE CHANGING WAYS OF GREAT SALT LAKE

1. Clarify as necessary that over a period of time Great Salt Lake will often remain in a state of balance, or *equilibrium*, meaning that the amount of water entering and the amount evaporating are nearly the same. This results in the lake level remaining nearly constant.
2. Be sure that students understand that whenever much more water flows in than evaporates out, such as in the spring or during periods of storms or overcast, the lake level will rise and the lake will expand in surface area. When evaporation exceeds inflow, such as during extended sunshine and heat in summer and fall or during long draughts, the lake level drops and it decreases in surface area.
3. Have the students compare conditions at Great Salt Lake with what happens with our own bodies. We are always losing liquid in various ways from breathing, perspiring and eliminating waste. Fortunately, we are also constantly replacing water by eating moist foods and drinking fluids. This keeps us in equilibrium between water going in and water going out. When we lose more water than we take in, we have less water in us and so we feel thirsty.

EXPLORE B A HISTORY OF LAKE FLUCTUATIONS

1. Inform the students that you are about to give them (or show them) a graph that lets us see exactly how much Great Salt Lake has fluctuated up and down for more than one hundred years.
2. Display or distribute copies of the “Fluctuations of Great Salt Lake” graph, (Activity Chart III.C.) showing Great Salt Lake fluctuations from 1847. Instruct the students to notice from the title that data regarding the height of Great Salt Lake has been gathered and recorded since 1847. Information from this long a period of time can tell us much more about the lake than just a few years.

3. Ask various students to assist the class in understanding how to read this graph, guided by the following questions:
 - a. What information is plotted on the bottom, along the x axis?
 - b. What information is plotted along the side, on the y axis?
 - c. Why is “surface elevation” used instead of just telling us how deep the lake was?

Allow students to provide several explanations before proceeding to any answers.

EXPLAIN B READING THE GREAT SALT LAKE GRAPH

1. Confirm student understanding that when we talk about the height of Great Salt Lake it is easiest to refer to surface elevation above sea level. Note that this is also how we describe the height of a mountain. Remind the students that the lake has many places with different depths, depending on where at the lake you are measuring. This could be confusing. However, because the water surface of Great Salt Lake lies flat and is the same in many places at once, measuring its height above sea level is the best way. Very accurate instruments are now used to provide these elevation measurements.

To increase understanding and provide a comparison, inform the students of their school’s elevation, which is likely higher than Great Salt Lake. The Salt Lake Basin in which Great Salt Lake lies is one of the lowest points in northern Utah. This is why water from hundreds of miles away flows downhill into it.

2. Be certain that the students understand that surface elevation is found on the horizontal lines of the graph, drawn from the y axis on the left side. If there are intermediate hatch marks shown between years specified on the graph, be sure everyone understands how to interpret them.
3. Inform the students that the average elevation of Great Salt Lake is 4,202 feet. Direct each student to carefully highlight the 4,202 feet line across their graphs using a pencil or marker and a ruler.
4. Ask the students to identify when in recorded history Great Salt Lake has stayed closest to average for the longest period. [During the first part of the twentieth century, about 1910 to 1920.]
5. Ask for a volunteer to explain why the elevation for each year is shown as a line between two points. Pick a year as an example.

Students should understand how each year Great Salt Lake reaches a high and a low. Thus, each year’s line on the graph shows the range that existed between high and low elevations for that year.

6. Direct students to consider the seasonal changes that affect Great Salt Lake by asking these questions: During what season of each year is

the lake at its highest? What are two reasons this is so? During which season each year is the lake lowest, and what are two reasons why?

The students should clearly understand the two factors that constantly determine the amount of water in Great Salt Lake: Inflow and Evaporation. Low evaporation from either clouds or cooler temperatures in the spring combine with high inflow from the runoff from mountain snowmelt to cause the lake to rise. Conversely, high evaporation from hot, sunny days of late summer and fall combine with reduced inflow to cause the lake to lower.

7. Go on-line to the USGS Web site to find the elevation for Great Salt Lake at this time. Locate the graph showing data for elevation changes during the years since your classroom graph stops.

ELABORATE UNDERSTANDING THE DEPTHS OF GREAT SALT LAKE'S "PERSONALITY "

The students should use the graph and their learning to answer the questions below. Employ a Think–Pair–Share format as follows: First, instruct the students to work independently in answering each question. Next, pair students in teams to review each question and compare answers. Following time to review and revise answers as needed, invite various teams to share their results with the rest of the class.

1. What was the elevation of Great Salt Lake at the beginning of the year you were born? [This answer may of course vary.]
2. What was the lake's highest and lowest elevation during the year your school was built? [Be sure to inform students of the year.]
3. Based on the graph, what elevation did Great Salt Lake reach one hundred years ago? [Consult the graph for the correct answer.]
4. Based on the graph, during which three years in a row did the peak elevation of Great Salt Lake stay closest to the same level? [During the years 1937–1939.]
5. Based on the graph, what was the lowest Great Salt Lake has ever reached since 1847? When did that occur? [An elevation of just over 4,191 ft. existed from fall of 1963 through spring of 1964.]
6. There were three years that Great Salt Lake tied for an all-time record high elevation. Based on the graph, what years were these? How high did the lake reach each of these years? [1874, 1986 and 1987 at just under 4,212 ft.]
7. Figure out the difference between Great Salt Lake's highest and lowest elevations ever recorded. What does this number tell you? [To the nearest half-foot, $4211.5 - 4191.5 = 20$ feet. This is the range, or the range over which that the lake has varied since 1847.]