Activity III.E. Endless Circle

PURPOSE Explain where water comes from and where it goes (the water cycle)

FORMAT Guided imagery, discussions, group activity, worksheets

BACKGROUND "Imagine" activity from Project WET, pg. 157. (1995. The Watercourse and Western Regional Environmental Education Council)

STAGES Students will . . .

1. Participate in a "guided imagery" story that follows a water molecule from place to place;
2. Diagram what happens to water as it cycles;
3. Use an illustrated block diagram to label the movement and changes of water in our environment.

MATERIALS

- ✓ The reading, "Molecular Movie," a story for guided imagery
- ✓ Recorded sounds of water or weather, such as of streams, ocean waves, rainfall, thunder, etc.
- ✓ Water-Go-Round water cycle Worksheet III.E.1. for each student
- ✓ Overhead transparency or classroom poster of the blank Water-Go-Round diagram
- ✓ Optional: 8 water change label cards: *evaporation, condensation, precipitation, melting, percolation, flowing, transpiration,* and *respiration*
- ✓ A block diagram worksheet of The Water Cycle for each student
- ✓ Physical or relief maps of Utah and the US
- ✓ Student Scrapbooks

IN ADVANCE Gather materials

DURATION TBA

SEQUENCE

ENGAGE NO BEGINNING, NO END

1. Ask the students to suggest where on earth water "comes from." Many appropriate responses are possible. For each suggestion offered, ask the class to confirm that water does indeed come from the source suggested. If so, write the suggestion on the board. Continue until several sources have been listed.

   [Valid responses include rainfall, snow, clouds, rivers, lakes, oceans, a faucet, pipes, a reservoir, the air, and many others.]

2. Next, ask the students if there is any place on the list where water actually starts. Discuss various suggestions. For any responses that specify a source, question whether that water could not have come from some earlier source. Students should see that no matter what place one begins this discussion, there is always an earlier place or condition in which the water existed.

3. Ask the students if there is any place on the list where water actually ends. Discuss various suggestions. For any responses that specify an end point, question whether that water could not next change into something else.

4. Explain to the students that water is so marvelous a substance because it keeps changing, with no beginning and no end. What's more, the same water that allows all life to exist today has been on Earth since its beginning, used over and over and over again.

   Inform the students that the water they drank this morning could have once dribbled down the back of a dinosaur, spent time at the bottom of a prehistoric ocean, been part of a huge glacier during our last ice age, or floated in a cloud over a rain forest halfway around the world.

   It is this special ability of water to keep leaving and coming back that allows life at Great Salt Lake, in our country, and throughout the world to go on. This process is called *The Water Cycle.*

EXPLORE A WATER ON THE MOVE

1. Ask the students to describe what is meant by the phrase, "water cycle." Invite a combination of responses to help the class begin to create a working definition.

2. Ask the students what it might be like to travel with a molecule of water as it moves through the water cycle. Seek out a student definition of a *molecule.* If necessary, briefly describe a molecule as, for example, the tiniest particle of a substance possible—too small to see even with a microscope.

3. Inform the students that you are about to take them on a water cycle journey in their imagination. It is called "A Molecular Movie." Instruct them to sit quietly with eyes closed. The teacher is the director, but the

students' help is needed because their imagination is the camera and they are the molecular movie stars.

4. Start the background recording of water or weather sounds, and begin the reading from the script, "A Molecular Movie."

   To be most effective, the reader should maintain a low, clear and even voice. To maximize student participation, pause a second or two wherever the symbol, " …… " appears in the text.

5. After the reading, discuss the different ways of "being water," by asking several students to describe a part of the story they remember most clearly. Include a review of how each student "water molecule" got to a place and where it went next.

6. Divide the students into groups of 4–6. Distribute a Water-Go-Round worksheet, providing a group activity sequence in 3 parts:

   a. PART ONE Where did they go? As a group, students are directed to create a list of all the places they went to as a water molecule in the story, beginning with the ocean. Each student should record the group's list in the space at the bottom of the worksheet. Be sure that every person in the group has a chance to suggest at least one place.

   b. PART TWO Next, students are to use their newly created list to complete the diagram, by writing the sequence of places visited in the blank ovals clockwise around the circle. To show the direction of movement, black arrows are drawn between each step.

   c. PART THREE How did they move from place to place? Each group of students should discuss what happened to cause them to travel from one place to the next. They begin by choosing the best word to describe the change they underwent between the ocean and the next step. Each group member then writes this word next to the arrow connecting the two steps. Activity continues until appropriate words have been written next to each of the arrows in the cycle diagram.

To help students recall the terms learned for phase changes involved in the story, suggest that they refer to their scrapbook notes from those earlier activities.

NOTE: A sample of a completed diagram is shown later in this section.

EXPLAIN A THE WATER CYCLE

Use a classroom poster or projected overhead transparency of the blank Water-Go-Round diagram in order to review the parts of the water cycle involved in the story. Invite reporters from different groups to help build the diagram as a class.

1. Where did they go? Starting with the Ocean at the top of the diagram, direct reporters from different groups to add an arrow and fill in the

sequence of ovals in the cycle. Have each student confirm an addition with the rest of the class before filling in a blank.

2. Encourage students to revise their own worksheets as necessary.
3. What happened as the water molecules moved from place to place? How did they change? Using a procedure similar to that employed in the first part of this review, ask student reporters from different groups to specify the changes that took place between each phase of the story. Once the class agrees with a reporter's description, the word may be added to the class diagram.

   Suggestion: To facilitate this portion of the activity, use a stack of poster board cards on which are written each of the following different kinds of water transformations:

evaporation	precipitation	percolation
condensation	melting	flowing

   Challenge different students to place a card in an appropriate place on the diagram. If the students are confused or stumped by a word, this becomes a good opportunity for review and clarification.
4. Encourage students to revise their own worksheets as necessary.
5. Why the sun? Note that the sun occupies a prominent position in the worksheet diagram. Ask the students to explain the reason for this.

   Explain as necessary that it is the energy of the sun (combined with gravity) that drives the water cycle, including the continuous changes shown on the diagram.

NOTE: A sample of a completed diagram is shown later in this section.

EXPLORE B MOLECULES THAT JUST KEEP GOING AND GOING AND GOING...

1. Ask the students to refer to the Water-Go-Round diagram and recall where their molecular journey began (the ocean). Using the classroom physical or relief map of the United States (or North America), have volunteers trace possible routes to Great Salt Lake they took as water molecules in the story. [Either of the two oceans or the Gulf of Mexico are acceptable suggestions at this point.]
2. Using the classroom physical or relief map of Utah, have students consider on which mountains they might have fallen as snow. In what streams or river might they have flowed? Where did they end up? Where might they have gone next? [Many alternatives are possible.]
3. Suggest to the students that the class diagram they have completed is really just one possible trip that a water molecule from the ocean might have made. To clarify that water can and does constantly move in many different directions, ask the students to think about how another molecule from the ocean might have told a story different from the one they shared. Discuss alternative routes that could have been taken. Below are a few examples:

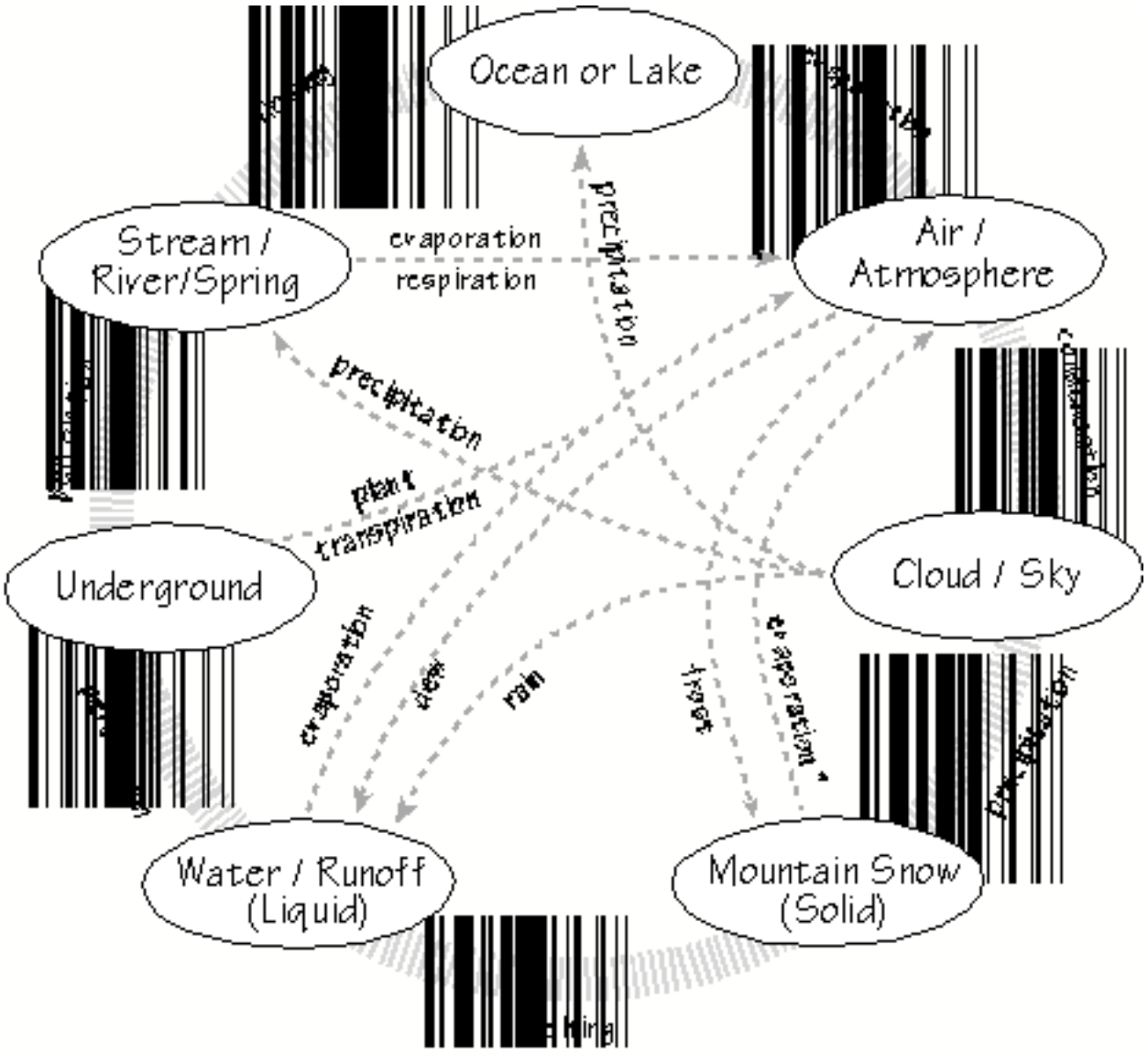
a. What if the cloud did not drop snow? (It might have rained instead.)

b. Where else might the cloud have dropped rain or snow, besides on the mountain? (Precipitation could have fallen directly into a stream or river, or into the ocean or lake. Also, the clouds could have simply moved on into another state, or even another country.)

c. What else might have happened to the water in the story after it melted from the snow? (It could have evaporated directly back into the air when it was on the ground or as it was flowing down the river.)

d. What about the roles of plants and animals in the water cycle? Plant *transpiration* and animal *respiration* can also play parts in the molecular tour. The students might recall from the story that when they were percolating down into the soil there were other molecules being absorbed by the roots of a plant. Also, a passing bird or mammal might have taken water from the stream and released it later through its breath or urination.

4. Invite several students to draw some or all of these alternative pathways on the classroom diagram using labeled dashed lines with arrows. (See sample diagram below.)



Activity III.E.1. Sample of a completed Water-Go-Round diagram

The outer circle of labeled ovals and large arrows shown above are created during the first phase of the activity, based upon the guided imagery story, "Molecular Movie." (See parts A above). The dashed lines, arrows and labels within the circle are suggestions for the second activity phase, when routes that may have been taken by other water molecules are considered (See part B above).

* NOTE: When snow or ice transforms directly into a gas without first becoming a liquid, it is more correctly called *sublimation*. However, "evaporation" is acceptable for the purposes of this activity.

EXPLAIN B THE DEEPER END OF THE WATER CYCLE

1. Clarify as needed how, as in the story, much of the water that travels in weather systems through Utah came eastward from the Pacific Ocean. They can observe this on practically every weather forecast map on local television. On occasion, moisture may also reach us by moving northwest from the Gulf of Mexico.
2. On the US map, point out the Sierra Nevada Range in California. Explain how it acts as a "sponge-wringer," to take back a huge amount of Pacific moisture and create a dry "rain shadow" to its east (The Great Basin Desert). On the Utah map, point out some of our state's larger mountains. Review how they gather moisture from the air that passes over them.
3. Remind the students of how the Wasatch Mountains collect moisture from clouds that gather over them, and that this range is a major contributor to the Great Salt Lake Watershed. Virtually all rivers or streams in the vicinity of the Salt Lake Valley carry water to Great Salt Lake, and so could have been part of the "Molecular Movie" story.
4. Initiate a class discussion that summarizes important attributes of the water cycle, prompted by the following questions:
   a. How can the same water that has been on Earth since the Earth's beginning get used over and over again?

      [The students should demonstrate an understanding that, with the help of energy from the sun and gravity, water is able to "recycle" over and over again by changing form and moving in the atmosphere, on the ground and beneath the surface.]

   b. What is it about the water cycle that allows water that has been used over and over again for millions of years to keep getting clean again?

      The students should demonstrate a basic understanding that two events in nature contribute to water purification: the ground (percolation) and the atmosphere (evaporation). Water passing through wetlands and underground tends to get filtered and purified. And, when water evaporates into the air it leaves impurities behind and is able to fall as clean precipitation.

   c. How would a change in one part of the water cycle affect other parts? Use the classroom Water-Go-Round diagram and hypothetical events in the Salt Lake Watershed as examples.

      The students should demonstrate a basic understanding that a change in quantity or quality at any one place in the cycle will impact future changes or conditions. Examples: Air pollution can cause precipitation to become impure again before it even reaches the ground. Runoff from city streets can become so polluted that it endangers living things downstream in the watershed. Less winter

snowfall in the mountains means less springtime melting to return water to Great Salt Lake

d. What should be the final classroom definition of "The Water Cycle?"

Students should construct a definition that refers in some way to movement, change and reuse. For example, *the movement of water on Earth in different ways, to different places, over and over again.*

ELABORATE **STUDENT BLOCK DIAGRAMS**

1. Distribute the block diagram worksheet, "The Water Cycle," to the students. Explain that this picture is a kind of puzzle. In it are hidden ten different ways that water moves in the water cycle around Great Salt Lake. The arrows are clues. Next to each arrow, write in the word that best describes what is happening at that place.
2. When they have finished, the students should enter their diagrams into their Great Salt Lake Scrapbooks.

EVALUATE Collect Student Great Salt Lake Scrapbooks

Molecular Movie

A Story for Guided Imagery
(Activity III.E.)

THE SEA . . .
Imagine a beautiful afternoon at an ocean beach …… the sky is blue …… white puffy clouds float overhead …… the sun is shining …… the sand is soft and warm …… a sea gull calls as it takes off …… it flies out over the water …… and disappears from view…… Far away from land, the gull finally sets down onto the ocean …… it bobs gently up and down with the waves …… You are in the water, nearby …… and you are very, very tiny …… You are a water molecule in the ocean …… moving gently back and forth …… you can feel other water molecules around you …… You are all gently moving against each other …… touching …… close …… bouncing into each other …… you are all rocking back and forth …… The sun warms the surface of the water …… you are slowly rising …… moving closer to the surface …… Now you are right at the surface …… You begin to move more rapidly …… the warmth and energy of the sun continue to strike you …… You become more energized and move more quickly …… Suddenly, you burst from the surface ……you are released into the air …… Now you have moved away from the others and you gently float upward …… too tiny to be seen by the human eye …… apart from any other water molecules ……

. . . THE ATMOSPHERE . . .
You are floating high in the air …… still rising slowly …… There is great space around you …… You can see the gull and the ocean far below …… growing more distant …… You continue to rise …… you can see other water molecules around you …… but they are on their own …… They, like you, continue to float and rise into the atmosphere …… As you rise, it is getting cooler …… your movement is becoming slower …… A tiny particle of something floats near you …… you grab onto it …… Then another water molecule grabs on to the same particle …… then another, and another …… You all begin to connect to each other …… You can see other particles with water molecules attached …… Far below you see that you have now moved over land …… fields …… forests …… mountains …… It has become much cooler …… everything around you is beginning to form patterns …… tiny crystals of ice …… light passes through these ice crystals, creating prisms and tiny rainbows …… More and more water molecules come together …… you feel some of them pressing in to surround you …… You are becoming heavier …… heavier …… heavier …… you begin to fall ……

. . . THE SNOW . . .
You are falling faster …… faster …… then, wind blows you up and around …… You swirl about …… trees appear …… you see a white layer blanketing all of the ground below …… Gravity gently pulls you down …… You land on the surface …… Above you and around you other particles fall …… you become part of this vast white blanket …… Everything becomes quiet …… cold …… All around you stillness settles in ……

. . . THE BIG MELT . . .

In a while …… gently, ever so slowly …… a soft light begins to appear around you …… a gradual brightness …… The light brings warmth with it …… You begin to move a tiny bit, ever so slowly …… As the light brightens, the warmth increases …… you move some more …… back, and forth …… Near you, other water molecules are beginning to slip away …… they seem to be moving downward …… sliding …… flowing …… Now, you and water molecules next to you are suddenly released, and begin to slide ……

. . . DOWN THE MOUNTAIN . . .
As you tumble and slide along, you feel other water molecules pushing together around you …… Suddenly, you reach the surface …… the sun is bright …… the air is fresh and dry …… it invigorates you …… All around you there are water molecules …… traveling on the ground …… moving through a forest …… More groups of molecules are joining you …… more …… and more …… all traveling down quickly …… you notice some rising up away from the rest, disappearing into the air above …… As you roll along you see trees, hills, fields, grasses …… Now you come upon a large tree …… bump against the roots …… and slow down ……

. . . INTO THE GROUND . . .
Your old friend gravity is beginning to pull at you …… You seep into the ground, weaving among particles of soil and sand …… then deeper, surrounded by roots and rocks and soil …… Look, some of the molecules near you are disappearing into tiny root hairs of the tree and other plants …… you continue moving into the ground …… Flowing underground feels like moving in slow motion, through a dark obstacle course …… But suddenly, your movement seems to be more sideways than down …… the pressure of other molecules behind you pushes you along …… sideways …… sideways …… Oh, it is beginning to appear lighter up ahead …… Whishhh …… You and surrounding molecules spring out of the ground …… bubbling, tumbling over ground, you continue your gradual descent …… through the foothills of the mountain ……

. . . BIG RIVER . . .
You flow along …… other streams join in and contribute to your journey …… more and more water molecules join together …… Gradually you slow down …… the ground is less steep now …… you move gently, gracefully in a large mass of water ……this is the big river …… particles of wood and rock and soil swirl around you …… You and other molecules work together to carry these particles …… Now, you are moving more slowly …… the land is getting flatter …… the slower you and the other molecules move, the less energy you have to carry the particles …… the particles slip from your grasp and sink …… but you move on ……

. . . THE GIANT POOL . . .
Ever so slowly now, gravity carries you and the rest of the water along …… grassy banks give way to cement walls and canals …… all around you civilization makes itself known …… old tires …… dogs barking …… cars …… people …… schools …… even an airport …… the sounds are loud and constant …… eventually you feel a change …… all around you are new materials …… molecules

of other substances …… they are strongly attracted to you …… these are the salts …… like in your ocean home but more of them …… they fill in the gaps between you and other water molecules …… you and other particles continue to move about ……

. . . WHAT NEXT? . . .
You are in Great Salt Lake …… one of the largest salt lakes in the world …… you touch the tail of a passing brine shrimp and it moves by …… a bird swims past …… What will happen next? …… Where will you go? …… There are many possibilities …… The sun's energy may invigorate you—you could break away and float into the sky again! …… Or. other water molecules may hold on to you—you could swirl around the surface or visit the shores of a new beach …… Gravity may pull at you—you could explore the darkness of the deep where the algae grows…… A pelican flies by and you think, "now there's a possibility" …… Imagine where you will go next …… Picture it in your mind …… [pause] …… when you are ready …… open your eyes.

Adapted from "Water Cycle Journey" from Project WET, pg. 159.
(1995. The Watercourse and Western Regional Environmental Education Council)

Activity III.F. Sheds & Cycles In Review: Diary of A Drop

PURPOSE Summary and Evaluative Activities

FORMAT Classroom displays, class review, student writing and drawing, Classroom Mural enhancements

BACKGROUND See Activities I.D. and I.E.

STAGES Students will . . .

1. Be introduced to some new displays for their classroom to which they will be contributing;
2. Review various topics covered in this unit;
3. Develop a plan for a summary writing project;
4. Create a writing assignment entitled "Diary of a Drop" to demonstrate their learning about the water cycle and the Great Salt Lake watershed.

MATERIALS

- ✓ Student Scrapbooks
- ✓ Writing materials and art supplies
- ✓ The evolving Classroom Mural

IN ADVANCE Find out the current elevation of Great Salt Lake

Construct and post a "How Big Is The Lake This Week?" classroom chart to be used to monitor the variations in Great Salt Lake as the year progresses.

Begin an ongoing Great Salt Lake News Board by posting clippings from recent newspapers and other publications.

Gather materials for the writing assignment

DURATION TBA

Produced in collaboration with ECOTRACS, Salt Lake City, UT ecotracs@aol.com

SEQUENCE

ENGAGE GREAT SALT LAKE UPDATES

1. Suggest to the students that now that they are all getting to know more and more about Great Salt Lake and how it works, it's time to start keeping better track of what happening there.
2. Introduce the "How Big Is The Lake This Week?" chart to be used in monitoring Great Salt Lake over time. Inform the students of the current surface level of Great Salt Lake and make this information the first entry on the chart.
3. Introduce the Great Salt Lake News Board containing late-breaking news about the Lake or its watershed.
4. Devise a plan with the class for how everyone can help contribute to and maintain the "How Big" and "News Board" displays over the coming weeks or months.
5. Ask students to describe what a "diary" is. Suggest to the students that the "How Big" and "News Board" information will become a sort of classroom "diary" for Great Salt Lake.
6. Inform the students that to help show how much they each now know about the Water Cycle and about the Great Salt Lake watershed, they will be creating their own story called, "Diary of a Drop." In this story they will be describing the adventures of a drop of water.

EXPLORE THE IDEA POOL

1. Suggest to the students that to help them begin thinking about things they might include in their "diary" adventure, they should review some of the things they have learned as a class. To aid in this process, distribute or have them take out their personal Great Salt Lake Scrapbooks and leaf through the latest series of activities from Unit III.
2. Ask students to contribute different pieces of information from each of the five activity themes, beginning with the first. They are:
   a. The Great Salt Lake Watershed
   b. The Salt Lake Basin (volume, surface area and depth)
   c. The size of Great Salt Lake (precipitation, runoff and evaporation)
   d. Lake Bonneville
   e. The Water Cycle

   Discuss ideas from each section that could go into a story.
3. Discuss ways the students can make a story more interesting, such as with skillful writing and the use of pictures or cutouts.

4. Discuss ways the students can keep the story more realistic, such as by describing only things that really happen to water, and by including many different kinds of things that happen over time.

EXPLAIN FINAL PROJECT PREPARATION

1. Discuss and clarify any demonstrated gaps or misconceptions about the water cycle or the Great Salt Lake Watershed.
2. Provide the students with final details regarding the materials, design, and time frame for their diary.

   The following suggestions are provided as a starting point:

   a. Include an illustrated cover page with a title and the author's name.
   b. Include Great Salt Lake and places near their own communities in telling their diary story.
   c. Use the information they have gathered in their Scrapbooks for vocabulary and ideas.
   d. Tell their story in first person, as in a real diary.
   e. Include at lease five different places they go to as a drop, and include a description of how they changed to get from one place to the next.

ELABORATE DIARY OF A DROP

Students create their illustrated stories and insert them into their Great Salt Lake Scrapbooks.

EVALUATE Collect and review Student Great Salt Lake Scrapbooks