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From Lake to Lake

Abstract: This unit will take students on an adventure through the formation of the Great Salt Lake from the time before Lake Bonneville's natural dam broke to the present. Students will learn about habitats and ecosystems during each phase. Students will work to create a time line of changes that occurred in Utah over the last 15,000 + years.

Grade Level: Grade Level: 4th

Integration: Science, Creative Arts, History, and Technology

Utah Core Curriculum Standards:

Standard 4:

- Science Benchmark
Fossils are evidence of living organisms from the past and are usually preserved in sedimentary rocks. A fossil may be an impression left in sediments, the preserved remains of an organism, or a trace mark showing that an organism once existed. Fossils are usually made from the hard parts of an organism because soft parts decay quickly. Fossils provide clues to earth's history. They provide evidence that can be used to make inferences about past environments. Fossils can be compared to one another, to living organisms, and to organisms that lived long ago.
- Students will understand how fossils are formed, where they may be found in Utah, and how they can be used to make inferences.
 - Objective 1: Describe Utah fossils and explain how they were formed.
 1. Identify features of fossils that can be used to compare them to living organisms that are familiar (e.g., shape, size and structure of skeleton, patterns of leaves).
 - Objective 2: Explain how fossils can be used to make inferences about past life, climate, geology, and environments.
 1. Explain why fossils are usually found in sedimentary rock.
 2. Based on the fossils found in various locations, infer how Utah environments have changed over time (e.g., trilobite fossils indicate that Millard County was once covered by a large shallow ocean; dinosaur fossils and coal indicate that Emery and Uintah County were once tropical and swampy).

Science language students should use:	infer, environments, climate, dinosaur, preserved, extinct, extinction, fossil, prehistoric, mineral, organism
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Standard 5:

- Science Benchmark
Utah has diverse plant and animal life that is adapted to and interacts in areas that can be described as wetlands, forests, and deserts. The characteristics of the wetlands, forests, and deserts influence which plants and animals survive best there. Living and nonliving things in these areas are classified based on physical features.
- Students will understand the physical characteristics of Utah's wetlands, forests, and deserts and identify common organisms for each environment.

- Objective 1: Describe the physical characteristics of Utah's wetlands, forests, and deserts.
 1. Compare the physical characteristics (e.g., precipitation, temperature, and surface terrain) of Utah's wetlands, forests, and deserts.
 2. Describe Utah's wetlands (e.g., river, lake, stream, and marsh areas where water is a major feature of the environment) forests (e.g., oak, pine, aspen, juniper areas where trees are a major feature of the environment), and deserts (e.g., areas where the lack of water provided an environment where plants needing little water are a major feature of the environment).
 3. Locate examples of areas that have characteristics of wetlands, forests, or deserts in Utah.
 4. Based upon information gathered, classify areas of Utah that are generally identified as wetlands, forests, or deserts.
 5. Create models of wetlands, forests, and deserts.
- Objective 2: Describe the common plants and animals found in Utah environments and how these organisms have adapted to the environment in which they live.
 1. Identify common plants and animals that inhabit Utah's forests, wetlands, and deserts.
 2. Cite examples of physical features that allow particular plants and animals to live in specific environments (e.g., duck has webbed feet, cactus has waxy coating).
 3. Describe some of the interactions between animals and plants of a given environment (e.g., woodpecker eats insects that live on trees of a forest, brine shrimp of the Great Salt Lake eat algae and birds feed on brine shrimp).
 4. Identify the effect elevation has on types of plants and animals that live in a specific wetland, forest, or desert.
 5. Find examples of endangered Utah plants and animals and describe steps being taken to protect them.

Science language students should use:	wetland, forest, desert, adaptation, deciduous, coniferous, invertebrate, vertebrate, bird, amphibian, reptile, fish, mammal, insect, hibernation, migration
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Vocabulary: infer, environments, climate, dinosaur, preserved, extinct, extinction, fossil, prehistoric, mineral, organism wetland, forest, desert, adaptation, deciduous, coniferous, invertebrate, vertebrate, bird, amphibian, reptile, fish, mammal, insect, hibernation, migration, herbivore, and carnivore

Intended learning outcomes:

- Students will understand how fossils are formed, where they may be found in Utah, and how they can be used to make inferences.
- Students will understand the physical characteristics of Utah's wetlands, forests, and deserts and identify common organisms for each environment.

Background:

There are 6 different time periods and stages that have effected the development of the Great Salt Lake. All information below is from Currey, Donald. et al. (1984). *Major Levels of Great Salt Lake and Lake Bonneville*. Utah Geologic Survey, Map 73.

- **Lake Bonneville: 15,000 years ago (Before the Dam broke)**

Lake Bonneville represents the highest lake level at about 5090 feet. The lake reached this level about 16,000 years ago. The Lake Bonneville stage occurred during an ice age and supported fresh water fish (Bonneville Cutthroat) and a wide variety of now extinct mega-fauna (Prehistoric Bison, giant beavers, etc.). A catastrophic event occurred about 15,000 years ago, in which the natural dam at Red Rock Pass gave way and released massive amounts of floodwater into the Snake River Valley. The lake was lowered by 350 feet as a result of this single event. The lake again stabilized about 14,500 years ago, when the erosion at Red Rock stabilized and the Provo level became established.

- **Provo Lake Bonneville: 14,000 years ago (After the Dam broke)**

The Provo stage of Lake Bonneville occurred from about 13,500-14,500 years ago. The lake level at this time was about 4,470 feet with overflow leaving the lake through Red Rock Pass, Idaho. This outlet flowed out to the Snake and Columbia Rivers and ultimately reached the Pacific Ocean. As the last major ice age came to a culmination, the lake began to decline dramatically. It may have reached levels as low as present day lake levels. The water at this time was primarily fresh water until the ice age subsided and the lake began to recede at which time it became more saline.

- **Gilbert Lake Bonneville: 10,500 years ago (Evolution of the GSL)**

The Gilbert stage of the lake occurred from about 11,000-10,000 years ago. During this time, the lake rose to a level of 4,250 feet and then began to decline. This level marks the culmination of historic Lake Bonneville and the beginning of the Great Salt Lake. This period shows a transition in climate from cooler, high precipitation to slightly warmer with less precipitation.

- **Altithermal Period: 6,000-7,000 years ago (Evolution of the GSL)**

The Altithermal Period occurred from about 6,000 to 7,000 years ago and may have seen complete desiccation (drying up) of the lake. Ancients and dunes and buried mud cracks on the floor of the lake suggest that a warming climatic trend may have evaporated all or close to all of the water content of the lake basin.

- **The Little Ice Age: 1600-1700's (Evolution of the GSL)**

A little ice age occurring about 1,600-1,700 AD suggests that a cooler climate may have resulted in higher lake levels. The lake level at this time may have exceeded another threshold at 4,217 feet in elevation increasing the lake level from 2,800 square miles to 3,700 square miles. The overflow would have filled the floor of the Great Salt Lake Desert located to the west of present Great Salt Lake.

- **Great Salt Lake at the present (Present GSL)**

The Great Salt Lake is a terminal lake located in the easternmost limits of the Great Basin in Northern Utah. The lake level is controlled primarily by climatic factors of evaporation and precipitation. The salt content of the lake varies from 10% to 28%. In 1963, the lake reached an historic low level of 4191 feet as low precipitation and high evaporation rates caused an overall decrease in water input. Water inflow is primarily controlled by stream discharge (66%), direct precipitation (31%) and ground water (3%). The lake reached an historic high level of 4211 feet in

1987. At an elevation of 4,174 feet the lake reaches a threshold at which it overflows and increases the surface area of the lake dramatically.

Materials/Scheduling:

1. Great Salt Lake Video/VCR/TV
2. Computer time in the lab/Library time

Pre-Unit Instructions:

Before starting the Lake Bonneville/Great Salt Lake activities, other instructions may need to be addressed. For example:

- Fossil instructions:
 - Describe Utah fossils and explain how they were formed.
 - Explain how fossils can be used to make inferences about past life, climate, geology, and environments.
- Ecosystem instructions:
 - Describe the common plants and animals found in Utah environments and how these organisms have adapted to the environment in which they live.
- Brief instructions on characteristics of wetlands, deserts, and forests.
 - Describe the physical characteristics of Utah's wetlands, forests, and deserts.

Prior knowledge Assessment:

HOW TO START: View video using a worksheet to ask and answer questions. This will give a brief introduction of the unit to start the students thinking. (20-30 minutes)
 (The video of the Great Salt Lake and Lake Bonneville is available at the Saltair gift shop during the months of April-October at N. West Frontage Road, Magna, UT 84044, 802-250-4388).

Procedures: Teacher’s notes of procedures and activities: (This activity could take up to 2 weeks to get all the information collected and assembled)

Instructions:

1. After viewing and discussing the video, place a sign-up sheet some where in the room (on the board or a bulletin board)

	Utah before Lake Bonneville Dam broke.	Utah after Lake Bonneville Dam broke.	The process from Lake Bonneville to the GSL	The Great Salt Lake at the present.
Time Period (2 people)				
Ecosystem (2 people)				
Physical Characteristics				

(2 people)				
Interesting facts (1 person)				

2. Have students sign-up in the area they are most interested in.
3. Explain to the students what is expected of each person in each group.
 - a. Research information on the topic of choice.
 - i. Some time will be provided in the computer lab and library for research.
 - ii. Some time will need to be spent at home to work on project.
 - b. Work in a group to organize information.
 - i. Some time will be provided in the computer lab and library for research.
 - ii. Some time may need to be spent at home to work on project.
 - c. Create a poster that explains their specific time period.
 - i. Some time will be provided in the computer lab and library for research.
 - ii. Some time may need to be spent at home to work on project.
 - d. Present the information found to the class.

Activity 1: Dividing the unit to research specific topics

- Have students sign-up for their preferred topics. (Instruction 2)
- Explain the expectations of the project (Instruction 3)
- Give students a copy of their topic and subtopic lists for each group from the list below:
 - Utah before Lake Bonneville dam broke
 - Time period:
 - Explain how fossils can be used to make inferences about past life, climate, geology, and environments.
 - Vocabulary terms to know and explain: infer, environments, climate, dinosaur, preserved, extinct, extinction, fossil, prehistoric, mineral, organism
 - Ecosystem:
 - Describe the common plants and animals found and how these organisms have adapted to the environment in which they live.
 - Vocabulary terms to know and explain: invertebrate, vertebrate, bird, amphibian, reptile, fish, mammal, insect, hibernation, migration
 - Physical characteristics:
 - Describe physical characteristics of wetlands, forests, and deserts.
 - Vocabulary terms to know and explain: wetland, forest, desert, adaptation, deciduous, coniferous
 - Interesting facts:
 - Describe 2 interesting facts that you learned while studying this topic.
 - Utah after Lake Bonneville dam broke
 - Time period:
 - Explain how fossils can be used to make inferences about past life, climate, geology, and environments.
 - Vocabulary terms to know and explain: infer, environments, climate, dinosaur, preserved, extinct, extinction, fossil, prehistoric, mineral, organism

- Ecosystem:
 - Describe the common plants and animals found and how these organisms have adapted to the environment in which they live.
 - Vocabulary terms to know and explain: invertebrate, vertebrate, bird, amphibian, reptile, fish, mammal, insect, hibernation, migration
 - Physical characteristics:
 - Describe physical characteristics of wetlands, forests, and deserts.
 - Vocabulary terms to know and explain: wetland, forest, desert, adaptation, deciduous, coniferous
 - Interesting facts:
 - Describe 2 interesting facts that you learned while studying this topic.
 - Create a question about your topic and present it to the class.
 - The evolution of the Great Salt Lake
 - Time period:
 - Explain how fossils can be used to make inferences about past life, climate, geology, and environments.
 - Vocabulary terms to know and explain: infer, environments, climate, dinosaur, preserved, extinct, extinction, fossil, prehistoric, mineral, organism
 - Ecosystem:
 - Describe the common plants and animals found and how these organisms have adapted to the environment in which they live.
 - Vocabulary terms to know and explain: invertebrate, vertebrate, bird, amphibian, reptile, fish, mammal, insect, hibernation, migration
 - Physical characteristics:
 - Describe physical characteristics of wetlands, forests, and deserts.
 - Vocabulary terms to know and explain: wetland, forest, desert, adaptation, deciduous, coniferous
 - Interesting facts:
 - Describe 2 interesting facts that you learned while studying this topic.
 - Great Salt Lake now
 - Time period:
 - Explain how fossils can be used to make inferences about past life, climate, geology, and environments.
 - Vocabulary terms to know and explain: infer, environments, climate, dinosaur, preserved, extinct, extinction, fossil, prehistoric, mineral, organism
 - Ecosystem:
 - Describe the common plants and animals found and how these organisms have adapted to the environment in which they live.
 - Vocabulary terms to know and explain: invertebrate, vertebrate, bird, amphibian, reptile, fish, mammal, insect, hibernation, migration
 - Physical characteristics:
 - Describe physical characteristics of wetlands, forests, and deserts.
 - Vocabulary terms to know and explain: wetland, forest, desert, adaptation, deciduous, coniferous

- Interesting facts:
 - Describe 2 interesting facts that you learned while studying this topic.
 - Create a question about your topic and present it to the class.

Activity 2: Internet exploration (May take 2 or more times in the computer lab and time in the library to complete activity)

- Each group will research their chosen topics and subtopics
- Some resources on the internet:
 - <http://geology.utah.gov/online/PI-39/index.htm> (All Groups)
 - <http://historytogo.utah.gov/lake.html> (Lake Bonneville)
 - <http://historytogo.utah.gov/gsl.html> (Great Salt Lake)
 - <http://svguide.com/s01/s01hagerman.htm> (Fossils)
 - <http://www.usd.edu/~theaton/greatbas.html> (Fossils)
 - <http://ut.water.usgs.gov/greatsaltlake/index.html> (Interesting Facts)
 - <http://raven.umn.edu/units/great.salt.lake/GSLbackground.html> (All Groups)
- For physical characteristics, students may have to refer to textbooks or specific books in the library because those books may have more detailed information about wetlands, deserts, and forests.

Activity 3: Artwork (May take a few days to complete)

- Each group will create a poster to show what Utah may have looked like during their time period using the information they found.

Closure: Presentations (20-30 minutes per group. May take a couple of days)

- Each group will present their poster, place it on the timeline rope along the bulletin board, and explain the characteristics of their time period using the set guidelines.
 - Vocabulary terms significant for each period
 - Time period
 - Ecosystems
 - Physical characteristics
 - 2 Interesting facts

Extensions:

Student could write an essay making predictions of what the Great Salt Lake might look like in 1,000 years from now and create a habitat using all the information researched and presented during the unit. All the essays and habitats will be displayed along with the time line and bulletin board activities. (Give students time in Language arts to work on essay. 1-2 weeks to finish the essay and create their model)

References:

- <http://geology.utah.gov/online/PI-39/index.htm>
- <http://historytogo.utah.gov/lake.html>

<http://historytogo.utah.gov/gsl.html>

<http://svguide.com/s01/s01hagerman.htm>

<http://www.usd.edu/~theaton/greatbas.html>

<http://ut.water.usgs.gov/greatsaltlake/index.html>

<http://raven.umn.edu/units/great.salt.lake/GSLbackground.html>

Additional Resources and Information:

Additional information about Great Salt Lake

FOR GEOLOGICAL, WATER SALINITY/CHEMISTRY, AND GENERAL LAKE INFORMATION: Utah Geological Survey, 1594 W. North Temple, Suite 3410, Salt Lake City, UT, 84114-6100, (801) 537-3326 or (801) 537-3366.

FOR LAKE ELEVATIONS AND HYDROLOGY INFORMATION: U.S. Geological Survey, 2329 West Orton Circle, West Valley City, UT 84119, (801) 908-5000.

FOR RECREATION, BOATING, LAKE-ACCESS, AND SEARCH-AND-RESCUE INFORMATION: Division of Parks and Recreation, 1594 W. North Temple, Suite 116, Salt Lake City, UT 84114-6001, (801) 538-7220.

FOR LEASING AND MINERAL EXTRACTION/ROYALTY INFORMATION IN THE GREAT SALT LAKE: Utah Division of Forestry, Fire and State Lands, 1594 W. North Temple, Suite 3520, Salt Lake City, UT 84114-5703, (801) 538-5555.

FOR WATER RESOURCES AND LAKE-LEVEL CONTROL PROGRAM INFORMATION: Utah Division of Water Resources, 1594 W. North Temple, Suite 310, Salt Lake City, UT 84114-6201, (801) 538-7230.

FOR WATER APPROPRIATIONS, DISTRIBUTIONS, AND ADJUDICATIONS: Utah Division of Water Rights, 1594 W. North Temple, Suite 220, Salt Lake City, UT 84114-6300, (801) 538-7240.

FOR WILDLIFE AND BRINE SHRIMP INFORMATION: Utah Division of Wildlife Resources, 1594 W. North Temple, Suite 2110, Salt Lake City, UT 84114-6301, (801) 538-4700.

FOR CONSTRUCTION IN AND AROUND THE LAKE (401 PERMIT) INFORMATION: U.S. Army Corps of Engineers, 1403 S. 600 W., Woods Cross, UT 84087, (801) 295-8380.

FOR BONNEVILLE SALT FLATS AND FEDERAL LAND-LEASING INFORMATION: U.S. Bureau of Land Management, Salt Lake City District Office, 2370 S. 2300 W., Salt Lake City, UT 84119, (801) 977-4300.

FOR BEAR RIVER MIGRATORY BIRD REFUGE INFORMATION: U.S. Fish and Wildlife, Bear River Migratory Bird Refuge, 866 S. Main, Brigham City, UT 84302, (801) 723-5887.

Other publications on the Great Salt Lake

- *Major Levels of Great Salt Lake and Lake Bonneville* by D.R. Curry, G. Atwood, D. Mabey, 1983.
- *Great Salt Lake; a Scientific, Historical and Economic Overview*, editor: J.W. Gwynn, 1980.
- *The Great Salt Lake, Utah*, by W.L. Stokes, 1984.
- *Geologic Resources of Box Elder County, Utah* by S.N. Eldredge, M.H. Bugden, and C.M. Wilkerson, 1989.
- *Great Salt Lake Information Sheet*, 1990.
- *Geology and Antelope Island State Park, Utah* by H.H. Doelling and others, 1988.
- *Geologic Resources of Box Elder County, Utah* by S.N. Eldredge, M.H. Bugden, and C.M. Wilkerson, 1989.
- *Antelope Island State Park, Davis County, Utah*, 1995.
- *Geologic Map of Antelope Island, Davis County, Utah* by H.H. Doelling and others, 1991.
- *Engineering Geology of the Salt Lake City Metropolitan Area, Utah* by W.R. Lund, 1990.
- *Dissolved-Mineral Inflow to Great Salt Lake and Chemical Characteristics of the Salt Lake Brine, Part I, 1963* by D.C. Hahl and C.G. Mitchell; and *Part II, 1964* by D.C. Hahl and R.H. Langford, 1964.
- *Great Salt Lake, Utah: Chemical and Physical Variations of the Brine, 1963-1966* by D.C. Hahl and A.H. Handy, 1969; 1966-1972 by J.A. Whelan, 1973; 1973 by J.A. Whelan and C.A. Peterson, 1975; 1974-1975 by J.A. Whelan and C.A. Peterson, 1977.
- *Effects of a Causeway on the Chemistry of the Brine in Great Salt Lake, Utah* by R.J. Madison, 1970.
- *Evaluation of Eddy Flux Techniques in Computing Evaporation from the Great Salt Lake*, by D.R. Dickson and A.E. Rickers, 1970.
- *The Effects of Restricted Circulation on the Salt Balance of Great Salt Lake, Utah* by K.M. Waddell and E.L. Bolke, 1973.
- *Hydrogeology of the Bonneville Salt Flats, Utah* by L.J. Turk, 1973.
- *Model for Evaluating the Effects of Dikes on the Water and Salt Balance of Great Salt Lake, Utah* by K.M. Waddell and F.K. Fields, 1977.
- *Effects of Breaching the Southern Pacific Railroad Causeway, Great Salt Lake, Utah - Physical and Chemical*

Changes, August 1, 1984 - July, 1986 by J.W. Gwynn and P.A. Sturm, 1987.

- *Geology and Mineral Resources of Box Elder County, Utah* by H.H. Doelling, 1980.
- *Shallow Ground Water and Related Hazards in Utah* by S. Hecker and K.M. Harty, 1988.
- *Flood Hazards from Lakes and Failures of Dams in Utah* by K.M. Harty and G.E. Christenson, 1988.
- *Glauber's Salt Bed West of Promontory Point, Great Salt Lake* by A.J. Eardley, 1962.
- *Gypsum Dunes and Evaporite History of the Great Salt Lake Desert* by A.J. Eardley, 1962.
- *Clay Mineralogy at the Brine-Sediment Interface in the South Arm of Great Salt Lake, Utah* by L.L. Hedberg and W.T. Parry, 1971.
- *Preliminary Report on Possible Solutions to "Fill Effect" causing Dilution of South Arm Brines and Concentration of North Arm Brines, Great Salt Lake, Utah* by J.A. Whelan and N. Stauffer, 1972.
- *Mineral Occurrences in the Emergency Withdrawal Area and Adjacent Lands in the Great Salt Lake Desert* by J.W. Gwynn and others, 1985.
- *An Approximation of the Physical and Chemical Characteristics of Farmington Bay and Bear River Bay, Great Salt Lake, Utah* by J.W. Gwynn, 1986.