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Great Salt Lake

Abstract: During this lesson students will make an ecosystem that brine shrimp can live in. In groups of 3, students will be bringing in materials to put in their small ecosystem (microcosm) that they think will keep brine shrimp alive. Before bringing in materials, discuss all of the factors that brine shrimp depend on to stay alive. Students will be taking data as to what level of salinity the water is, how cold it is, and other data that these students may think is important. Students will be hypothesizing and predicting the outcomes of their investigations of their microcosm. Students will also write observations that they see and will be drawing pictures of the changes that take place.

Grade Level: 4th grade

Utah State Core Curriculum Standards:

Standard V:

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.

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.

Instructional time : 40-50 minutes

Materials: brine shrimp eggs (site where one can buy eggs blow)
(http://www1.shopping.com/xGS-buy_brine_shrimp~NS-1~linkin_id-3062118)
Glass jars (brought by children, don't pick pickle jars. These definitely would not allow for the growth and hatching of eggs no matter how well they are washed.
Water
Materials that students bring from home for their mini ecosystems
Microscope/magnifying glasses

Terminology:

Brine shrimp-(Artemia)

Salinity- salinity is the amount of salt in a body of water.

Algal- algal is the growth of algae. **Students will be introduced to this terminology by taking a trip to the Great Salt Lake and gathering a sample of algae. We will be looking at it in class under the microscope and we will also be discussing what makes algae.**

Intended Learning Outcomes: Predict how changes in part of an ecosystem affect the system. Make observations. Identify variables and describe relationships between them. Plan controlled experiments. Collect and record data using procedures designed to minimize error. Analyze data and draw warranted inferences. Seek and weigh evidence between drawing conclusions. Report results honestly. Include a full description of negative findings. Construct tables, charts, and diagrams to describe and summarize data. Share results with others.

Background information:

The food chain begins with the brine shrimp (*Artemia*) in the Great Salt Lake ecosystem. Brine shrimp (*Artemia*) and brine flies are a major food source for birds. Brine shrimp make Utah an exuberant amount of money. The brine shrimp industry is a \$25 million dollar industry. Every year millions of pounds of brine shrimp cysts are harvested and sold to pet stores and other industries that can be used as fish food.

In order for brine shrimp to live, there are many factors that must be met. Brine shrimp live in hypersaline lakes in which the salt content may be 25%, predators and competitors are few, and algal production is high. Salinity of the water is of most importance. The life of a brine shrimp starts as a dormant cyst that contains an embryo in a suspended state of metabolism (known as diapause). The cysts are very hardy and may remain viable for many years if kept dry. Water-temperature and salinity changes in Great Salt Lake occur in about February and cause the cysts to rehydrate and open to release the first growth stage, known as a nauplius larva. Although the cysts from Great Salt Lake will hatch at 2 to 3% salinity, in the lake environment there is greater production of cysts at salinities above about 10%. If salinity gets too low, the cysts lose buoyancy and begin to sink. If this is the case, the brine shrimp have difficulty harvesting. Juvenile brine shrimp can last through the winter months of the year, while adult brine shrimp can not withstand the winter's temperatures.

Brine shrimp are a major food source for 250 species of birds in the area. The brine shrimp can produce up to 300 cysts every four days. The eggs are capable of drying out and remaining viable for many years. During their life cycle, the brine shrimp molt fifteen times before reaching adult size.

Prior knowledge assessment/invitation to learn: Sprinkle a few eggs on a white piece of paper. Have students brainstorm a list of what the "brown stuff" could be (this could be done by looking through magnifying glasses or microscopes). Students record their observations that they recognize (size, color etc.). They could also brainstorm what kinds of animals could come out of these eggs.

Use this information to guide instruction by explaining what these things actually are. Talk about the brine shrimp that come from the little eggs and look at them under magnifying glasses to get a better idea of what they look like.

Procedures:

1. After students write their observations down on paper, tell them what the eggs are.
2. If you feel that the students do not understand, you may want to brainstorm the list of animals that can be hatched from these eggs here in class.

3. Discuss the possible ways that eggs can be hatched and the possible conditions for hatching.
4. Have students make hypotheses as to what conditions they think will be ideal for hatching.
5. Investigate salt- have students look at salt under a microscope or magnifying glass.
6. Have a list of instructions ready for the students to follow when setting up their ecosystems.
7. Salinity level- **4 teaspoons of salt to 250 ml. = 10% salinity level**
8. You may want to read instructions as a class. This will help be clearer about what is expected of them.
9. Explain to the students that these brine shrimp eggs will hatch in various salinity levels. Encourage students to explore the differences in salinity levels.
10. At this point it is a good idea to discuss the concept of evaporation. Warn students of the risk of killing the brine shrimp eggs if the concentration of the salt gets too high. Tell them it is a good idea to refill on a regular basis.
11. After filling up the ecosystem with water, have students mark the glass with a marker so that as water evaporates, the water level can be replaced to the exact level.
12. Add a pinch of eggs to each jar.
13. Make observations (at first will float but then will eventually begin to sink). Keep jars in a warm area.
14. Observation will go on after the first day.
15. On the recording sheet include things such as when they hatch, what they look like, did the ecosystem change etc.
16. Watch ecosystems for 2-5 days. After experiment is over, students are allowed to take the ecosystems home for further observations.
17. Ask, **“Were you successful in the growth of the brine shrimp? In not, why do you think so? If you were, why do you think so?”** Students can compare with classmates and see what worked and what didn’t work.
18. Have students write what they would do differently next time.

Adaptations and Modifications for Special Learning Needs:

For students with special needs, the writing part may be replaced with drawings of observations. Students will be able to work as partnerships if they feel more comfortable in completing the experiment. Predictions and observations may also be verbalized.

Assessment:

Ask students why their ecosystems worked and hatched the eggs of the brine shrimp, or in some cases, why did they not hatch the eggs of the brine shrimp. Write in their journals the things that they learned as well as one thing that they still do not understand. The teacher may choose to either assess both the journals as well as the observation sheets, or they may choose to pick one of them to assess in depth. Another form of assessment is the rubric that is attached.

Observations / Inquiries

1. State your hypothesis (prediction) of what is going to happen.
2. What materials did you bring that are going to be used in the ecosystem?
3. Make some observations as to what is happening to the ecosystem. What does it look like, smell like etc. Draw a picture of observations.
4. **Conclusions**- what happened in the end?
5. Did you have any problems carrying out this experiment? What would you change next time? What would you keep the same?

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Bibliography

1. <http://www.usoe.k12.ut.us/curr/science/core/plans/bio/shrimp.html>

This web site has a core experiment on it that deals with different concentrations of saline and how the different levels of saline will affect the brine shrimp eggs hatching. This is a junior high- high school level site.

2. <http://teachers.net/lessons/posts/659.html>

This web site also has an experiment on it that deals with growing brine shrimp. It goes into a lot of depth with recording observations, investigating, exploring salinity levels etc. This is at the elementary level.

3. <http://hmsc.oregonstate.edu/odfw/devfish/sp/brine.html>

This site states the life of the brine shrimp. It talks about the ecology of the shrimp as well. It mentions populations as well as harvesting of the eggs.

Various sites visited

www.acclaimimages.com

www.treearth.com

www.worldisround.com

www.aliendave.com

www.xmission.com

www.scenicutah.com

www.wildlife.utah.gov

www.visitsaltlake.com

www.goechange.er.usgs.gov

www.utah.stateparks.gov

www.ugs.state.ut.us/

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Unit Overview: Great Salt Lake
Lesson Plan 2 – Buoyancy

Grade: 4th Grade

Instructional Time: Day 1: 10 minutes
Day 2: 90 minutes

Abstract: In this unit, students will become familiar with some of the properties of Great Salt Lake water and its unique ecosystem. In Lesson 1, students will journey through the life cycle of the brine shrimp, understanding the physical conditions that must be present in order for the organism to grow, reproduce, and survive. In Lesson 2, students will mimic the saline content of the lake's water by conducting hands-on experimentation with common household items, discovering the difference in the density of water, how it affects buoyancy and why this is important to bird migration and the brine shrimp industry.

Terminology:

- Buoyancy – The tendency or capacity to remain afloat in a liquid or rise in air or gas.
- Crustacean – Any mainly aquatic arthropod, including lobsters, shrimp, crabs, and barnacles.
- Density – The mass of a substance per unit volume.
- Dilute - To make thinner or less concentrated by adding a liquid such as water.
- Dissolve - To reduce (solid matter) to liquid form; melt.
- Dormant - In a condition of biological rest or inactivity.
- Hypothesis - A tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation.
- Industry – A specific branch of manufacture and trade.
- Observation - The act or faculty of observing.
- Salinity - Of, relating to, or containing salt; salty.

Utah State Core Curriculum Standards:

Science:

Standard V, Objective 1b: Describe Utah's wetlands where water is a major feature of the environment.

Standard V, Objective 2b: Cite examples of physical features that allow particular animals to live in specific environments.

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.

Intended Learning Outcomes:

- Make simple predictions and inferences based upon observations
- Conduct a simple investigation when given directions
- Use observations to construct a reasonable explanation
- Demonstrate a sense of curiosity about nature
- Record data accurately when given the appropriate form and format (e.g., table, graph, chart)
- Use scientific language appropriate to grade level in oral and written communication

Background Information:

Great Salt Lake is considered one of the natural wonders of the world. Geologic evidence suggests that it is a remnant of the ancient lake, Lake Bonneville, an enormous fresh-water sea that existed thousands of years ago. The lake is fed by several fresh-water streams, but it has no outlet. This means that the water does not drain out of the lake. Instead, it evaporates, or dries up, leaving tons of salt deposit behind. Because of this, Great Salt Lake is from four to seven times as salty as the ocean.

Due to its high salt content, fish can not live in Great Salt Lake. A small **crustacean** species called brine shrimp, however, thrives in the waters of Great Salt Lake. The life cycle of the brine shrimp begins from a **dormant** cyst. In February, when the water temperature and the amount of salt in the lake changes, the cysts rehydrate and begin their growth stage. Fishermen harvest both the brine shrimp cysts and the adults to process for fish food.

The brine shrimp **industry** makes millions of dollars every year. The water **density** of the lake is very important for the harvesting of the brine shrimp cysts. In order for the fisherman to gather up the cysts, they have to be floating near the top of the water. This ability to float is known as **buoyancy**. If the **salinity** level of the lake drops too low, the cysts will float to the bottom of the lake and the fisherman will not be able to harvest them.

Officials of the brine shrimp cyst industry are not the only ones concerned about the buoyancy of the brine shrimp cysts. Great Salt Lake and its islands are the breeding grounds for thousands of

migrating birds, such as ducks, geese, gulls, pelicans, and many other species. Most of the birds feed on the adult brine shrimp, but a few, like the Eared Grebe and the Northern Shoveler, feed on the brine shrimp cysts, as well.

If salt is **dissolved** in water, the density, or weight, of the water will increase. This occurs because the density of salt is greater than the density of water. The greater the water density, the greater buoyancy objects in the water will have.

Many years ago, before refrigerators were available, pork and other meats were preserved in a strong salt solution, called brine. To make the brine, large amounts of salt were mixed into water. To assure the brine contained the proper amount of salt, grandmother, or another cook, would drop a raw egg into the solution. If the egg floated to the top, the solution was just right for the meat.

Resources:

- <http://ut.water.usgs.gov/shrimp/>
- http://www.utah.com/stateparks/great_salt_lake.htm
- The World Book Encyclopedia, Volume 8. G.
- bbq.about.com/cs/barbecuetips/a/aa112000b.htm
- hmsc.oregonstate.edu/odfw/devfish/sp/brine.html

Day 1: Pass out vocabulary words and definitions with the Word Search puzzle. Have students complete the puzzle for homework and return the next day.

Day 2: Give a short quiz on the vocabulary terms. Students will turn in quiz for grading.

Invitation to Learn:

- **Observe** the live brine shrimp from Lesson 1, using a magnifying glass or microscope.
- Determine what stage of development they are in.
- Determine if there are any cysts that haven't hatched yet.

Assess Prior Knowledge:

- Ask students if they like to swim.
- Ask where they usually swim.
- Ask if anyone has ever gone swimming in Great Salt Lake.
- Ask what it means to float.
- Demonstrate a beach ball (preferably with a globe design) floating on a tub of water.

- Ask why the beach ball doesn't sink (encourage them to discuss difference in weight between beach ball and water).
- Discuss the info listed above, especially the importance of buoyancy and the process of making the proper brine solution.

Materials:

- 2 wide mouth pint jars or other glass containers per group
- Masking tape
- Waterproof marker
- Scale
- 2 Raw eggs per group
- Large serving spoon or salad tongs
- Salt
- Measuring cups
- Water
- "Sink or Float" worksheet per group
- Pen/pencil or marker
- Word Search Puzzle
- Magnifying glass/Microscope

Preparation:

- Arrange students in groups of 2-4, depending on class size.
- Tell students that we are going to conduct an experiment to determine if salt affects buoyancy.
- Give each group 2 jars or containers and a "Sink or Float" worksheet.
- Have students place a piece of masking tape on each jar or container.
- Label 1 jar "fresh water" and 1 jar "salt water".
- Add 1 ½ cups of water to each jar.
- Weigh each jar separately and record data on worksheet (weight should be approximately the same for each jar).
- Inform students that they are going to keep fresh water in one of the jars but they are going to add salt in small increments (1/4 cup at a time) to the other jar. Then they are going to add 1 egg to each jar.
- Have students work together as a group to form a **hypothesis** of what will happen to the eggs that they put into each jar. Why? Record hypothesis on worksheet.

Procedure:

- Instruct students to add ¼ cup of salt to jar labeled "salt water". Stir to dissolve.
- Have students use the spoon or tongs to lower 1 egg into the "fresh water" jar and 1 into the "salt water" jar. Record the results.
- If there is no difference between the 2 jars, have the students continue adding salt in ¼ cup increments to the "salt water" jar until a change is observed. Record the results after each addition.

- Observe students until all groups have recorded a change in the “salt water” jar.
- Instruct students to remove the eggs from both jars.
- Reweigh the jars and record the results. Ask why the results are different.
- As a group, have the students record a conclusion to the experiment on their worksheet.

Conclusion:

- Reconvene as a class.
- Ask students to discuss their hypothesis and why or why it wasn’t supported.
- Ask why the egg floated in “salt water” but not “fresh water”.
- Ask how this is related to Great Salt Lake.

Experiment Adaptations:

- If students complete their worksheet early, have them experiment with other objects of differing weights. Make note of the results.

Assessment:

- Students will be introduced to new vocabulary through a worksheet and puzzle. Students will be given a quiz to verify understanding of vocabulary words.
- During class discussion of the “Background Information”, students will identify characteristics of water in Great Salt Lake and which organisms can survive there.
- Students will hypothesize, observe, experiment, and record data.
- Students will understand the importance of industry and nature in relation to Great Salt Lake.

Accommodations for Special Needs:

- Students will work in groups to assist with any fine motor skill limitations.
- The experiment can be conducted in a large open area to accommodate any physical handicap assistance devices.
- Interpreters will be available for needed language assistance.

Additional Resources:

- http://www.educationworld.com/a_lesson/04/lp337-02.shtml
- <http://www.umfa.utah.edu/index.php?id=MjMw>

Sink or Float Worksheet

	Fresh Water Jar (Control)	Salt Water Jar
Weight at Beginning		
Hypothesis		
Notes during experiment		
Weight at End		
Conclusion		

What did you learn?

Rubric:

Lab Experiment on Buoyancy

Student Name: _____

CATEGORY	4	3	2	1
Experimental Hypothesis	Hypothesized relationship between the variables and the predicted results is clear and reasonable based on what has been studied.	Hypothesized relationship between the variables and the predicted results is reasonable based on general knowledge and observations.	Hypothesized relationship between the variables and the predicted results has been stated, but appears to be based on flawed logic.	No hypothesis has been stated.
Scientific Concepts	Report illustrates an accurate and thorough understanding of scientific concepts underlying the lab.	Report illustrates an accurate understanding of most scientific concepts underlying the lab.	Report illustrates a limited understanding of scientific concepts underlying the lab.	Report illustrates inaccurate understanding of scientific concepts underlying the lab.
Participation	Used time well in lab and focused attention on the experiment.	Used time pretty well. Stayed focused on the experiment most of the time.	Did the lab but did not appear very interested. Focus was lost on several occasions.	Participation was minimal OR student was hostile about participating.
Experimental Design	Experimental design is a well-constructed test of the stated hypothesis.	Experimental design is adequate to test the hypothesis, but leaves some unanswered questions.	Experimental design is relevant to the hypothesis, but is not a complete test.	Experimental design is not relevant to the hypothesis.
Summary	Summary describes the skills learned, the information learned and some future applications to real life situations.	Summary describes the information learned and a possible application to a real life situation.	Summary describes the information learned.	No summary is written.

Buoyancy

The 10 words listed on the terminology page were placed into the puzzle.

Find each word horizontally, vertically, or diagonally. Circle each word.

N Y L O W H V R Y Y C D P D S T Y X Q Z
T T R P S X K O H T Z B I G R T U V O D
L Y C T Z W G T P I O V O L I Y O Z W Y
E V L O S S I D V N L U M S U S W T H P
L J L D Y U S X I I X Q N H D T Y I Y F
S H K X Q O D U Q L G E W T E N E O N R
R F G O D A P N B A D R Q H Z L C U S D
P Q E T W U A U I S P R O Y R F J G I E
U D P U B C O G R J A Q X P C U R E I G
A Z Q L J Y R M P M U Y M O I A I L K H
G S R G A A J U Y F F Y G T N A R S G L
T Q H N G X J L S G A R V H K B M Z R M
A I C T X W Q O M T F N H E N T J R N J
Q Y R O R Z E O E C A G J S D O H L L W
O B S E R V A T I O N C R I M Y Z S O S
D O R M A N T X K E X O E S D D P X B W
D J X Y J M D T Q T G R L A X I E W B Y
M X O D F D T U M W H G C D N H C E G E
G V L K F D Y T W O B P Z H Q R Q E W U
G O B D J T C Q K I Q N R B Y G V X V R

TERMINOLOGY

BUOYANCY - The tendency or capacity to remain afloat in a liquid or rise in air or gas.

CRUSTACEAN - Any mainly aquatic arthropod, including lobsters, shrimp, crabs, and barnacles

DENSITY - The mass of a substance per unit volume.

DILUTE - To make thinner or less concentrated by adding a liquid such as water.

DISSOLVE - To reduce (solid matter) to liquid form; melt.

DORMANT - In a condition of biological rest or inactivity.

HYPOTHESIS - A tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation.

INDUSTRY - A specific branch of manufacture and trade.

OBSERVATION - The act or faculty of observing.

SALINITY - Of, relating to, or containing salt; salty.

Resources:

- <http://www.puzzlemaker.com>
- www.answers.com/topic/buoyancy
- www.dictionary.com