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An Introduction to Brine Shrimp

Abstract:
During the lesson students will have the opportunity to discover what brine shrimp are and what environmental surroundings they will be found in. Through an inquiry based free exploration period and class discussions the children will discover some basic components of brine shrimp, their cysts, and their habitat. The students will discover that brine shrimp are not completely predictable animals and gain a sense of the delicacy and complexity of a living organism and the rather narrow range of conditions under which it can live.

Grade Level: 2nd

Utah Elementary Core Curriculum Standards:
Standard 3020-01: Students will compare changes and adaptations of plants and animals.

3020-0103: Observe and describe how plants and animals change during their lives.
- Compare and contrast the life cycles of different animals.

In class instructional time: 30 minutes

Terminology:
Brine Shrimp: any fairy shrimp of the genus *Artemia*, found only in hyper saline environments.
Cysts: dormant brine shrimp babies.
Habitat: Place where an organism lives and reproduces.

Intended Learning Outcomes:
- Students will gain a very basic understanding of brine shrimp.
- Students will be able to identify a brine shrimp cyst and a brine shrimp.
- Students will identify characteristics of the brine shrimp habitat.

Background:
The brine shrimp (*Artemia salina*) are very important organisms in the Great Salt Lake ecosystem. What makes them so important? Without them, all of the birds that use the Great Salt Lake as a stop along their migratory path would be unable to obtain the nourishment required for their long and strenuous trip. Some prominent birds that use the Great Salt Lake are the Eared Grebe and Wilson's Phalarope. The brine shrimp have many other significant roles in the Great Salt Lake besides being food for the birds. They assist in the clean up of the lake by ridding the waters of contaminants such as phosphorous, nitrogen and other household waste products. These small organisms have

a complex life cycle and are one of the few organisms that can survive in the very salty waters of the Great Salt Lake. In fact, they would not be able to survive in fresh water. Their cysts hatch best in about one to six percent salinity and brine shrimp can survive in conditions as high as twenty-five percent salinity.

Brine shrimp are quite prolific in Great Salt Lake. They survive by eating the various microscopic organisms (algae and bacteria) that live in the lake. Brine shrimp are always in constant motion because they are filter feeders and use their appendages to funnel nutrients towards their mouths. They generally consume a species of green algae called *Dunaliella*. This variety of algae is preferred because they are small, single celled and have a soft exterior, which makes them easier to consume for the newly hatched shrimp. When there is too little or too much salt in the lake, the *Dunaliella* become scarce and the brine shrimp must eat the larger cells of the *diatoms*, golden brown algae, instead. These are not the preferred food source due to their rigid cell wall of silica which makes them much more difficult to consume and digest, except for the older and larger brine shrimp. The green and golden brown algae are too large for juvenile brine shrimp to ingest, so they have found yet another food source, bacteria.

Brine shrimp cysts can be totally desiccated and over the winter remain in a dormant state. These cysts float to the surface and form red brown streaks that cover an enormous area of the lake during the fall and winter. They will stay like that until the lake has warmed sufficiently during the spring and they will hatch once again.

The brine shrimp have a simple life cycle that is very well suited for the environment that they live in. They are one of the few multi-cellular organisms that have flourished in the Great Salt Lake. The baby brine shrimp hatch in the spring from the dormant cysts. However, towards the end of fall, males are required to produce over wintering cysts. The production of cysts requires sexual reproduction, which means that males need to contribute sperm to the egg. This special adaptation allows the brine shrimp to flourish in the Great Salt Lake and maintains genetic variability.
(Refer to reference 1 & 2)

Materials:
One microscope per four or five students
One slide per microscope of an adult brine shrimp &/or a juvenile brine shrimp
Several brine shrimp cysts (about ½ teaspoon) per group to view under microscope
Magnifying glass (if desired)
Paper towels for clean up

Prior Knowledge Assessment:
Assess students' prior knowledge by having a group discussion on the life cycle of living organisms, focusing first on the types of things that the students need in order to survive. Next, focus on the brine shrimp, their life cycle and habitat by having an open group discussion. Introduce the microscope and review the proper use, asking questions as you go.

Instructional Procedures:

1. Sprinkle a few brine shrimp cysts on white paper. Have the students brainstorm a list of what the "brown stuff" might be. (Use either the microscope or the magnifying glass.)

2. Have the students record observations of the brine shrimp cysts (size, color, shape, etc) on the attached observation sheet.

3. After the children have had a chance to investigate the cysts, tell them what they are. At this time you could make a class list of possible animals that would hatch from cysts and the possible ways they hatch. You could also talk about how the brine shrimp carry their eggs and how they are dry up and remain dormant for the colder months.

4. Have the students look at the brine shrimp cysts, and a juvenile or adult brine shrimp slide through a microscope.

5. Have the students draw a picture of the things they saw in each microscope. At this time, also encourage the students to be thinking of any questions they have about the cysts and/or brine shrimp.

6. Talk about their observations and questions.

7. Have an open class discussion about brine shrimp and their habitat. You may also wish to watch a video on brine shrimp or read books about them to reinforce the subject matter even more.

Assessment Strategies

Self assessment and Brine Shrimp observation sheet

The criteria could include:

Self-assessment- effort, participation, observations

Brine Shrimp observation sheet- completeness, evidence of thought put into the assignments as noted by clear and understandable observation pictures, neatness

Name_____

My Observations

Using the space below draw your observations of the brine shrimp cysts and slides. Be sure to include things such as shape, size and color.

1. Cysts
2. Juvenile Brine Shrimp
3. Adult Brine Shrimp

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Salinity and Brine Shrimp Part Two: A Salinity Level Experiment

Abstract:
Following the introductory lesson and observational experiments, students will have the opportunity to further explore the delicacy of the brine shrimp's habitat. In groups of four, students will create various models of brine shrimp habitats that will allow them to explore more in depth the effects that various salinity levels have on the brine shrimp's hatching and survival.

Grade Level: 2nd

Utah Elementary Core Curriculum Standards:
Standard 3020-01: Students will compare changes and adaptations of plants and animals.

3020-0103: Observe and describe how plants and animals change during their lives.
- Compare and contrast the life cycles of different plants.

In class instructional time: 30 minutes

Terminology:
Brine Shrimp: any fairy shrimp of the genus *Artemia*, found only in hyper saline environments.
Cysts: dormant brine shrimp babies.
Habitat: Place where an organism lives and reproduces.
Salinity: A saline (salt) solution

Intended Learning Outcomes:
- Students will recognize some effects of habitat change on an organism.
- Students will be able to understand the effects of different levels of salinity on brine shrimp.
- Students will reflect upon their prediction of the effects of altering the habitat of the brine shrimp.

Background:
Brine shrimp are interesting and very adaptive to varied environment conditions. Scientists say they can survive in both cold (38 degrees) and hot (106 degrees) water temperatures. The brine shrimp in Great Salt Lake must tolerate the changing salinity levels (from 7% to 25%), which are influenced/regulated by the results of high or low water year levels which occur naturally with the weather conditions.

Ideal conditions are:
Water temperature 80 degrees F
Salinity level 12%
They eat green algae which grows in the lake naturally.

The brine shrimp life cycle is dependent on the naturally occurring and varied environment conditions. They can reach adulthood in as little as 21 days and begin the reproduction cycle, producing cysts. Adults may survive and reproduce for several months. The salinity level in the south arm of the lake changes with the amounts of water received during the spring run off from the mountain snow pack of the year. If Utah receives unusual amounts of heavy snow in the winter, the run-off from the snowmelt will drop the salinity level to around 7%. If it is a drought year with little or no snow pack, the salinity levels will become higher, 12% or more. If the environment conditions are ideal, as stated above, the eggs will begin to hatch within 18-24 hours.

When winter approaches, and the weather temperature drops the lake water temperature to 45 degrees or below, the adults begin to produce cysts rapidly, laying in a natural reserve for the next spring hatches. Then, as the water temperature drops to freezing, the adults die off and the eggs float in the lake waiting for the warmer temperatures of spring to begin the life cycle again.
(Refer to reference 3)

Materials: (Per one group of four students)
½ tsp sodium chloride mixed with one cup (250 ml) distilled H2O (creates a 1% salinity level)
1¾ tsp sodium chloride mixed with one cup (250 ml) distilled H2O (creates a 5% salinity level)
3½ tsp sodium chloride mixed with one cup (250 ml) distilled H2O (creates a 10% salinity level)
7 tsp sodium chloride mixed with one cup (250 ml) distilled H2O (creates a 20% salinity level)
Approximately one flat toothpick covered amount of algae or yeast per salinity mixture for feeding
Four one-quart size Ziploc freezer bags
Four medium size plastic cups
Approximately 1/12-teaspoon brine shrimp cysts
**Brine shrimp cysts can be purchased online from the following locations:*
http://www.brineshrimpdirect.com
http://www.pondsolutions.com/brineshrimp.htm

Instructional Procedures:

1. Review the information on Brine Shrimp, including definitions of cysts, brine shrimp, and brine shrimp habitat. Talk about what salinity is focusing particularly on the salinity levels of water and the hatching of their cysts.

2. Set up the hatcheries (see the above mixtures under materials). Each student in the group of four should have a bag with a level of salinity different from those of his/her peers in the group.
3. Add a pinch of cysts to each bag. Sprinkle the cysts on top of the salt water. Over the next several days, observe the changes. Keep the hatcheries in a warm location; the water should remain at around 75 to 80 degrees Fahrenheit.
4. During our discussion of brine shrimp and their habitat ask students to share some of the lakes/rivers/ocean they have been to. As the students name the various bodies of water ask them if they saw any brine shrimp in the water. Discuss the lack of or the abundance of salt in the various bodies of water to help students to better understand the amount of salt needed for brine shrimp.
5. Using the prediction chart on the following page, have the students predict what they think will happen to the brine shrimp in the different levels of salinity.
6. Watch carefully. In 3-5 days there should be small shrimp swimming. They might be a bit difficult to see but those in the habitats with the right components will grow.
7. Feeding the brine shrimp is not necessary if tiny green threads or spots start to grow in the baggies (algae). If your containers receive enough light the algae should grow. If no algae are growing, you can add powdered yeast or dried algae (available at health food stores) to the hatcheries 72 hours after constructing them (approximately one toothpick end). Be careful, though, too much may kill the shrimp and alter the results of your experiment. A general rule is to feed no more than disappears and leaves the water fairly clear in two days. One or two weekly feedings is enough.
8. Two days after setting up the hatcheries, you will begin to record experimental results. Using a pipette, stir the water and place the pipette in the center. Gather one milliliter of water from one of the hatcheries and put it on a tray for observing under a microscope.
9. Count the number of both the living and dead brine shrimp in the one-milliliter of water. Multiply this number by 250 (the number of milliliters in one cup) to get an averaged total for the number of brine shrimp in that specific hatchery. Record your data. (You can do one record for the dead and one for the living, or combine them, it is up to you.) Attached is a sample chart that you may use if you wish.
10. Repeat steps six and seven for the other three salinity levels.
11. Each group of four should chart the number of brine shrimp for each salinity level. You may do this in several different ways, just be sure that the way your class chooses to use will allow you to find an average.
12. After about seven to ten days, you may want to conclude your experiment. Find an average for the numbers of brine shrimp in each salinity level.
13. As a class discuss the results. Students should now be able to conclude that organisms' habitat conditions play a critical role. They should also be able to recognize the life cycle of brine shrimp. (Although this is not directly investigated, the students should notice the different phases of the cycles. As a class, you may want to discuss this.) Talk about how their microorganisms differed from those in Great Salt Lake ecosystem.

Assessment Strategies:
Group assessment and completion of the prediction chart.
The criteria could include:
Group assessment- Effort; Participation, observations and cooperation
Prediction chart- Completeness, evidence of thought put into the assignment as noted by quality and ability to follow directions.

Resources:
1. http://people.wcslc.edu/faculty/t-harris/gslfood/index.html

2. http://people.wcslc.edu/faculty/t-harris/index.html

3. http://www.ali-artemia.com/noframes/env.htm

Name _____

Brine Shrimp Experiment

	Day 1	Day 2	Day 3	Day 4	Day 5
1% Salinity					
5% Salinity					
10% Salinity					
20% Salinity					