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Fall 2002

## **Part I: Brine Shrimp Life Cycle**

**Abstract:** Students will have an opportunity to learn about the life cycle of a brine shrimp and relate it to their own life cycles. Students will create diagrams of their life cycle as well as the life cycle of a brine shrimp. Students will then compare and contrast brine shrimp life cycles and their own.

**Grade Level:** 2<sup>nd</sup> Grade

**Utah Elementary Core Curriculum Standards:**

Standard 1 – Students will compare changes and adaptations of plants and animals

- Objective 3 – Observe and describe how plants and animals change during their lives.

**In-Class Instructional Time:** 2 hours

**Terminology:**

- Life Cycle – A progression through a series of differing stages of development. This lesson focuses on the progression from the stages of birth through death.
- Brine Shrimp (*Artemia salina*) – A phyllopod crustacean of the genus *Artemia*, inhabiting the strong brines of natural salt lakes; small crustaceans related to shrimp and crabs that live in very salty (or hypersaline) lakes.
- Cysts – A small capsule-like sac that encloses certain organisms in their dormant or larval stage. Introduce this term as the students are constructing a diagram of the life cycle of brine shrimp.
- Nauplii - The free-swimming first stage of the brine shrimp, after it has hatched. Introduce this term as the students are constructing a diagram of the life cycle of brine shrimp.
- Ecosystem – A system formed by the interaction of a community of organisms with their physical environment. Introduce this term to the students at the end of the lesson as they discuss the relevance of this lesson.

**Objectives:**

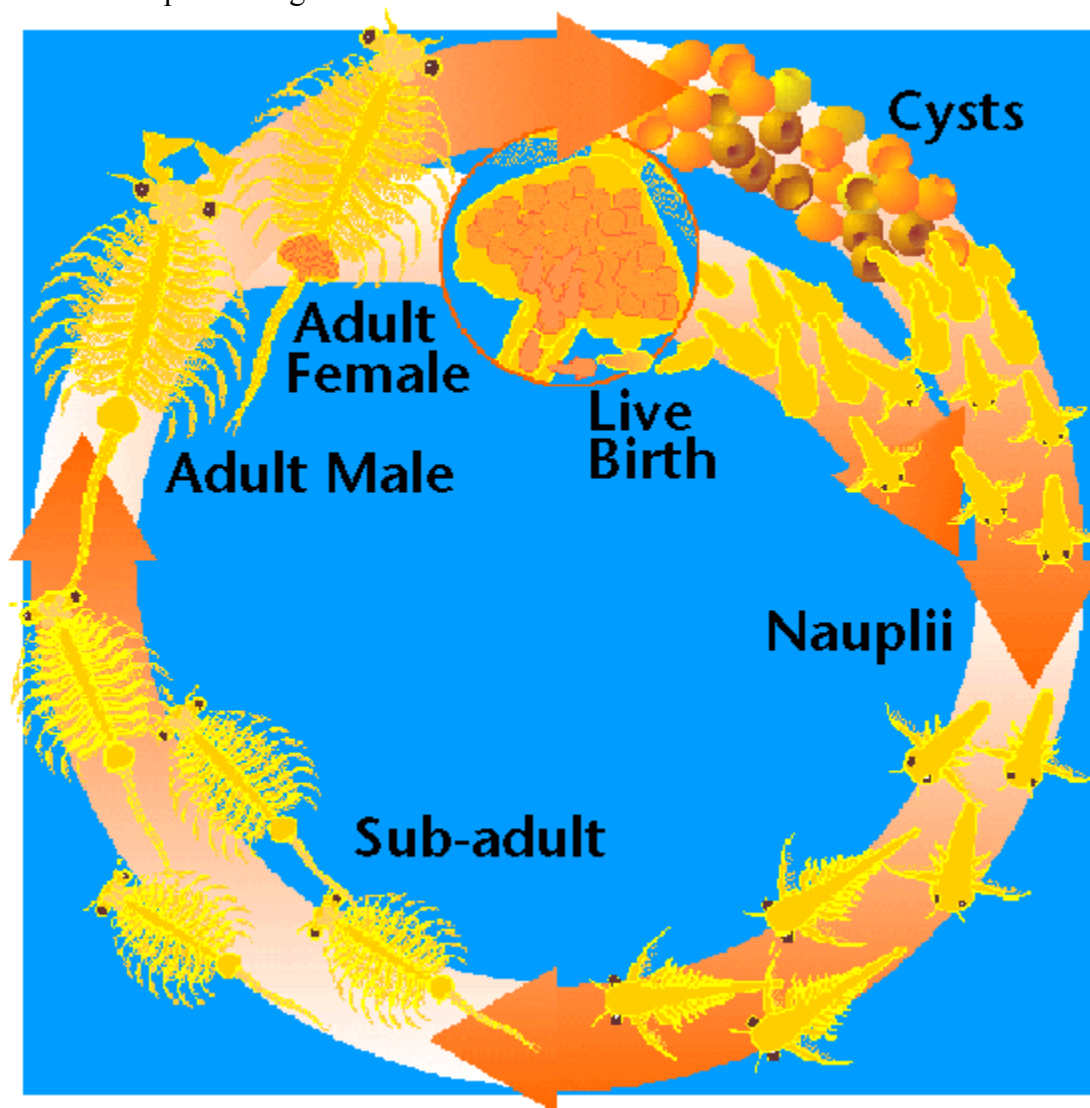
- Students will be able to identify the different stages of a brine shrimp's life cycle.
- Students will be able to identify the different stages of their life cycle.
- Students will be able to compare and contrast the differences between their life cycles and the life cycles of brine shrimp.

**Background:** “Brine shrimp, measuring only 10 millimeters in length at adulthood, start their lives as tiny eggs, or cysts. The cysts are so small that 50 could easily fit on the head of a pin. Baby brine shrimp, called nauplii, will molt about 11 times before reaching adulthood. In the Great Salt Lake, cysts first hatch in late February and early March. During the warm months, brine shrimp grow and reproduce, consuming algae, cyanobacteria and diatoms. When food is abundant and water conditions good, the eggs will hatch not long after emerging from the adult female. Late in the season, as food becomes scarce and temperatures begin to drop, the females produce hard-walled cysts that will stay dormant until the following spring. A female's typical lifespan is about 3 months. During this time, she could produce as many as 4 cysts per day. Due

to seasonal temperature extremes and food availability, only 2 to 3 generations of brine shrimp are produced in the lake each year. The brine shrimp population begins to decline in the fall, and by December, most are dead from cold temperatures and lack of food. Cysts produced by females late in the season float on the lake, often as large reddish-brown streaks. These eggs will produce a new generation of brine shrimp the following spring.” (Quote taken from “Brine Shrimp in the Great Salt Lake” by Shireen Gonzaga; October 1999; found at: <http://www.earthsky.com/Features/Articles/brine-shrimp1.html>)

Brine shrimp hatch in the early spring and most die by December. Brine shrimp begin their life cycle as tiny eggs (cysts). When brine shrimp hatch they are known as Nauplii (see definition above). They continue through the sub adult stage to the adult male stage. Adult male brine shrimp then transform into adult female brine shrimp. Adult female brine shrimp give birth to live brine shrimp in cysts. The brine shrimp remain dormant within these cysts until ideal hatching conditions. At which time they hatch and the cycle is started again.

This information, specifically when the brine shrimp hatch and what temperatures are ideal for hatching, will be the basis for the following lesson in this unit, “Ideal Water Temperature for Brine Shrimp Hatching.”



Picture found at:

<http://people.westminstercollege.edu/faculty/tharrison/gslfood/studentpages/brine.html>

**Materials:**

- Blank, white pieces of paper (enough for each student)
- Pictures of humans in different stages of their life cycles
- Crayons, colored pencils, markers, pencils
- Poster board (enough for each group of four students to have a piece)
- Computers for students to research websites about brine shrimp life cycles. The students can search the internet or use the following websites to assist them:  
<http://www.earthsky.com/Features/Articles/brine-shrimp1.html> (contains information about the life cycle of brine shrimp); <http://www.msj.edu/davisr/bio115/brinesch.htm> (contains pictures of brine shrimp at the different stages in their life cycles); <http://people.westminstercollege.edu/faculty/tharrison/gslfood/studentpages/brine.html> (contains information about how brine shrimp reproduce and a picture of their life cycle).

**Prior Knowledge:** Have the students complete a KWL chart (chart is included with lesson).

This will help determine what the students already know about the Great Salt Lake, life cycles, and brine shrimp; what questions/ what they want to learn about the Great Salt Lake, life cycles, and brine shrimp; and what they learn as they progress in the activity.

**Activity:**

Introduce the unit by having the students fill out a KWL chart (chart is included with lesson).

Discuss with the students what they know about life cycles. As a class, define the term “life cycle.” Discuss the life cycle of humans, specifically what the students think about their own life cycle. Show students pictures of people at different stages in their lives and have them put the pictures in the correct order. Discuss the fact that all living organisms have a life cycle with different stages and that all organisms will eventually die at the end of their life cycles. Have the students draw a picture of their life cycle.

Separate the students into groups of four. Have the students research the life cycles of brine shrimp on the Internet and use the poster board to draw a picture of and label the stages of the life cycle of brine shrimp. The materials section of this lesson plan lists a couple of good websites the students can use as references when researching brine shrimp.

**Closure:** Discuss with the students, as a class, the differences and similarities between their life cycles and the life cycles of brine shrimp. Have the students record their reflections and what they learned on the KWL chart that was used for the initial assessment (chart is included with lesson). Ask the students why it is important to understand the life cycle of brine shrimp.

Explain the concept of an ecosystem. Discuss with the students the fact that the Great Salt Lake is an ecosystem that they live near. Explain that understanding a portion of the Great Salt Lake ecosystem, namely brine shrimp, allows them to have a better understanding of their role within the ecosystem (the lesson titled “The Brine Shrimp Industry” will allow the students to understand the importance of brine shrimp in our world).

**Assessment:** Have the students turn-in the pictures of their life cycles and assess their comprehension of this topic. Monitor the groups as they research the brine shrimp life cycle and draw the life cycle, to ensure that all students are putting an equal amount of work into the project and understanding the concepts. Hang the completed projects on the walls of the classroom. Listen to the students’ discussion of the differences and similarities between their life cycles and the life cycles of brine shrimp to check for understanding. Collect the KWL charts and assess the students’ reflections and recordings of what they learned.

## References

- <http://www.dictionary.com/>
- <http://www.earthsky.com/Features/Articles/brine-shrimp1.html>
- <http://www.msj.edu/davisr/bio115/brinesch.htm>
- <http://people.westminstercollege.edu/faculty/tharrison/gslfood/studentpages/brine.html>

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### **Ideal Water Temperature for Brine Shrimp Hatching**

**Abstract:** Students will explore how various water temperatures affect brine shrimp hatching. By using the scientific method, students will hypothesize set-up, conduct, and gather research on their experiments to determine the ideal water temperature for brine shrimp hatching.

**Grade Level:** 2<sup>nd</sup> Grade

**Utah Core Curriculum Standards:**

Standard 1 – Students will compare changes and adaptations of plants and animals.

- Objective 3 – Observe and describe how plants and animals change during their lives.

**In-class Instructional Time:** 1 hour (for set-up); approximately five (5) days to conduct experiment

**Terminology:**

- Cyst: A small capsule-like sac that encloses certain organisms in their dormant or larval stage.
- Microcosm: A small, representative system having analogies to a larger system in constitution, configuration, or development.
- Oolitic sand: Sand that is formed from the feces of the brine shrimp.

**Intended Learning Outcomes:**

- Students will create hypotheses about which water temperature is ideal for hatching brine shrimp.
- Students will learn how to set-up experiments and gather data from them.
- Students will use critical thinking skills to draw conclusions from their collected data.

**Background:** “The life cycle of brine shrimp begins from 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. Depending on the water temperature, the larvae remain in this stage for about 12 hours, subsisting on yolk reserves before molting to the second nauplius stage, which feeds on small algal cells and detritus using hair-like structures on the antennae known as setae” (<http://www.dutslc.wr.usgs.gov/shrimp/index.html>). Students should become familiar with the months in which cysts hatch in the Great Salt Lake. They should make connections with the water temperatures during these months and hatching (as this is the basis of the following experiment).

**Materials:**

- 3 transparent jars (8-9 oz. each) for each pair of students
- Plastic wrap (1 box)
- Rubber bands (200)
- Toothpicks (one box)
- 1 candle warmer for each student
- Refrigerator
- Magnifying glasses (1 per student)

- Ziploc baggies (3 for each pair of students)
- Dry, dormant brine shrimp cysts (0.063 grams—or approx. 3 flat toothpicks full-- per pair of students)
- Salt (3 tsp. per pair of students)
- Measuring spoons (teaspoon)
- Thermometers (1 per pair of students)
- Natural oolitic sand from the Great Salt Lake (3 tsp. per pair of students)
- Algae (for food for the shrimp—to keep them alive after hatching).
- Recording chart
- Marker

**Prior Knowledge Assessment:** In groups of 4, have students complete a KWL (attached) regarding brine shrimp cysts and hatching. Each group should write at least one statement under each of the headings (What I know, What I want to know). Have each group share with the class one item on each of the parts of their KWL.

**Procedure:** Portions of the procedure taken from “Brine Shrimp Microcosm Observation Experiment” developed by Westminster College of Salt Lake City Biology Department—Paige Walker (student) and Dr. Ty Harrison).

To begin this experiment, review or introduce the term “cyst”, which is listed in the terminology portion of this lesson. Next, students should write in their journals. They should observe cysts with a magnifying lens and draw what they see. Discuss what the students found out about cysts from visiting the web sites in the previous lesson. Engage students by asking them to answer the following questions:

- Where are cysts found?
- When do cysts hatch? During what months? During which season(s)?
- Why do you think they hatch during this time?
- Is the water temperature important in cyst hatching? Why or why not?
- How could we find out if water temperature is important in cyst hatching?

Students will be able to answer these questions using their prior knowledge, and by recalling information that they acquired during the previous lesson (Part I: Brine Shrimp Life Cycle).

Explain that today the class is going to conduct an experiment to find out which water temperature supports the most brine shrimp cyst hatching—room temperature water, hot water, or cold water.

Next, students should predict which water temperature will support the largest number of cysts (room temp., hot, or cold). Each student writes down their predictions in their journal.

**Microcosm set-up:** Introduce the terms “microcosm” and “oolitic sand”. Have students pair up. Each pair of students creates nine (9) Ziploc baggies “that each contain approximately 1 tsp. of natural oolitic sand from the bed of the Great Salt Lake, 10 grams of salt (1 tsp.), and 0.021 grams (approximately a flat toothpick full) of dry, dormant brine shrimp cysts” (which can be purchased at [www.brineshrimpdirect.com](http://www.brineshrimpdirect.com)) (Brine Shrimp Microcosm and Observation Experiment developed by Westminster College of Salt Lake City Biology Department

Paige Walker (student) & Dr. Ty Harrison). “The contents of the bag can be carefully examined under the microscope or with a hand lens to verify and identify the shape, color, and size of the dry mixture components” (Brine Shrimp Microcosm and Observation Experiment developed by Westminster College of Salt Lake City Biology Department Paige Walker (student) & Dr. Ty Harrison).

**Hatching:** “To begin the observation experiment, each group adds 250 ml (one cup) of pure spring water (room temperature) or de-chlorinated tap water to each baggie. Close each baggie and agitate to dissolve the salt. Place each microcosm in an 8-9 oz. transparent jar to allow support of the microcosm and observation through the wall of the cup” (Brine Shrimp Microcosm and Observation Experiment developed by Westminster College of Salt Lake City Biology Department Paige Walker (student) & Dr. Ty Harrison). Cut a portion of plastic wrap large enough to cover the top of each jar (to act as a lid), secure with a rubber band, and then poke a few small holes in the plastic. Next, so that the jars don’t get mixed up, each pair of students labels three (3) jars “cold”, three (3) jars “room”, and three (3) jars “hot”. Before placing the jars in/on their heat sources, each pair of students should take the beginning temp. of the water and record it on their charts. Next, each pair of students places each jar with its corresponding heat source (the 3 “cold” jars go in the refrigerator, the 3 “room” jars stay in a room temp. area, and the 3 “hot” jars go on 3 candle warmers). “Hatching should occur within the first 24-36 hrs. of hydration. Aeration and agitation are important. Taking the microcosms on walks around your house or classroom for about 15seconds once a day while gently agitating and circulating the water is a must. This movement will help the baby shrimp detach from the cyst and begin swimming” (Brine Shrimp Microcosm and Observation Experiment developed by Westminster College of Salt Lake City Biology Department Paige Walker (student) & Dr. Ty Harrison). Each pair of students should visually estimate how many cysts have hatched each day by looking at each jar one time per day and recording their observations in their journals. Students should use words like “a few”, “many”, “a lot”, “a couple”, etc. to record their observations. Finally, students should take the temperature of the water each day and record this in their journals.

**Closure:** Allow each pair of students to discuss their findings and draw diagrams related to their results in their journals. Next, have 2 pairs of students come together to form groups. Each group should compare results and draw conclusions from their data. Ask the groups to answer the following questions:

- In which water temperature did the most cysts hatch (room temp., hot or cold)?
- Were your predictions correct?
- Why or why not?
- Do your results support what you know about during what season brine shrimp hatch? (Review during what seasons brine shrimp cysts hatch (February- early March) , and discuss what the temperature of the water may be during these seasons)

Next, groups should refer back to the KWL and complete the “What I learned” portion. The students can simply write down two (2) things that they learned from conducting this experiment, or they can answer all of the above questions on their KWL if time permits.

Finally, each group should share their results with the class.

At the very end of the lesson, introduce the concept of harvesting brine shrimp cysts. Briefly review the concept of cysts remaining dormant during cold seasons and only hatching when many factors exist (such as proper water temperature, etc.). The concept of harvesting brine shrimp cysts will be the basis for the final lesson in this mini-unit.

**Assessment Strategies:** Teacher should assess the following areas:

- Partner/group/class participation
  - \*Each student should play an active role in setting up, gathering data, and drawing conclusions.
  - \*Each student should play an active role in discussion with their partner, group and class.
- Students' journals (hypotheses, recording of data, and conclusions)
  - \*Each student should record a prediction in his or her journal.
  - \*Each student should take record data in the journal daily.
  - \*Each student should take turns in each of the following areas (daily):
    - Agitating baggies
  - \*Each student drew their own conclusions
    - Taking temperature of water

### References:

- <http://www.dutslc.wr.usgs.gov/shrimp/index.html>
- **Brine Shrimp Microcosm and Observation Experiment developed by Westminster College of Salt Lake City Biology Department  
Paige Walker (student) & Dr. Ty Harrison**
- <http://www.dictionary.com>

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### **Part III: The Brine Shrimp Industry**

**Abstract:** Students will have an opportunity to learn about the brine shrimp industry in the Great Salt Lake. Students will discuss how it is important to our community. Students will then create a poster about everything they have learned about brine shrimp to help increase the sale of brine shrimp for pets.

**Grade Level:** 2<sup>nd</sup> Grade

**Utah Elementary Core Curriculum Standards:**

Science Standard 1 – Students will compare changes and adaptations of plants and animals

- Objective 3 – Observe and describe how plants and animals change during their lives.

Social Studies Standard 4-Students will identify goods and services, where they come from, and how to get them.

- Objective 2-Identify the sources of goods and services in the community

**In-Class Instructional Time:** 1 hour

**Terminology:**

- Brine Shrimp (*Artemia salina*) – A phyllopod crustacean of the genus Artemia, inhabiting the strong brines of natural salt lakes; small crustaceans related to shrimp and crabs that live in very salty (or hypersaline) lakes.
- Cysts – A small capsule-like sac that encloses certain organisms in their dormant or larval stage.
- Nauplii - The free-swimming first stage of the brine shrimp, after it has hatched.
- Salinity- The amount of salt in the water.
- Industry-A specific branch of manufacture and trade.

Terminology would be reviewed and introduced during the KWL.

**Objectives:**

- Students will be able to identify the different stages of a brine shrimp's life cycle.
- Students will be able to create a visual display of what they have learned from the unit on brine shrimp.
- Students will be able to identify what the brine shrimp industry means to Utah and what influences its success.

**Background:**

**Brine Shrimp Industry:**

- Brine shrimp usual rake in \$10 million per year

- Business depends on the conditions of the GSL especially salinity of the water
- Brine shrimp industry is often competing with the salt industry because they have different needs

“These little cysts have become big business, worth tens of millions of dollars each year. Harvesting brine shrimp cysts is a major commercial activity at the Great Salt Lake. There has been an increasing market demand for the cysts, especially in the past decade, for use in the aquaculture industry. This is because newly-hatched nauplii are a nutritious food for young fish. If kept dry, the cysts have a shelf life of several years, making it a convenient and easy-to-use product. Competition for locating large floating mats of cysts is intense. Harvesters routinely use hi-tech means to locate cyst windfalls, such as planes, fast boats, radar, global positioning system receivers, and night vision cameras. A small percentage of the harvest is also used in the aquarium hobbyist trade as food for pet fish. And anyone who has reared Sea Monkeys as a child is well-acquainted with brine shrimp. After each year's harvest, environmentalists wonder if enough cysts will be left over for a new generation of brine shrimp the following year. The brine shrimp population is determined by various environmental factors that change each year, such as salinity, water circulation, water temperature, dissolved nutrients, and algal abundance.”

From [www.earthsky.com/Features/Articles/brine-shrimp2.html](http://www.earthsky.com/Features/Articles/brine-shrimp2.html)

#### **Materials:**

- Crayons, colored pencils, markers, pencils
- Poster size paper-enough for each student
- Task card describing the students job

**Prior Knowledge:** This is the culmination activity for the brine shrimp unit. To assess prior knowledge and what the students have learned thus far, teacher should have students list everything they have learned about brine shrimp. This includes life cycle, hatching, how to care for, and anything else they may have discovered during the unit. This list will help them to do the activity. The KWL will also consist of what they know about the brine shrimp industry what they would like to learn, and after the lesson; what they have learned.

#### **Activity:**

- Discuss the Brine shrimp industry and what it means to Utah's economy.
- Discuss the variables that affect the success of each year's harvest. Ask students many questions to get them thinking about what they have already learned about what brine shrimp need to reproduce and survive.
  1. What are some things that brine shrimp need to survive?
  2. What are the best conditions for them to hatch in?
  3. How does the Great Salt Lake provide for the brine shrimp?
- Have students think about how the harvesters find the cysts, ask them to make predictions about methods before continuing the discussion.
- Read the task card to students. They will each have their own as well.
- Students use their knowledge about brine shrimp to create a poster that will help increase the sell of brine shrimp for pets. They should include information about their life cycles,

how to care for them, what they need to survive, as well as observations they have made during the unit.

**Closure:** Students show their posters to their table. Class assembles for a group discussion. Each student shares the most interesting thing he/she learned during this unit.

**Assessment:** Have the students turn-in the posters. This should be a great resource for assess what the students have learned throughout the unit. Use the rubric below to assess the posters. During discussion keep an informal record of those students who participated.

#### References

- <http://www.dictionary.com/>
- <http://www.earthsky.com/Features/Articles/brine-shrimp2.html>
- <http://www.brineshrimpdirect.com/brineshrimpnews.htm>
- <http://166.70.46.216/specials/gsl/stories/monies.htm>
- <http://ut.water.usgs.gov/shrimp/>
- <http://people.westminstercollege.edu/faculty/tharrison/gslfood/studentpages/brine.html>

#### Task Card

## Group Project

You have been hired by the brine shrimp industry to help increase the sell of brine shrimp as pets. Make a poster that shows everything you have learned about brine shrimp. Use pictures and words to show what you have learned. You should include information about the life cycles, how to care for them, what they need to survive, as well as observations you have made during the unit.

Rubric:

Poster Includes:

Students name:	Information about the life cycle.	Information on caring for brine shrimp.	Information regarding what they need to survive.	Some personal observation made during the unit.
Check the ones that apply. Give set points for each component.				

KWL Chart (enlarge and put on a poster)

What we <b>Know</b> :
What we <b>Want</b> to know:
What we <b>Learned</b> :

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**What I Know**

**What I Want to Know**

**What I Learned**