What Environmental Conditions Lead to the Hatching of Brine Shrimp?
A Lesson on Environmental Habitats

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Dubois, IN

Lesson #12

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Note: The activities that follow are DRAFT activities and have not yet been peer reviewed for content accuracy or pedagogy. The lesson plans and opinions in this report are those of the authors and do not necessarily reflect the opinions of any of the supporting institutions or the editors.
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References

Alignment and references to state science education standards as of 2010 are cited by the authors.
## What Environmental Conditions Lead to the Hatching of Brine Shrimp?

**A Lesson on Environmental Habitats**

### Purpose

The purpose of this investigation is to determine the best environmental conditions for the hatching and growth of brine shrimp. This fits into the Life Science portion of the curriculum that deals with environmental habitats.

### Objectives

Upon completion of this activity, students will be able to:

- determine the factors needed in an environment for brine shrimp to survive.
- design an investigation to test how environmental conditions affect the hatching of brine shrimp eggs.
- determine the environment that allows for the most brine shrimp to hatch and grow to maturity.
- create a presentation to explain the best environment for the hatching and growth of brine shrimp.

### Grade Level

This lab is intended for 5th and 6th grade students.

### Prior Knowledge

- Students should be familiar with the needs of multi-cellular and unicellular organisms.
- They should also be aware that different organisms require different environmental conditions to survive.
- Students should be proficient in liquid measure.

### Time Required

This lesson should take 5—8 class periods of 45 minutes depending on extensions chosen by teacher and students.

### Including All Students

- The tactile modality is addressed by setting up the hands-on experiments with the brine shrimp.
- The visual modality is addressed in the viewing of the video and in observing the brine shrimp environments.
- The auditory modality is addressed through listening to all that is explained in the movie and as the teacher gives oral directions.
- The written modality is addressed by writing lab reports and recording data on the brine shrimp environments.
- An analogy could be developed to compare the needs of brine shrimp with any organism in any environment to meet the needs of a culturally diverse student population such as: brine shrimp are to salt water as pigeons are to city parks.
- Grouping students in cooperative groups can improve the understanding for many students needing accommodations for physical or learning issues. Team members offer assistance to special needs students, particularly learning disabled or physically challenged, by working individually with them. If a physically challenged student is unable to pour water in a cup for the brine shrimp, a team member can do that task and the physically challenged student can observe. Team members can help a learning disabled student fill out their lab report and record data.

### Questions to Ask Along the Way

- After viewing the video about Mono Lake, what type of experiment could you set up to find the best environment for brine shrimp?
- Looking at the data from your experiments, what other environmental factors could affect the life cycle of the brine shrimp? Why do you think so?
- If brine shrimp lived in an Arctic region, how would that effect their life cycle? Why do you think so?
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QUESTIONS TO ASK ALONG THE WAY

- Are there any current world environmental problems that could effect the life cycle of brine shrimp? What evidence do you have to back this up?
- Compare what you have learned about the environmental problems of brine shrimp to another organism and its environmental issues.
- What other materials could be added to the water to see if the brine shrimp eggs would hatch? Why did you choose these materials?

NATIONAL SCIENCE EDUCATION STANDARDS

K-12 Unifying Concepts and Processes
- Evidence, models, and explanation
- Change, constancy, and measurement
- Evolution and equilibrium

Grades 5-8
Science as Inquiry
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Life Science
- Structure and function in living things
- Regulation and behavior
- Population and ecosystems
- Diversity and adaptations of organisms

Science and Technology:
- Understanding about science and technology

Science in Personal and Social Perspectives
- Science and technology in society

INDIANA STATE SCIENCE EDUCATION STANDARDS

Grade 5
The Nature of Science and Technology
5.1 Students work collaboratively to carry out investigations. They observe and make accurate measurements, increase their use of tools and instruments, record data in journals, and communicate results through chart, graph, written, and verbal forms. Students repeat investigations, explain inconsistencies, and design projects.
5.1.5 Explain that technology extends the ability of people to make positive and/or negative changes in the world.
5.1.6 Explain how the solution to one problem, such as the use of pesticides in agriculture or the use of dumps for waste disposal, may create other problems.

The Living Environment
5.4 Students learn about an increasing variety of organisms – familiar, exotic, fossil, and microscopic. They use appropriate tools in identifying similarities and differences among these organisms. Students explore how organisms satisfy their needs in their environments.
5.4.2 Observe and describe that some living things consist of a single cell that needs food, water, air, a way to dispose of waste, and an environment in which to live.
5.4.4 Explain that in any particular environment, some kinds of plants and animals survive well, some do not survive as well, and some cannot survive at all.
5.4.5 Explain how changes in an organism's habitat are sometimes beneficial and sometimes harmful.
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MATERIALS

Materials needed for a group of 3-4 students:

- plastic cups with lids
- labels for cups
- Kosher salt
- table salt, non-iodized
- Epsom salt
- baking soda
- borax
- laundry detergent
- vegetable oil
- vinegar
- newly purchased brine shrimp eggs
- 1 mL spoon
- 1 5 mL spoon
- craft stick for stirring
- 1 qt. container
- 100 mL beaker
- tape
- hand lens

SAFETY

- Follow the use and care of animals in the classroom guidelines from the National Academy of Sciences. Proper disposal of brine shrimp must be followed.

PREPARATION AND PROCEDURE

I. Introducing Mono Lake

A. Students begin with a KWL chart to assess prior knowledge. Ask them to write what they already know about brine shrimp and their environment in the K column, and what they would like to know in the W column.

B. Use a large sheet of chart paper and record the students’ answers in the K column. Discuss similarities and differences of the items recorded. Also use the chart to dispel any misconceptions presented on the chart. Hang the chart in the classroom during the unit.

C. Record the answers from the W column on chart paper. Hang this chart to remind students to find the answers to their questions while doing research. Show students the Mono Lake video and discuss, as a class, what issues effect the brine shrimp’s survival in Mono Lake. The video can be found at www.openroad.tv/video.php?vid=30.

D. After showing the video, students should fill in the L column of the K-W-L chart with anything they have learned.

II. Background Research

A. Research

1. Materials: Computers, Internet Treasure Hunt worksheet (Student Section), Fossweb pdf about Mono Lake (address listed in Step C.)
2. Time: 45 minutes

B. Give each team an Internet Treasure Hunt worksheet and computer access and have them complete the worksheet.

C. Let students know the Mono Lake booklets are available for additional research. A PDF can be downloaded at www.fossweb.com/popecoweb/ecoscenario/pdfs/Ecoscenario_MonoLake.pdf.

D. Students should record new knowledge gained from research in the L column of their KWL sheet. The new knowledge should be used to guide the development of the group’s hypothesis and experiment in their lab report.
III. Student Practice Lab #1
   A. This lab is adapted from the second website used in the Internet Treasure Hunt. Before beginning the lab, discuss Lab Safety Procedures and ABC Rules for Animal Care. A copy of the Animal Care rules can be found in the student section. The Safety Rules can be found at [www.middleschoolscience.com/notebook.htm](http://www.middleschoolscience.com/notebook.htm). Divide students into groups of 3 or 4. Each student should be given a job responsibility such as Materials Manager, Reporter, Lab Manager, and Timer.
   B. Give students the lab report worksheet in the student section containing the following:
   C. Question: Is the formula of Mono Lake Water a good hatching environment for brine shrimp?
   D. Hypothesis: Mono Lake water is/is not a good hatching environment for brine shrimp. Circle your choice, is/is not, for your hypothesis.
   E. Materials: 2.5 tbs. table salt, not iodized (chloride), 4.5 tbs. baking soda (carbonate), 2 tsp. Epsom salt (sulfate), pinch of borax, pinch of laundry detergent
   F. Procedure:
      1. Label 2 transparent plastic cups, one distilled water and the other Mono Lake water.
      2. Measure and pour one qt. of distilled water into a pitcher.
      3. Add 2.5 tbs. table salt, 4.5 tbs. baking soda, 2 tsp. Epsom salt, a pinch of borax, and a pinch of laundry detergent to make Mono Lake water.
      4. Stir all ingredients until dissolved.
      5. Pour 1 cup distilled water into the cup labeled distilled water and pour 1 cup of the Mono Lake water into the cup labeled Mono Lake water.
      6. Add one mL of brine shrimp eggs to each container. Gently swirl to moisten the eggs.
      7. Place cups in a secure location.
      8. Check cups daily for 5 days and record the number hatching each day on a data table.
      9. After checking the 5th day’s results, write a conclusion that includes: the purpose of the lab, comparison of hypothesis to data, and summary of data findings.

IV. Inquiry Lab Preparation
   A. Students should be reminded of safety rules and animal care rules.
   B. Students should be divided in groups of 3 or 4. Each student should be given a job responsibility such as Materials Manager, Reporter, Lab Manager, and Timer.
   C. Materials—All materials listed above in the Materials Section should be made available for students. Additional materials such as vinegar and vegetable oil (pollution), ice (cold environment), hot or warm water, and shallow and deep containers could be added. These should be gathered before class.
   D. Time: 45 minutes needed for the Lab Preparation Section.
   E. Review data and conclusions from first experiment. Discuss possible environments that could be tested for brine shrimp hatching. Brainstorm hypotheses, using the same question from the first experiment, as a
class and record them on the chalkboard or large paper. This should take about 45 minutes of class time.

E. Each group should choose a hypothesis to investigate. This should be written in their lab report, and checked by the teacher. Students can copy the format from the worksheet used in Lab 1.

F. They should then choose the materials they will use in their investigation and make a list in their lab report worksheet. The materials list should then be checked by the teacher.

G. Each group should outline the procedure, draw data tables for the investigation, and have it checked by the teacher.

V. Inquiry Lab
   A. Materials—Materials Manager should gather the needed materials from their lab report sheet.
   B. Time—45 minutes to set up the lab according to the students’ procedure.
   C. Students should set up the lab according to the procedures they designed in the Lab Preparation section.
   D. Once the lab is set up, students should monitor and record data every day. Hatching should occur on the 3rd or 4th day.
   E. Once hatching has occurred, students should explain the results and draw conclusions. They should also finish completing the K-W-L worksheet.
   F. Students should write a reflection paragraph in their science notebooks. They should answer the questions:
      1. What have I learned about the needs of brine shrimp?
      2. Are there other questions I have about the environmental conditions of brine shrimp?
      3. What other investigations could I do concerning brine shrimp?
   G. Each team will share their individual reflection paragraphs with the other members of their team. They will then create a poster or PowerPoint slide containing their Hypothesis, Procedure, Data, and Conclusion. The posters or slides should also include additional questions the team has that could extend their research.
   H. The teams will present their poster or slide to the rest of the class. A rubric for grading the presentations is included in the Student Section.

Teacher Note: Students can design any environment for the hatching of the brine shrimp eggs. Included in the materials list are several kinds of salt that can be used. Letting students design the investigation adds the element of inquiry.

WHERE TO GO FROM HERE
- Suggest that students investigate other environmental factors such as temperature, global warming, and amount of rainfall.
- Students could also investigate food chains at Mono Lake.
- Students could begin an aquarium with all the brine shrimp hatchlings and do a life expectancy study.
- Students could study the predator/prey relationships at Mono Lake.
- Students could also study the geological history of the Mono Lake area.
- Students could also test the effects of pollution on brine shrimp by using vinegar (acid rain) or vegetable oil (oil spill).
- For more advanced students, there is a Webquest on brine shrimp at http://serc.carleton.edu/microbelife/topics/monolake/index.html.
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SUGGESTIONS FOR ASSESSMENT

- K-W-L worksheet
- Internet Treasure Hunt worksheet
- Lab report worksheet

*The preceding items to be assessed can be graded using the dichotomous key included in the student section.*
- Presentation slide of brine shrimp investigation rubric.

REFERENCES AND RESOURCES

1. Source for equipment or supplies: Delta Education, P.O. Box 3000, Nashua, NH 03061-3000, 1-800-442-5444, [http://www.deltaeducation.com](http://www.deltaeducation.com)
   Source for FOSS Kit, Environments, Brine Shrimp Hatching

2. *The Brine Shrimp Project*

3. Life at the Limits: Earth, Mars, and Beyond Mono Lake ecosystems

4. *Mono Lake Lives!*
   Information about Mono Lake that includes the video used in introducing the investigation on Mono Lake. Accessed on August 29, 2010.

5. *Mono Lake*
   PDF produced by fossweb.com to complement the FOSS Environments kit. This is the PDF mentioned in the introducing section. Accessed on August 29, 2010.

6. *Mono Lake*

7. Microbial Life Educational Resources Mono Lake
   [http://serc.carleton.edu/microbelife/topics/monolake/index.html](http://serc.carleton.edu/microbelife/topics/monolake/index.html)

8. Teach-nology
   [http://www.teach-nology.com/cgi-bin/presentation.cgi](http://www.teach-nology.com/cgi-bin/presentation.cgi)


10. *Middle School Science*
## GROUP PRESENTATION RUBRIC

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization</strong></td>
<td></td>
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</tr>
<tr>
<td>Audience cannot understand presentation because there is no sequence of information.</td>
<td></td>
<td></td>
<td>Student presents information in logical sequence which audience can follow.</td>
<td>Student presents information in logical, interesting sequence which allows audience to follow.</td>
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<tr>
<td><strong>Content Knowledge</strong></td>
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<tr>
<td>Student does not have grasp of information; student cannot answer questions about subject.</td>
<td>Student is uncomfortable with information and is able to answer only rudimentary questions.</td>
<td>Student is at ease with content, but fails to elaborate.</td>
<td>Student demonstrates full knowledge (more than required) with explanations and elaboration.</td>
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<tr>
<td><strong>Visuals</strong></td>
<td></td>
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<tr>
<td>Student used no visuals.</td>
<td>Student occasional used visuals that rarely support text and presentation.</td>
<td>Visuals related to text and presentation.</td>
<td>Student used visuals to reinforce screen text and presentation.</td>
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<tr>
<td><strong>Mechanics</strong></td>
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<tr>
<td>Student's presentation had four or more spelling errors and/or grammatical errors.</td>
<td>Presentation had three misspellings and/or grammatical errors.</td>
<td>Presentation has no more than two misspellings and/or grammatical errors.</td>
<td>Presentation has no misspellings or grammatical errors.</td>
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<tr>
<td><strong>Delivery</strong></td>
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<tr>
<td>Student mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear.</td>
<td>Student incorrectly pronounces terms. Audience members have difficulty hearing presentation</td>
<td>Student’s voice is clear. Student pronounces most words correctly.</td>
<td>Student used a clear voice and correct, precise pronunciation of terms.</td>
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</table>

**Teacher Comments:**

Powered by TeAch-nology.com - The Web Portal For Educators! (www.teach-nology.com)
Brine Shrimp Lab 1

**Question:** Is the formula of Mono Lake Water a good hatching environment for brine shrimp?

**Hypothesis:** Mono Lake water is / is not a good hatching environment for brine shrimp. Circle your choice [is/is not] for your hypothesis.

**Materials:** 2.5 tbs. table salt, not iodized (chloride), 4.5 tbs. baking soda (carbonate), 2 tsp. Epsom salt (sulfate), pinch of borax, pinch of laundry detergent

**Procedure:**
1. Label 2 transparent plastic cups, one distilled water and the other Mono Lake water.
2. Measure and pour one qt. of distilled water into a pitcher.
3. Add 2.5 tbs. table salt, 4.5 tbs. baking soda, 2 tsp. Epsom salt, a pinch of borax, and a pinch of laundry detergent to make Mono Lake water.
4. Stir all ingredients until dissolved.
5. Pour 1 cup distilled water into the cup labeled distilled water and pour 1 cup of the Mono Lake water into the cup labeled Mono Lake water.
6. Add one mL of brine shrimp eggs to each container. Gently swirl to moisten the eggs.
7. Place cups in a secure location.
8. Check cups daily for 5 days and record the number hatching each day on a data table.
9. After checking the 5th day’s results, write a conclusion that includes: the purpose of the lab, comparison of hypothesis to data, and summary of data findings.

**Data:** Number of brine shrimp hatched

<table>
<thead>
<tr>
<th>Water</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
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</thead>
<tbody>
<tr>
<td>Mono Lake</td>
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<td>Distilled</td>
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**Conclusion:**
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Internet Treasure Hunt

Name: ______________________ Date: _______

This web info search will help you find information about brine shrimp and their environment. You will be looking at pre-selected web sites to answer each question. It is important to not only find the information at the site, but also to consider who wrote the site, what their purpose is in writing it, and how credible (accurate) you think the information is.

<table>
<thead>
<tr>
<th>Question 1: What are the conditions that brine shrimp need to survive?</th>
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<tbody>
<tr>
<td><strong>Site 1</strong></td>
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<td>Website Title</td>
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<tr>
<td>Who created this web site (organization, etc.)?</td>
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<td>Why did they create it? (check all that apply)</td>
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<td>How credible (accurate) do you think the info is?</td>
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<td>What did you learn?</td>
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### Topic of Discussion:
Environment and Brine Shrimp

<table>
<thead>
<tr>
<th>What I <strong>Know</strong> about this topic/question</th>
<th>What I <strong>Want</strong> to know about this topic/question</th>
<th>What I <strong>Learned</strong> about this topic/question</th>
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USE OF ANIMALS
IN THE CLASSROOM

ABC Rule:     Appropriate
             Beneficial
             Caring

National Academy of Sciences
Guidelines Summary

1. Observational/non-intrusive studies preferred.
2. Supervision by someone who knows.
3. Appropriate care...every day.
4. Healthy animals...veterinary care.
5. Report all injuries & illnesses.
6. Have a plan for getting them AND disposing of them.
7. Student experimentation has rules & limits.
8. Chick embryo experiments have additional rules.
9. No aversive stimuli in behavioral studies.
10. Plans should be in writing and should be approved BEFORE experimentation.

I, __________________________, have read and agree to follow these ten guidelines
(printed student full name)

set forth by the National Academy of Sciences for the use of animals in the classroom.

_________________________________     ________________________
Student Signature                     Date