

Tayrn Cox  
Melissa Trujillo  
Ashley Page  
Spring 2002

### **Effects of Acid Rain**

Abstract:

This lesson will explore the concept of acid rain and its effects on ecosystems.

Grade Level: 3<sup>rd</sup> grade

Utah Core Curriculum Standards:

Standard 3030-02: Students will analyze the influence of people in ecosystems.

Objective 3030-0201

- Predict a possible future for this ecosystem and explain the prediction.

In class instructional time: 40-60 minutes

Terminology:

- Acid Rain: Acid rain is defined as any form of wet precipitation that has a pH less than 5.6 (on a scale of 0 to 14, with 7 being neutral). The "rain" becomes acidic when water molecules (H<sub>2</sub>O) react with gases in the air.
- Air Pollution: Defining air pollution specifically, proves as demanding as the general definition of pollution. Very simply, atmospheric pollution can be defined as any gaseous or particulate matter in the air that is not a normal constituent of air or is not normally present in such high concentrations.
- Chemical Reaction: The exact definition of a chemical reaction is: the events that take place when two substances act on each other to produce new compounds.

Intended Learning Outcome:

Students will be able to...

- Acquire data through the senses. The students will be able to observe properties and patterns of objects, organisms, and events in the environment.
- Communicate data and information in appropriate oral and written form. The students will be able to describe objects, organisms, and events from the environment, describe changes that occur to objects and organisms in the environment.

Background Knowledge: (teacher)

Acid rain is more acidic than normal rain and forms through a complex process of chemical reactions involving air pollution. The two most important pollutants that contribute to the formation of acid rain are oxides of nitrogen and sulfur dioxide, which react with moisture in the atmosphere to form nitric and sulfuric acid. The sulfur and nitrogen compounds that contribute to acid rain primarily come from man-made sources, such as industries and utilities. Emissions also come from automobiles and other forms of transportation and industrial processes, such as smelting. Acid rain can harm forests and crops, damage bodies of water, and contribute to the damage of statues and buildings, which are made out of limestone. Researchers

are considering the possible affects of acid rain on human health. These acidic pollutants can be deposited through rain, snow, fog, dew, or sleet. Large quantities can also be deposited in a dry form carried by the wind in dust. Pollutants that contribute to acid rain may be carried hundreds of miles before being deposited on the earth. Because of this, it is sometimes difficult to determine the specific sources of these acid rain pollutants.

Reference: <http://www.tnrcc.state.tx.us/air/monops/lessons/statuelesson.html>

Materials:

- Sticks of chalk
- Vinegar
- Small plastic cups
- Eyedroppers or straws
- KWL charts
- Graphic organizers

Prior Knowledge Assessment:

Discuss terminology and fill out KWL chart on acid rain. Ask students to share their thoughts on this topic with the class. Questions for students: What is acid rain? What might be some causes of acid rain?

<b>(K)</b> What students know about acid rain?	<b>(W)</b> What students want to know about acid rain?	<b>(L)</b> What have you learned after the lesson has been presented?

After each discussion, students will turn in this KWL sheet, for teachers to see where their students are in their understanding.

Procedures:

1. Explain that acids react chemically with limestone.
2. Explain that vinegar is an acid.
3. Fill a cup with 1/3 full with vinegar.
4. Place the limestone into the cup filled with vinegar.
5. Using the eyedropper, drop single drops of vinegar onto your chalk.
6. What is happening to the chalk?

Closure:

Discuss the slow deterioration of the limestone. Discuss the implications of acid rain fall on the environment around us. Discuss how acid rain can harm forests and crops, and damage bodies of water. In groups, have students brainstorm what would happen to the ecosystems living within these environments if they were polluted by acid rain. Students will use a Graphic organizer as they brainstorm their ideas. As students finish group discussions have them share one idea with the whole class. Have students revisit their KWL chart to write what they have learned and any new questions they have.

Assessment:

Actively listen to students during whole group discussion. Students will complete a graphic organizer on how acid rain harms the environment. Students will turn in KWL chart and graphic organizer showing what their prior knowledge was and what they have learned.

References:

<http://www.tnrcc.state.tx.us/sir/monops/lessons/statuelesson.html>

<http://www.tnrcc.state.tx.us/air/monops/lessons.acidraininfo.html>

## **Experimenting with Brine Shrimp**

### *Abstract:*

This lesson is an experiment to determine the effects of acidity levels on brine shrimp hatching.

*Grade Level:* 3rd Grade

### *Utah Elementary Core Curriculum Standards:*

3030-01: Students will explore ecosystems and discover relationships among living organisms and the nonliving world.

*Standard:* 3030-0102

- Experiment to determine the effects of habitat changes.

*In-Class instructional time:* 45 minutes for initial setup, then 10 minutes per day for three days

### *Intended Learning Outcomes:*

- Students will create a hypothesis about how acidity levels affect the hatching of brine shrimp eggs.

### *Background Information:*

- The tiny brine shrimp (*Artemia salina*) is one of the few animals that live within Great Salt Lake. The brine-shrimp population plays an important part in the lake's ecosystem, especially in keeping the lake waters clean through algae consumption.  
Reference: <http://www.ugs.state.ut.us/online/PI-39/PI39PG12.HTM>
- Acid rain is more acidic than normal rain and forms through a complex process of chemical reactions involving air pollution. The two most important pollutants that contribute to the formation of acid rain are oxides of nitrogen and sulfur dioxide, which react with moisture in the atmosphere to form nitric and sulfuric acid. The sulfur and nitrogen compounds that contribute to acid rain primarily come from man-made sources, such as industries and utilities. Emissions also come from automobiles and other forms of transportation and industrial processes, such as smelting. Acid rain can harm forests and crops, damage bodies of water, and contribute to the damage of statues and buildings. Researchers are considering the possible affects of acid rain on human health. These acidic pollutants can be deposited through rain, snow, fog, dew, or sleet. Large quantities can also be deposited in a dry form carried by the wind in dust. Pollutants that contribute to acid rain may be carried hundreds of miles before being deposited on the earth. Because of this, it is sometimes difficult to determine the specific sources of these acid rain pollutants. Reference:  
<http://www.tnrcc.state.tx.us/air/monops/lessons/statuelesson.html>
- It is important to discuss that one sample is not enough and that replication is necessary. It is recommended to have at least three samples of each cup.

### *Materials:*

- Masking tape
- Marker
- 9-12 clear plastic cups
- Measuring cup
- Plastic spoon
- Brine shrimp eggs (see references)

- Toothpicks
  - Sm. zip-lock bags
  - GSL water (filtered) or water at 10% salinity (average of GSL water)
  - Vinegar
  - Hand lenses or microscopes
  - Lab worksheets
- *Prior Knowledge Assessment:* Review concepts about acid rain and its effects on the environment and ecosystems. (Reference to KWL charts and Graphic Organizers from introductory lesson) Review the concept of acid rain. Show pictures of brine shrimp and brine shrimp eggs. Explain to the students that Great Salt Lake water is not very acidic. Ask students if they think the eggs could hatch in water containing high levels of acid. Have students explain their reasoning.

*Procedures:* See Experiment Sheet

- State the Problem:  
Does the amount of acid in the water affect how many brine shrimp eggs hatch?
- Formulate Your Hypothesis:  
Will more eggs hatch in water with a higher acidic level or in water with a lower acidic level? Write your hypothesis.
- Identify and Control the Variables:  
The amount of acid is the variable you can change. You will set up two cups of water with different levels of acidity. A third cup with no change in acidic level will serve as the control. (GSL water or water with 10% salinity) Keep the amount and temperature of the water the same for each cup.
- Test Your Hypothesis:  
Follow these steps to perform an experiment.
  1. Use the attached chart to record and collect your data.
  2. Use the masking tape and marker to label the cups 1, 2, and 3.
  3. Add 250 ml (1 cup) of Great Salt Lake Water to each cup.
  4. Add 5 ml of vinegar to cup 2.
  5. Add 10 ml of vinegar to cup 3.
  6. Place some brine shrimp eggs on a square of paper. Use the flat end of a toothpick to place a small amount of eggs in cup 1.
  7. Place about the same amount of eggs in each of the other cups.
  8. Place the cups together in a place where they will not be disturbed.
  9. Observe the water in the cups each day through a hand lens. In some cups you may see brine shrimp moving. Compare the amount of movement in cups in which the eggs have hatched. Decide if there is no movement, little movement, or a lot of movement in each cup. Collect your data in your chart.
  10. For further observation students can take 1 mL of water and put that drop in a petri dish and watch for movement.
- Collect Your Data:  
Use the “Collect Your Data” sheet to record movement.

- **Interpret Your Data:**  
In which of the cups did you see the most movement? In which of the cups did you see the least movement?
- **State Your Conclusion:**  
How do your results compare with your hypothesis? Communicate your results. Explain how the level of acid in the water affected the hatching of the brine shrimp eggs.

*Closure:* Discuss how the level of acid affected the hatchings. Extend the discussion and refer back to the affects of the acid rain on ecosystems. Students can refer to their graphic organizers and make changes and additions.

*Assessment:* See Rubric

*References:*

- Scott Foresman SCIENCE (Teacher's Edition.) Addiston-Wesley Educational Publishers Inc. 2000.
- To purchase brine shrimp eggs see website  
<http://search.ebay.com/search/search.dll?query=brine+shrimp&newu=1>
- Information on Brine Shrimp see website:  
<http://www.ugs.state.ut.us/online/PI-39/PI39PG12.HTM>
- Information about the Great Salt Lake see website:  
[http://www.hcn.org/servlets/hcn.Article?article\\_id=11170](http://www.hcn.org/servlets/hcn.Article?article_id=11170)

**Collect Your Data**

	<b>Amount of movement in each cup</b>		
<b>Day</b>	<b>Cup 1 GSL H2O</b>	<b>Cup 2 GSL H2O+5ml of vinegar</b>	<b>Cup 3 GSL H2O+10ml of vinegar</b>
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

# Experimenting with Brine Shrimp

## State the Problem

Does the amount of acid in the water affect how many brine shrimp eggs hatch?

## Formulate Your Hypothesis

Will more brine shrimp eggs hatch in the plain GSL water, the GSL water with 5ml of vinegar, or the GSL water with 10ml of vinegar?

Write your hypothesis.

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## Identify and control the variables

The amount of vinegar is the variable you can change. Keep the amount and temperature of the water the same for each group

## Test Your Hypothesis

Perform Experiment by following procedures.

Use the chart to record your observations of brine shrimp in each cup.

## Collect Your Data

Use the data chart

## Interpret your data

In which of the cups did you see the most movement? In which of the cups did you see the least movement?

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## Conclusion:

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## Activity Rubric

Scoring Criteria	1	2	3	4
Student made a hypothesis about how the amount of acid in the water would affect the hatching of the brine shrimp eggs.				
Student identified and controlled variables.				
Student followed instructions to perform an experiment with brine shrimp.				
Student collected and interpreted data in chart.				
Student communicated about how the amount of acid affected the brine shrimp eggs.				

### Scoring Key

4 points: Correct, complete, detailed

3 points: Partially correct, complete, detailed

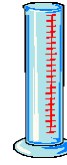
2 points: Partially correct, partially complete, lacks some detail

1 point: Incorrect or incomplete, needs assistance



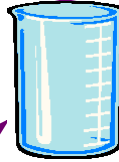
**INTRODUCTORY  
LESSON  
CONCEPTS**

- Acid Rain
- Affects of Acid Rain on Environment
- Affects of Acid Rain on Ecosystems



**EXPERIMENTAL  
LESSON  
CONCEPTS:**

- How Acidity levels Affect Hatching of Brine Shrimp Eggs
- Scientific Method

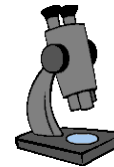


**EFFECTS OF  
PH LEVELS  
IN NATURE**



**NATIONAL  
SCIENCE  
EDUCATION  
STANDARD:**

Life Science Content Standard C: As a result of activities in grades K-4, all students should develop understanding of organisms and environments



**UTAH STATE  
CORE  
CURRICULUM:**

Standard 3030-01: Students will explore ecosystems and discover relationships among living organisms and the non-living world.  
Objective 3030-0102: Experiment to determine the effects of habitat changes.



**BENCHMARKS  
FOR SCIENCE  
LEARNING:**

The living environment  
Grades 3-5: By the end of the 5th grade students should know that changes in an organism's habitat are sometimes beneficial to it and sometimes harmful