

Lindsey Montague
Ryley Martin
Teresa Smith
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Brine Shrimp and pH Levels

Abstract:

This lesson is designed to familiarize students with the life cycle of brine shrimp cysts, mostly related to hatching them. Students will learn about pH, the different levels, how to test it, and how it might affect the hatching and survival of the cysts. The activity involved with this lesson is a visit to the Great Salt Lake to use their knowledge in a real-world context by testing its pH level and collecting items for a microsystem.

Grade Level: 3rd grade

Standard 2 - Science Benchmark For any particular environment, some types of plants and animals survive well, some survive less well and some cannot survive at all. Organisms in an environment interact with their environment. Models can be used to investigate these interactions.

Objectives:

- Students will learn the life cycle of brine shrimp.
- Students will learn the best conditions for hatching brine shrimp pertaining to pH levels.
- Students will come to a basic understanding of pH and the effects on living things.

- Students will understand how pH can affect the normal environment that is conducive to hatching brine shrimp cysts.

Vocabulary:

Brine Shrimp Cysts- dormant baby brine shrimp

Brine Shrimp- any fairy shrimp of the genus *Artemia*, found only in hyper saline environments

pH level- a figure expressing acidity or alkalinity

acid- having a pH less than 7

base- having a pH higher than 7

neutral- having a pH of 7

Background Information:

Brine shrimp can survive in harsh environments, such as high salinity levels and extreme weather conditions. The brine shrimp produce offspring in the form of cysts, which consist of tough shell-like exteriors. These cysts remain in this state as long as they are dry or anaerobic. They begin to hatch as temperature becomes warmer, salinity levels are lower, and there is movement or aeration in the water; usually in spring. These cysts remain in the water throughout the water, causing a reddish-brown coloration near the surface. Once hatched, the brine shrimp are filter feeders, meaning that they push nutrients to their mouths by constantly moving. This looks like a fluttering of their like, almost like flying through the water. Their main source of food comes from the algae called *Dunaliella*.

The term and concept of pH is too complex for this young of students. Though, there are simple ways to present the information. If students are asked to discuss common household liquids that they consider sour, that will introduce the concept of acidic liquids. (such liquids: lemon/orange juice, vinegar, etc.) Basic liquids will be harder to explain, but if they are compared to acidic liquids as opposites it will be easier to understand. Of course, water is not sour so we can say it is neutral. Living organisms survive best, and most of the time, in neutral liquids, or water. So we will be predicting the survival rate or hatching of shrimp cysts in acidic and basic liquids.

These lessons mainly cover the brine shrimp cysts, but other aspects of the GSL will be discussed. Lessons and activities dealing with other wildlife, mountains, and formation are all apart of a larger thematic unit.

Materials: Great Salt Lake journal, pencils, jars with lids, pH strips or tape, large water jugs

Prior Knowledge:

- Ask if any have visited the Great Salt Lake, and what they remember.
- Have the students do a quick write.
 - Have them include wildlife they saw, smells, sounds, and any other information they may know already.
 - You can then ask them if they know what animal populates the water and have them write down what they think if they do not know.
- After discussing pH in simple terms (using commonly known liquids), put students in to groups.
 - The groups will make drawings on small posters of what they know or want to know about pH.

In-class:

After doing the quick write and group work, students will learn about pH and the affects it plays in the environment and living things. They will have the opportunity to test pH in the water at the GSL. For this part of the unit, they will also learn about the life cycle of brine shrimp, mainly focusing on the cysts and necessary environment in which to hatch.

- Students will use pH strips on the liquids that will show them the difference between the levels.
 - this will orient them on the strips and how they look, feel, and change
- To introduce brine shrimp, they can visit web sites at a technology center as well as look at diagrams.
 - the microscope will come later when we have actual shrimp from the GSL

Field Activity:

The students will go on a trip to the GSL. There they will test the pH level of the water and begin to gather water to bring back to the classroom. They will also fill their own jars with GSL water and include algae or algae-covered rocks to create a microsystem for the brine shrimp.

Assessment:

The assessing will be done on the prior knowledge quick writes and the diagram done by the groups. There will be chances to identify different organisms they find when collecting water, which they were to find along with the other information on the GSL. Since they do have a GSL journal, this would be the beginning of reflecting on learnings and experiences they have while participating in the unit.

Resources:

<http://www.projectlinks.org/shrimp/>

http://www.westminstercollege.edu/education_gslp/Brine_Shrimp_Cysts.pdf

Teresa J. Smith
Lindsey Montague
Riley Martin
Fall, 2003

pH and the Hatching of Brine Shrimp Cysts

Abstract: This part of the unit will focus on experimenting with pH and brine shrimp cysts. Students will work in an inquiry-based lesson to create water environments with different pH levels. Students will then try to hatch brine shrimp cysts in these altered environments as well as in their normal environment. Students will create their own hypothesis, observe and collect data and come to their own conclusions of how differing pH levels will affect the hatching of brine shrimp.

Grade Level: 3

Utah Core Standards and Benchmark:

-Science Benchmark

- For any particular environment, some types of plants and animals survive well, some survive less well and some cannot survive at all. Organisms in an environment interact with their environment. Models can be used to investigate these interactions.
- Students will understand that organisms depend on living and nonliving things within their environment

-Science Standards/Objectives

- Describe the interactions between living and nonliving things in a small environment.
- Predict the effects of changes in the environment (e.g., temperature, light, moisture) on a living organism.
- Observe and record the effect of changes (e.g., temperature, amount of water, light) upon the living organisms and nonliving things in a small-scale environment.

Time: 3-4 days

Terminology:

pH: a measure of acidity(acidic) and alkalinity(base) of a solution that is a number on a scale on which a value of 7 represents neutrality and lower numbers indicate increasing acidity(more acidic) and higher numbers increasing alkalinity(more basic).

Brine Shrimp: any of a genus (*Artemia*) of branchiopod crustaceans that can exist in strongly saline environments.

Cysts: a capsule formed about a minute organism going into a resting or spore stage; dormant brine shrimp babies.

Nauplii: The first stage in the life of brine shrimp after hatching from cysts.

Acidic: having a pH less than 7.

Basic/Alkaline: having a pH of more than 7.

Environment: the circumstances, objects, or conditions by which one is surrounded

Intended Learning Outcomes:

The students will understand how pH can affect the environment that is conducive to hatching brine shrimp cysts.

Background Information:

Brine shrimp are inhabitants of the Great Salt Lake. They are in fact one of the few types of organisms that can live in the extremely salty water of the lake. Brine shrimp, measure a mere 10 millimeters in length at adulthood, they begin their lives as cysts or tiny eggs. Brine shrimp cysts are so small that 50 could fit on the head of a pin. Baby brine shrimp are called nauplii after they hatch from their cysts. Brine shrimp thrive best in an environment with air that is circulating them around. Brine shrimp are an important part of Utah economics. The Great Salt Lake has a pH of 8-8.59 on average. Many things could account for this pH, including but not limited to the brine shrimp, animal wastes and pollution. pH is measured on a scale of 1-14. The lower a pH the more acidic a substance is. The higher the pH the more basic or alkaline a substance is. A 7 on a pH scale is considered neutral.

Materials:

Brine shrimp cysts, (Cysts can be bought online at <http://brineshrimpdirect.com> or <http://pondsolutions.com/brineshrimp.htm>) baby food sized jars, labeling tape, markers, vinegar, diluted ammonia, GSL water*, colorpHast pH1-14 pH strips from EM Science 480 Democrat Road, Gibbstown, N.J. 08027, straws, microscope, slide of brine shrimp cyst and brine shrimp, overheads of brine shrimp, brine shrimp cysts and pH scale.

*If GSL water is not available you can create your own solution to resemble GSL water. Mix 3tsp of salt to 250 ml of water to create water with 10% salinity.

Prior Knowledge Assessment:

To assess student's prior knowledge, we will discuss as a class the field trip to the GSL and what they know about it. Also we will discuss familiar objects and their pH. At this time brine shrimp overheads and pH scale can be presented. Students can also look under the microscope to see brine shrimp and brine shrimp cysts. This will be supplemental information to that learned at the Great Salt Lake previously.

Students can also play a memory game with words and definitions to help them retain vocabulary. Students will flip over a card with a picture and the word on it then flip over another card to find the definition. Memory comes in by remembering where you last saw a picture and word to match a definition. Matches of definitions and pictures are picked up until the memory board is clear.

Instruction:

1. Review with students the importance of the Great Salt Lake to our economy and just how brine shrimp fit into the importance of the economy.
2. pH is a term that can be used just so students are exposed to the correct terminology, but for the lesson it might be easier to say, "More acidic" or "more basic". Keep referring to how the water make up has changed so students understand we are changing the make up of the water, even if they don't fully grasp pH.
3. After discussion Great Salt Lake field trip and pH, ask the students, "How do you think changing the pH of Great Salt Lake (GSL) water will affect how the brine shrimp hatch. Will changing the make-up of the water change hatching? Why?"
4. Model to students how to set up experiment. For management purposes, it might be easier to have pre-mixed solutions of basic and acidic GSL water. To make GSL water more acidic, use vinegar. To make GSL water more basic use ammonia. If students are able, they can do the mixing of the GSL water and the vinegar. However, with the ammonia and GSL water, it is very strongly suggested that the teacher have this mixed prior to experiment.
5. Allow students to test pH by sticking a pH strip in jars. The pH strip will change color and students can match the color change to the chart on the pH strip box. For a more accurate measure of pH, students should measure and record the pH while the strip is still moist.
6. Students will need to have three jars per group.
 - a. Jar 1: Control, GSL water only
 - b. Jar 2: GSL water and ammonia
 - c. Jar 3: GSL water and vinegar
7. Students should label their jars accordingly. Labels should include pH levels.
8. Cysts should be added to each jar.
9. With straws, blow into jars to create air circulation two times a day.
10. After set up of experiment, students should create a hypothesis. Students should write out their hypothesis in their journal and determine how they wish to measure and record their observations. They could create a simple check list; did the shrimp hatch yes or no? They could graph how many days it takes for the brine shrimp to hatch. Give them these ideas but let them come up with their own record keeping strategies as a group.
11. Give brine shrimp 3 days to hatch.
12. Students should make observations and record them in their journal everyday.
13. Once brine shrimp have hatched, students should come to a conclusion on whether or not the pH of the water is a factor in brine shrimp hatching.
14. Students should decide on a method to share and present their conclusion with classmates, other classes, and parents. Students could add information to class website.
15. Students should also participate in a discussion about living and non-living things in an environment for closure. What non-living things factored into our experiment? Did anything become living in our experiment? What would these

living things need to survive according to what we've learned about brine shrimp in the Great Salt Lake?

Assessment:

Students can be assessed on journal entries, as well as their method of presenting experiment. Their presentation and ability to answer questions about their experiment to others will constitute a large portion of their assessment. To assess students on the concepts of living and non-living, they could play the memory game again and explain in writing how they know that their matches are correct.

References

<http://www.m-w.com/home.htm> Merriam-Webster online used to find definitions for terminology.

<http://majordomo.clarkson.edu/archives/confchem/200203/msg00022.html> Found GSL pH.

<http://www.bpa.gov/corporate/kr/ed/kidsinthecreek/topics/waterquality/ph.htm>

Information found about pH.

http://www.westminstercollege.edu/education_gslp/ Ideas for lesson plan found here.

Ryley Martin
Teresa J. Smith
Lindsey Montague

Will it freeze?

Abstract: Students will hypothesize about how pH affects water. They will experiment the pH of water affects the freezing rate of water. They will learn what it takes to freeze something.

Grade level: 3

Standards 2: Describe the interactions between living and non-living things in a small environment.

Objective 2: Predict the effects of changes (e.g. temperature, amount of water, light, the living organisms and non-living things in a small-scale environment.)

Time: 1 period set up- overnight and then one time period to observe and record findings.

Vocabulary:

- pH: A measure of the degree to which a substance is an acid, a base, or neutral.
- Freezing: The point where some liquid becomes solid
- Acid: any of various compounds that in solution have a pH less than 7.
- Base (non-acid): Various compounds that in a solution have a pH more than 7.
- Salinity: The amount of salt that is in something.

Objectives: Students will know what freezing looks like.
Students will understand the difference between acidic and basic.
Students will gain knowledge on pH.

Background: Review what students have learned from field trip to GSL and experimental lesson (brine shrimp hatching). Talk about what the salinity of it was. Talk about why the salt content of the lake is important to know. Talk about at what temperature salt water freezes. Know that water freezes at 31 degrees F. For every gram of salt added to every liter of water the temperature needs to drop about .154 degrees to freeze. Talk about what this means.

Materials: GSL water or same salinity salt water
For example 12tsp. of salt to 1 liters of water = 10% salinity.
Pre-made acidic water taken from lesson 2
Pre-made basic water taken from lesson 2
10 square Ice Tray
pH strips
Toothpicks (colored preferred)

Materials contd.:

GSL Journal
Small poring jars/cups

Prior Knowledge: Ask Students if the GSL freezes?
Do they know why it does or doesn't?
Do they know what affects freezing in the GSL or in any water?
Review pH levels
Review Brine Shrimp environment

Instructions:

- Show the students the GSL water (or saline solution).
- Talk about the salinity level in the GSL.
- Talk about pH and what number it needs to read to be basic and what number it needs to read to be acidic.
- Review things that make water acidic and basic.
- Discuss that was used in the water they will be using that made it acidic and basic. (from lesson 2).
- Review temperature and freezing points.

Procedures:

- Have each student or group of students take a liter of salt water.
- After having the students test the pH of the water, students could also take this opportunity to talk about what the pH of the GSL is.
- After deciding what the pH of the regular water is, have them test the pH of the basic water.
- If the number is 2 numbers above the original pH have them record that number in their GSL journals. If not, have them discuss what they would have to add to make it higher.
- Have them discuss what made it basic.
- Have them test the pH of the acidic water.
- Have them record the number if it is 2 numbers below. If not have them discuss how to make it lower.
- Have them discuss what was used to make it acidic.
- Have them pick up an ice cube tray per group.
- Have them fill 2 squares with the regular salt water.
- Skip 2 squares and fill 2 squares with the basic salt water.
- Skip 2 squares and fill 2 squares with the acidic salt water.
- Have them use colored toothpicks or make little "flags" out of the toothpick labeling the waters.
- Have them write down what they did (if they used colored toothpicks have them write down which colors were used for what.)

Assessment: Keep looking at their journals to make sure they understand. Make sure they are writing down the information and their observations of the water and the

freezing. Have them write why this is important to the environment of the brine shrimp. (that they can't really live in frozen water).

Their final project will be a cyst science fair:

They will all take their findings and their little home made jars of different pH waters and have a fair. Have them teach other classes and students, and parents about what they did and what they learned from this. Including what pH is and what the difference in the pH is for acid, regular, and basic water. What water they discovered would hatch brine shrimp and what they learned about the freezing of salt water that is regular, basic and acidic. Having them talk about the environment that Brine shrimp live in and what affects that.