

Lesson Plan: Long-term Biochemical Experimentation

Egg Shell and Vinegar

Subjects: Earth Science, Ecology

Grade-level: Elementary [2-5], Middle [6-8]

Time required: 60 minutes for 3 or more days*

Materials required: 3 Flasks (or a clear glass or plastic cup), 3 hard boiled eggs, water, vinegar, camera/video (optional), pH meter

*Additional time is required for homework assignments and assessment tools.

Content Standards: This lesson fulfills various aspects of the following Guam Department of Education Standards depending on grade level: 1st through 3rd and 7th grades.

Part I: Experiment- Egg Shell

Description

Simple chemistry experiments will be conducting investigating the effects of water and vinegar on egg shell.

Emphasis

Learning about the chemistry that surrounds us.

Objectives

- Students will identify that egg shell behaves differently in water and vinegar.
- Students will be able to describe the chemical reaction observed when hard boiled eggs are added to vinegar.
- Students will be able to articulate what they observed in the chemical reaction.

Procedure

Teacher Notes

This experiment will require students to fill out the “Egg Shell Experiment Worksheet.” A copy can be downloaded with lesson plan.

Activity

1. Have students note the appearance of the egg.
 - Is it hard, soft, smooth, rough, squishy?
2. Label one cup “water”, label the other “vinegar”.
3. Place one egg in the water cup, place the other egg in the vinegar cup, leave the third egg in a empty container.
4. Fill each cup with the appropriate liquid (to within 1/2” from the top).
5. Have students use the Egg Shell Experiment Worksheet to note their observations of each cup.
 - Encourage students to be very detailed.
 - At each time point, students can take the egg out and feel the surface.
6. Take pictures and/or video for record keeping in addition to Egg Shell Experiment Worksheet.
7. Compare the egg shell in water or vinegar to the non-submerged egg; do they notice any differences?
8. After at least eight hours**, students you notice that the hard shell shell has been broken down and is now soft.

(**Note: This experiment can be conducted over several days.)

Teacher Notes

The vinegar has reacted with the calcium carbonate in the egg shell and broken it down in to water (H₂O) and carbon dioxide (CO₂).

Refer to the chemical reaction below:

CaCO₃ (calcium carbonate) + CH₃COOH (vinegar) = CO₂ (carbon dioxide) + H₂O (water) + Ca

- This is a good opportunity to discuss how and why molecular formulas are written as such.

Periodic Table of Elements

Refer to the periodic table located below.

All atoms in the universe are abbreviated with either one capital letter (oxygen = O, hydrogen = H, carbon = C, nitrogen = N,) or one capital letter followed by a lower case letter (calcium = Ca, Helium = He, Sodium = Na, Chloride = Cl). Next to each letter, or set of letters, is usually a number, the number tells you how many of that particular atom are present in any given molecule (H_2 = 2 atoms of hydrogen). If a number appears in front of the molecule or atom, it means that there are two of that particular molecule or atom. So to be technically correct we should write the aforementioned chemical reaction like this:



- You need at least two molecules of vinegar for this chemical reaction to occur. Typically, when we perform this chemical reaction in the classroom we are using millions of molecules of vinegar and therefore this isn't a concern.

Some more examples of this are:

- $2(CaCO_3)$ = two molecules of calcium carbonate
- $2(H_2O)$ = two molecules of water
- $24(NaCl)$ = Twenty-four molecules of sodium chloride (salt!)
- $6(CO_2)$ = six molecules of carbon dioxide

Part II: Go Further- pH Experiment

Note: Appropriate for advanced 5th grade classes.

Materials required: pH meter

Objective

Do the following experiment to learn more about pH and how it can change, record your results in Table 1.3.

Emphasis

Chemical compounds can have an effect on the pH of a solution.

Questions or Assessment

What is pH?

pH is a measure of the number of hydrogen atoms in a solution. The more hydrogen atoms in a solution, the lower the pH is. Conversely, the less hydrogen atoms that are present the higher the pH. pH can range from 0 to 12. Hydrochloric acid is a very strong acid and has a pH of 1. Acetic acid (also known as VINEGAR!) has a pH of 2.4. While vinegar is still a strong acid, one could say that it is less potent than hydrochloric acid. It is easy to measure the pH, using a pH meter. The pH meter measures the number of hydrogens in any given solution.

Procedure

1. Measure the pH of the water.
2. Measure the pH of the vinegar.
3. Place an egg in each flask.
4. Measure the pH of the water and vinegar again.
5. Leave the eggs in the flasks and measure the pH every 24 hours for three days.
6. What changes did you observe, if any?
 - Did the egg behave differently in the water compared to the vinegar?
 - Can you make any conclusions about the effect that calcium carbonate had on the pH of the vinegar and the water?
 - In which solution did the pH change? Why?
 - Compare the surface of the egg shell in water or vinegar to the one in the empty container. What differences do you notice?

Table 1.3

	pH (no egg)	pH (plus egg)	Day 1 pH + 24 hours	Day 2 pH + 48 hours	Day 3 pH + 96 hours
Water					
Vinegar					

Egg Shell Experimentation Worksheet

Minutes After Insertion	Hard Boiled Egg	Egg in Water	Egg in Vinegar
0 minutes			
5 minutes			
30 minutes			
3 hours			
8 hours			
24 hours			
36 hours			
48 hours			
72 hours			

Editor’s note: Funding for this lesson plan was provided by the Howard Hughes Medical Institute, Olivera Lab, University of Utah. Please email Laura Biggs, PhD at biggs.laura@gmail.com with questions or comments.