Student Name:

Teacher Name:

Class Name/Subject: Chemistry

Period:

Assignment Week #: 4

How to make a Shell-less Egg – At Home Laboratory

A "shell-less egg" is an egg that has no shell. Let me say that again, an egg with no shell. This is not something you normally run across and even when I show a shell-less egg to someone they often just don't get the idea that the shell is gone – yet the egg stays intact. You might want to check out the anatomy of an egg to get an idea what we are dealing with.

The shell of an egg (typically a chicken egg) is made up of primarily calcium carbonate. If you soak this egg shell in vinegar (which is about 4% acetic acid), you start a chemical reaction that dissolves the calcium carbonate shell. The acetic acid reacts with the calcium carbonate in the egg shell and releases carbon dioxide gas that you see as bubbles on the shell.

$$CaCO_3\,(s) + 2\,HC_2H_3O_2\,(aq) \rightarrow Ca(C_2H_3O_2)_2\,(aq) + H_2O\,(l) + CO_2\,(g)$$

The egg insides remain intact and are held together by the two fragile membranes just inside the shell. A quick reminder, **DO NOT EAT YOUR EGG**! This is a lab and your egg has been unrefrigerated. If you are really interested in creating a Pickled Egg that you **can** eat, check out some of the recipes from the National Center for Home Food Preservation and for more information about safe egg handling practices check out the Egg Safety Center.

Here's what you need

Let's get to the fun stuff. In order to make a Shell-less Egg you will need the following items:

- Vinegar (at least 16 ounces)
- A couple of glasses or cups
- Raw eggs (you can use "acid relief" tablets like tums if you don't want to waste eggs. They will model the reaction but you won't have a shell-less egg left over.)

1. The process is really very simple. Carefully place the egg in a cup and fill the cup with vinegar so that the egg is completely covered. Don't worry if the egg floats a bit. Just get enough vinegar in the cup to mostly cover the egg.
2. Now the hard part – you will have to wait as the acetic acid in the vinegar begins to react with the calcium in the egg shell. In just a short while, you should see some bubbles appearing on the outside of the egg. It can take 12-24 hours before a good portion of the shell is removed. A good sign of progress is a white frothy scummy layer on the top of the surface of the vinegar.
3. After a day of soaking you can carefully remove the egg from the vinegar. I would suggest pouring the liquid into another cup and catching the egg in your hand. Using a spoon to fish the egg out might seem like a good idea, but I've seen a few eggs break or get damaged when using a spoon to remove them.
4. At this point you may be able to literally rub the shell off the egg with your fingers. It will rub off as a white powdery substance. Give it try, just be very careful, you don't want to break the egg, it's getting more fragile as the shell is slowly dissolved. Depending on your particular egg, you may already have a shell-less egg. However, I would suggest you fill a cup with fresh vinegar and soak the egg for at least one more day.

After two days of soaking you should have a pretty cool Shell-less Egg. Notice that the egg is a bit bigger than when you first started. This is because some of the vinegar (and some of the water in the vinegar) has moved through the membranes to the inside of the egg. The membranes are semi-permeable and allow water to move through them. This is called osmosis.

Questions:

1. What are the bubbles that appear when you place the egg in the vinegar?
2. Why is this a good model for what happens to shells in the ocean?

Extension

Want to do more, try one or two of the things below with your shell-less egg! Answer the question(s) that go with the extension you tried.

-Acid-Relief Tabs

Do the same procedure above but with acid-relief tabs like tums.

*Questions: Compare the results between the egg and the tabs. What was similar? Different? What do you think happens in your stomach when you have "heart-burn" and you chew the tabs?

- Will Other Liquids Create a Shell-less Egg?

Try the same procedure above with another liquid you have in your kitchen.

*Questions- Compare the results between the vinegar and the other liquid you chose. Which liquid do you think has a higher concentration of acid? Why?

-Do Eggs Bounce?

Shell-less eggs are cool, but experimenting with them is even cooler. You have probably already noticed that your shell-less egg is kind of rubbery. Try dropping it! I would suggest you start at one inch, then try two inches, and so on. Keep in mind that eventually this is going to get messy when it the membrane breaks. You might want to do this experiment outside.

*Question: How far above the table can you drop your egg and have it survive by bouncing?

-Expand your Egg

If you want to see your egg get really big, simply put it in a cup filled with water. The makeup of the inside of the egg is around 90% water. Put the egg in a cup of (100%) water. You can even soak the egg in some water with food coloring.

*Questions: Why dos the egg expand? What happens with the food coloring?

-Shrink your Egg

Slip your Shell-less Egg into a cup filled with corn syrup and let it sit for a day, or two, or more and you will begin to see your egg begin to shrink and look sort of baggy.

If you get tired of the shriveled egg look, can you reverse the process by just dunking the egg back in a cup of water.

*Questions: Why does the corn syrup make the egg shrink? What happens when you put the egg back in water?

Laboratory revised from: https://www.imaginationstationtoledo.org/educator/activities/how-to-make-a-naked-egg