Egg Science: Dissolution & Osmosis

Description: This is a two-part lesson that can be done over a week. It begins by using vinegar to dissolve an egg's shell (dissolution) without breaking the membrane that contains the egg. The shell-less eggs are used in the second part of the experiment to study osmosis, the movement of water across a membrane.

Background: Eggshells can have as many as 17,000 pores. A chicken eggshell is made almost entirely of calcium carbonate. It has a semipermeable membrane, so air and moisture can pass through its pores.

When the eggs are placed in vinegar they bubble as the vinegar (an acid) reacts with the calcium carbonate (a base, the same material used in antacids) of the shells.

Directions Part I: Making Shell-less Eggs

1. Place the eggs in the container so they are not touching.

2. Add enough vinegar to cover the eggs. Notice bubbles form on the eggs. Cover the container, refrigerate, and let the eggs sit in the vinegar for 24 hours.

3. Use a large spoon to carefully scoop the eggs out of the vinegar. The egg membrane may be the only thing holding the egg together and it is not as durable as the shell.

4. Pour out the vinegar. Put the eggs back in the container and cover them with fresh vinegar, cover container. Leave the eggs in the refrigerator for another 24 hours.

5. Scoop the eggs out again and rinse them carefully. If any of the membranes have broken, throw those eggs away.

6. When done, you will have an egg without a shell. It looks like an egg, but it's translucent—the membrane flexes when gently squeezed.

After the second day of soaking, carefully rinse eggs of extra eggshell pieces. Eggs may need to soak an extra day to dissolve all of the shell.

What's Going On?

When you submerge an egg in vinegar, the shell dissolves. The eggshell is dissolved in a process called *dissolution* - i.e., when a solid, liquid or gas forms a solution in a solvent. Another common example is making a saline water solution by dissolving table salt in water. The salt is the solute and the water is the solvent.

The egg contained by its thin membrane is translucent and will flex when it is gently squeezed.

Vinegar is an acid, which breaks apart the solid calcium carbonate crystals that make up the eggshell into their calcium and carbonate parts. The calcium ions float free, while the carbonate goes to make carbon dioxide—the bubbles that you see. The reaction of the eggshell and vinegar is an acid-base reaction. Calcium carbonate, a base, reacts with the acid in vinegar to make carbon dioxide.

Grade Level: 5 -10

Essential Skills: 1, 2, 5, 9

CCSS: RI.5.7, RST.6-8.7

NGSS: 5-PS1-1, 5-LS2-1. MS-PS1-4, HS-ESS2-5

Time: Part 1 - 2 days; Part 2 - 3 days

Materials Part I: 4 eggs • white vinegar • a container big enough to hold all the eggs and a cover for the container • large spoon

Materials Part II: at least 2 shell-less eggs (from part 1) • containers big enough to hold a single egg and some liquid • corn syrup • water • large spoon

Vocabulary:

Dissolution **-** when a solid, liquid or gas forms a solution in a solvent.

Osmosis **-** movement of water across a membrane.

Selectively Permeable Membrane **-** lets some molecules move through it while it blocks other molecules.

Solute - a dissolved substance.

Free Library Resources: Egg Kit - activity, *Eggs 101* DVD; Poster - *From Inside an Egg;* Egg Hatching Incubators

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Directions Part II: Shell-less Eggs & Osmosis

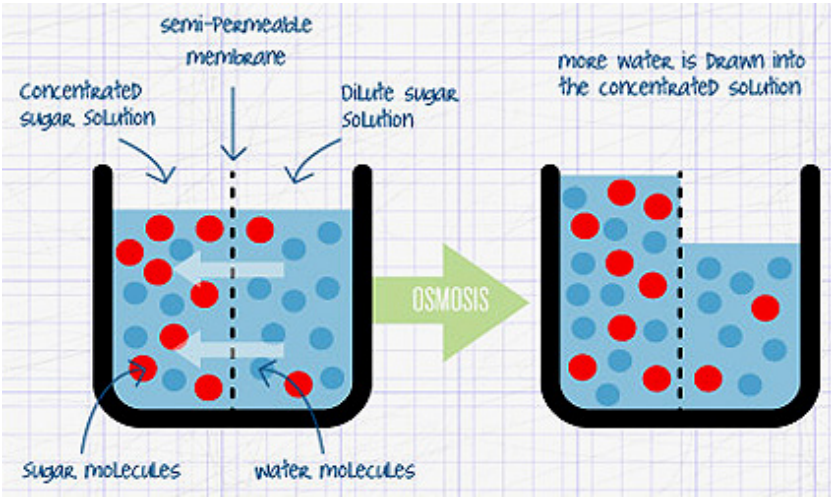
In the second part of this lesson, students use the shell-less eggs they made in part 1 of this lesson to observe osmosis, the movement of water across a membrane.

The egg immersed in the corn syrup will shrivel.

1. Put one shell-less egg (or half of the group of prepared eggs) into a small container and add enough corn syrup to cover the egg.

2. Put the second egg (or other half of the prepared eggs) in the other container and add enough water to cover the egg. Refrigerate for 24 hours.

2. After 24 hours, take a look at your eggs. Observe.



What's Going On?

The egg in water should be plump and firm. The egg in corn syrup (above) should look shriveled.

After the eggshell dissolves it is still surrounded by a membrane. This membrane is ***selectively permeable***—meaning it lets some molecules move through it while it blocks other molecules.

Water moves through the egg membrane easily. Bigger molecules—like the sugar molecules in the corn syrup—don't pass through.

By putting a shell-less egg in corn syrup, you create a situation where the egg membrane separates two solutions with different concentrations of water. The egg white is about 90% water; corn syrup is about 25% water. In this situation, random movements of water molecules cause them to move from the side of the membrane where they are more abundant to the side where they are less abundant. So water migrates from inside the egg to outside the egg, leaving the egg shriveled.

Extension Activities:

Have students think of a way to take the shriveled egg and make it plump again. How? Carefully lift the shriveled egg from the corn syrup and place it into a container of water. Leave the egg in the water for 24 hours and refrigerate. The water will migrate from the side of the membrane where water molecules are abundant (outside the egg) to the side where water molecules are less abundant (inside the egg). After 24 hours, the egg will be plump again.

* Put the shell-less eggs into other solutions. Try water colored with food coloring or salty water. Have students record their hypothesize on the what they think will happen and summarize their findings.