Eggshell Geodes

Target Grade: Kindergarten – 12th Grade

Time Required: 2 Days

Standards/Topics Covered:

Next Generation Science Standards:

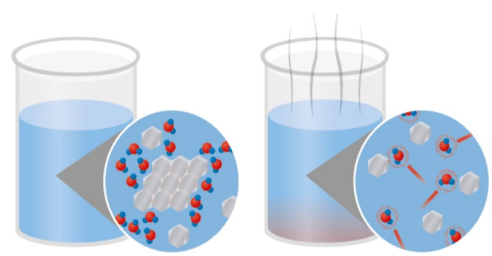
- 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
- 5-PS1-3. Make observations and measurements to identify materials based on their properties.
- HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

Central Focus:

This activity is "egg-citing"! In this activity, students will learn about solutes, solvents, and solutions, while discovering saturation and supersaturation. Students will be able to observe sedimentation causing crystals to form on the surface of the eggshell. The result is a phenomenal eggshell geode!

Key terms: unsaturated, saturate, saturating, solute, solvent, solution, sediment, geology

Background Information:



https://www.sciencefocus.com/science/why-is-hot-water-a-better-solvent-than-cold-water/

Liquids, or solvents, are restricted to dissolving a specific amount of solute, or what is being dissolved. At room temperature, the solvent can only dissolve a specific amount and the rest of the solute will not dissolve. This solution (the solvent and solute mix) is saturated, meaning it cannot dissolve any more solute. At room temperature, the water molecules move around at a certain speed and can only break apart a specific amount of the solid, as shown in the beaker on the left. However, when the solvent is heated, it is able to dissolve much more solute than at room temperature. When the solvent is heated, the molecules in the water move around more quickly, causing more collisions between the water molecules and the solid, breaking more of the solid apart, as shown in the beaker on the right. When more solute is dissolved in the heated solvent, it is called supersaturated. As the solution cools, the solute "falls out" of the solvent (precipitates), creating crystals. This process is called sedimentation.

Sedimentation occurs naturally when there is a hollow space caused by groundwater dissolving existing structures within rocks. Minerals that are present in the groundwater are deposited into the inside of the space when the temperature causes the water to evaporate, leaving more minerals than can "fit" in the water. Over time, this creates the amazing geodes that we see today.

A well-known example of supersaturation is seen in the process of making sweetened tea. When the tea is cold, very little sugar can dissolve in the tea. This is because the molecules are not moving very much. If the tea is stirred, a little more sugar will dissolve because the molecules are moving a little more. However, if the tea is heated and then the sugar is added, much more sugar can be added to the tea due to the fast moving molecules.

For a fun video, watch *Magic School Bus Rides Again* Season 1, Episode 8 "Three in One" on Netflix. This episode shows the three forms of water in a solid, liquid, and gas and can help students to understand molecular movement.

Vocabulary: Solvent, Solute, Supersaturation, Sedimentation, Crystallization, Geode, Precipitates

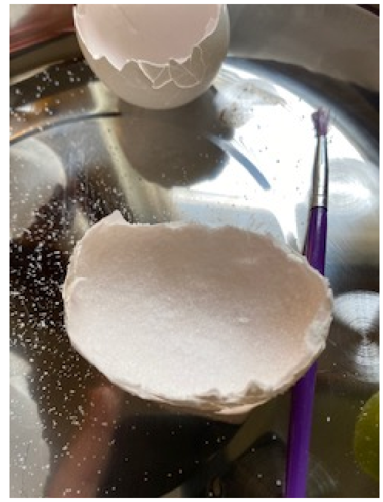
Materials

- 2 Eggs
- Straight pin or safety pin
- Liquid glue
- Paintbrush
- ¾ Cup plus 2 tablespoons Alum powder (can be bought in the spice aisle at the grocery store)
- 2 Cups hot water
- Saucepan
- Food coloring (up to 4 colors!)
- 4 Glasses
- Spoon
- Paper towels

Instructions

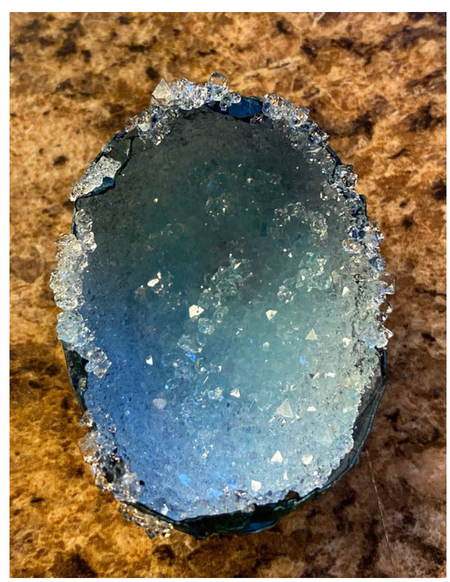
Day 1

1. Remove the yolk by poking a hole in both ends of the egg with a pin and blowing on one end, causing the yolk to come out on the other end.
2. Separate the eggshell in half lengthwise.
3. Clean and dry the eggshell.
4. Using a paintbrush, spread enough glue to coat the inside of the eggshell. If you would like the crystals to grow along the edges of the shell, make sure to add glue there too.
5. Sprinkle the 2 tablespoons of alum powder over the glue on the eggshell.
6. Gently tap the excess alum powder out of the eggshell.
7. Allow the eggshell to dry overnight or for several hours. If the glue is not completely dry, the alum powder will fall off and crystals will not attach to the eggshell.



Day 2

1. Bring 2 cups of water to a boil in a saucepan. Turn off the heat source once the water is boiling.
2. Add ¾ cup of alum powder to the hot water and stir until the powder is dissolved.
3. Divide the mixture into four separate glasses.
4. Add at least 25 drops of food coloring to each glass and mix until the color is spread throughout the glass.
5. Let the solution cool to room temperature.
6. Gently place one eggshell half in each of the glasses using the spoon to lower the shell to the bottom. Make sure to put the alum side up.
7. The eggshells should sit in the solution for at least 12 hours. The longer the eggshells are in the solution, the larger the crystals will be!
8. Carefully remove the eggshell geodes from the glasses using a spoon.
9. Place the geodes on a paper towel to allow them to dry. Be careful handling the geodes as they are very fragile and the crystals can fall off easily from the edges.
10. Stand back and look at your creation!



Closure

1. What process causes the crystals to form?
   Geodes form through sedimentation. When a room temperature liquid is not able to dissolve any more solute, in this case alum powder, the solution is called saturated. When the liquid is heated, it is able to hold more solute than it normally would and is supersaturated. As the water cools, the alum begins to “fall out” of the water (precipitate), creating crystals which form on the eggshells. This process is called sedimentation!

2. What would you expect to happen if the water was not boiled before adding the alum powder?
   The water would be unable to dissolve as much of the alum powder and would not be able to become supersaturated. As the supersaturated water cools, the solute (the alum) separates from the water and crystalizes onto the eggshell. Without the supersaturated solution, the alum would not be able to crystalize onto the eggshell unless the water evaporated.