LAB

Tested, edited & approved by:

Sarah Springer, Aurora High School Senior

Borax Crystal Snowflakes

TIME:

15-20 Minutes for craft plus 1-2 Hours for crystals to form

GATHER THIS:

- Borax Powder
- Pipe Cleaners
- Plastic disposable cups for each student or pint jars
- Straw for each student
- Markers and masking tape for kids to label thor container
- Magnifying glasses
- Zip sandwich baggies

THEN DO THIS:

1. Boil 8 cups of water in a pot on the stove.
2. Add 3 cups of borax powder to the boiling water and boil until the water turns clear. There may be a few borax grains still at the bottom of the pot but that is perfectly OK and helps the borax crystal form more quickly.
3. Pour the liquid into cups and let it cool a bit before letting the kids handle the solution.
4. Have the kids write their names on a piece of masking tape and put it on their container.
5. While the borax solution is cooling, form pipe cleaners into snowflakes shapes (or any shape they desire.)
6. Make sure the pipe cleaner shape is small enough to fit into the the container
7. Leave a longer tail of pipe cleaner to bend around a straw or hook onto the edge of the cup.
8. Lower the snowflake into the liquid and adjust the height of the pipe cleaner so that it doesn't touch the bottom or sides of the cup.

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9. Set cups aside and wait at least an hour. Use magnifying glasses to watch the crystal forming process but do not pull the pipe cleaner shape out of the liquid.
10. As the solution cools it will form crystals covering the pipe cleaners and even sides and bottom of the container too!
11. Pull the crystals from the liquid and allow to dry on a paper towel before sending the project home with the kids in zip baggies.

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TALK ABOUT THIS:

Borax is also known as sodium borate. It is from the mineral Boron.
Crystals are made up of a repeating pattern of connected molecules. They are usually geometric and angular with smooth sides.
Crystals can be formed with a supersaturated liquid. When you dissolve borax into hot water, it can dissolve more than you could dissolve in cold water.
The heat causes the molecules to move away from each other allowing more to dissolve. As the solution cools, the water molecules move closer together allowing the crystals to form. Cool!
Have kids wash their hands after creating and analyzing the crystals to remove the borax from their hands.

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Bridge Building

TIME:

30-40 Minutes

GATHER THIS:

- Painter's tape
- Popsicle sticks bundled into groups of 25
- Classroom desks or chairs

THEN DO THIS:

Challenge– to make the strongest bridge across a 1 foot divide between the chairs/desks/tables.

1. Divide the kids into groups of 2.
2. Each pair of kids is given 2 small chairs to place 1 foot apart they will attach their bridge to. (kids can move their chairs to a location around the classroom or designate an area for each group of two)
3. Give each group 25 popsicle sticks and 3 feet of painter's tape.
4. * Brainstorm as a group possible ways to make the bridge. Show pictures as examples. Teams must work together to create their bridge.
5. Kids have 15 minutes to build.
6. At the end of 15 minutes– Test the strength of each bridge. The teacher/helpers move from bridge to bridge and test the strength of each bridge using pennies on each structure to determine the bridge that is the strongest.
7. For young builders - partner them up with older students/volunteers.
8. Clean up – throw away tape. Rebundle craft sticks into groups of 25 for the next group to use, put chairs back to their original position.

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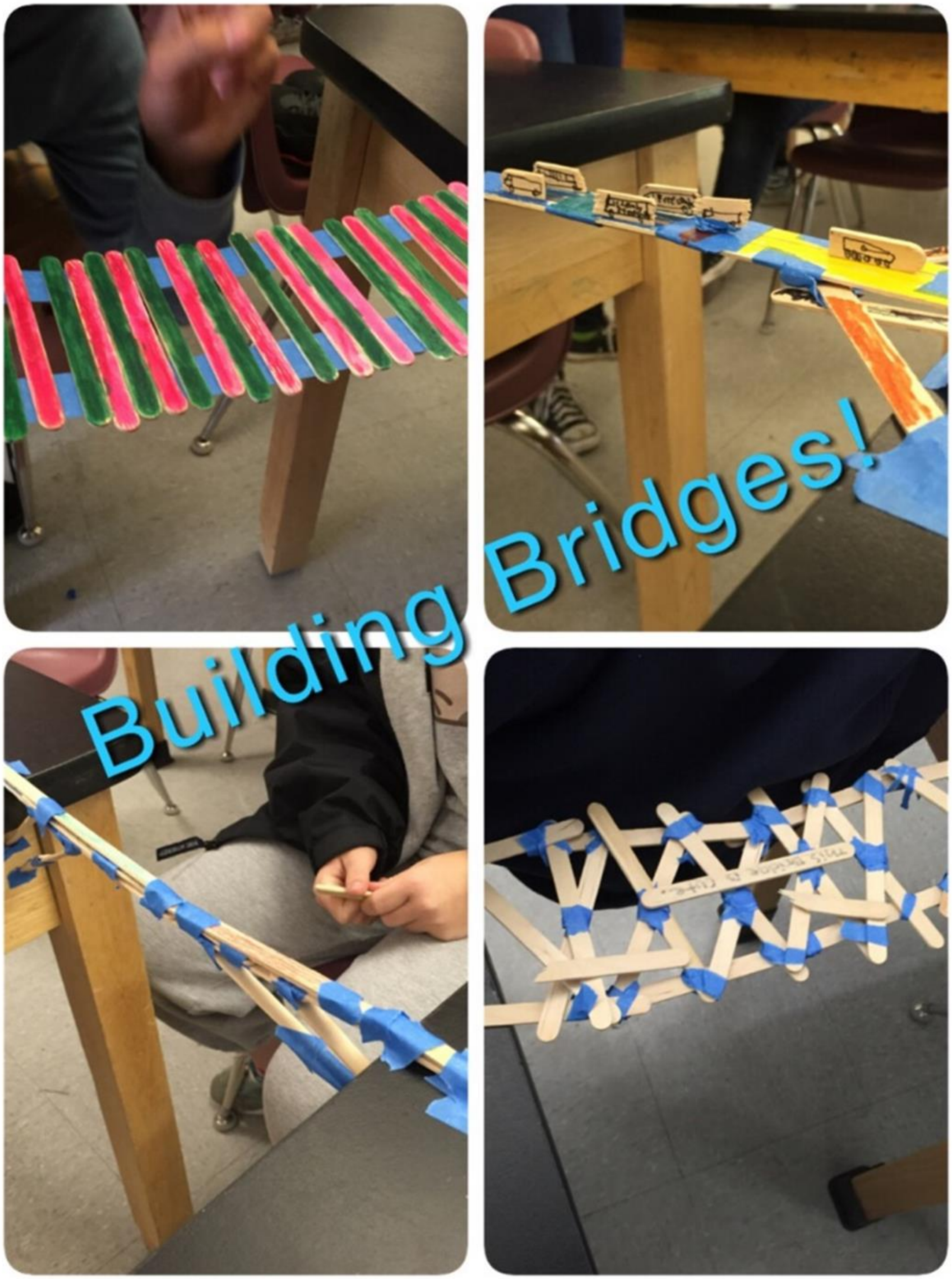

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LAB

Tested, edited & approved by:

Shawna Vinkenberg, Edgerton Afterschool Coordinator

BALLOON SCULPTURE LAB

TIME: 30-45 minutes

BACKGROUND:

This is an informal lab that does not rely on technical knowledge or skills, so it works especially well when your group consists of participants of different job levels. It's a fun activity that allows for the group to work together without thinking about their formal roles within the organization.

You may notice that participants may behave in ways contrary to their job levels or job roles (e.g. someone with lower authority in the office may step up and lead the team or someone who does a more technical job may turn out to be more creative).

MATERIALS: (each group)

- 25 balloons of varying colors and sizes
- Roll of Masking Tape
- Large cardstock for each team to build towers on.

Additional Materials: a tape measurer, sticky notes and pen, and an electric balloon inflator (optional).

CHALLENGE:

Can your team create the tallest free-standing balloon tower using 25 balloons and masking tape?

Free standing means – without anyone holding it up or touching it and without the tower leaning against the wall.

INSTRUCTIONS:

- Put kids into 3 teams. (3-4 kids in each group)
- Determine who can blow up/tie balloons in each group. Adult helpers help with this. Give each team about 10 minutes to blow up balloons. Use a portable electric balloon-inflating machine as well help all team out as well.

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(Helpful Hint - have some balloons blown up ahead of time for each group)

- On "Go" - Team have 10 minutes to build their towers using all 25 balloons and pieces of masking tape. Teams stop building after 10 minutes. (Allow extra time if needed…the process is more important than the time limit). Adult helpers become part of each team to help the process along.
- Use the remaining time to measure each group's balloon tower and determine the tallest.
- On a sticky note - Label each tower with height in inches so kids have a visual of each tower's height.

Take a photo of each group and their finished tower and celebrate teamwork.

WHAT DID YOU LEARN?

- Communication
- Creative thinking

Suggested questions to ask:

- What did you learn about your team members that you didn't know before?
- What communication methods did your team use?
- Did everyone agree with the idea for the balloon sculpture? If not, did you have to compromise?
- How well did you work as a team?
- Did others in the team listen to your opinion? Did everyone have their input?
- Did anyone emerge as a leader, and how did having a leader help?
- What is the one thing you can take away from the task?

LAB

Tested, edited & approved by:

Shawna Vinkenberg, Edgerton Afterschool Coordinator

Blubber

GATHER THIS:

- Large bowls, enough for 2-3 students to share one
- Ice
- Cold water
- Ziploc sandwich bags
- Vegetable shortening
- Spatulas
- Towels
- Thermometer

THEN DO THIS:

Start by filling a large bowl with ice and water, each small group needs their own. Take a ziploc bag and turn it inside out, then put your hand inside. Use a spatula to cover both sides of the bag with vegetable shortening. Place the bag with shortening inside of another bag, and seal if possible.

Take another bag, turn it inside out, and place it into another bag, again sealing if possible. Put your other hand into the bag without shortening, and place both hands into the bowl of ice water.

Observe how your hands feel, and use a thermometer to check the temperature inside of both bags.

If you want to try more experimenting, use the thermometer to check the temperature of the bag before placing it in the ice water. You can also try adding different things in the bags instead of vegetable shortening to see if they work to keep your hand warm.

ASK THIS:

Have a discussion about the differences in temperature and why there is a difference.

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WHAT IS HAPPENING?

The ocean can be a cold place, so some animals have adaptations to help them live better in their environment. Some animals, such as whales, have blubber, and this experiment will demonstrate how it keeps them warm in icy conditions.

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SINKING OR FLOATING FOIL BOATS

BACKGROUND INFORMATION:

- The science behind floating was first studied by an ancient Greek scientist named Archimedes. He figured out that when an object is placed in water, it pushes enough water out of the way to make room for itself. This is called displacement.
- Have you ever experienced displacement? Of course, you have! Remember the last time you got into the bathtub and the water level went up? That's displacement. When you got into the tub, water got out of your way to make room for you, so the water level in the tub got higher.
- When an object enters water, two forces act upon it. There's a downward force (gravity) that's determined by the object's weight. There's also an upward force (buoyancy) that's determined by the weight of the water displaced by the object.
- An object will float if the gravitational force is less than the buoyancy force. So, in other words, an object will float if it weighs less than the amount of water it displaces. This explains why a rock will sink while a huge boat will float. The rock is heavy, but it displaces only a little water. It sinks because its weight is greater than the weight of the small amount of water it displaces. A huge boat, on the other hand, will float because, even though it weighs a lot, it displaces a huge amount of water that weighs even more.

GATHER THIS:

- 12” x 12’ sheets of foil for each student
- A clear tub of water to test completed boats in
- 500 pennies to use a weight to test each boat
- Towels for clean up and wiping up drips

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- A variety of objects to test their sinking and floating capability -(golf ball, small inflatable ball, penny, clothes pin, metal ball, volleyball, paperclip, etc).

CHALLENGE:

Each student will be an engineer and will build/design a boat using 1- 12” x 12” sheet of foil. You want your boat to hold the greatest amount of pennies (mass) possible before sinking. (about 10 minutes).

Kids can work individually or with a partner to create their boat.

When the boat is complete, each student/team brings their boat to the “testing station” (tub of water) to be tested. An adult uses pennies to see how much mass each boat will hold.

Important -- Gently add one penny at a time. To prevent the hull from tipping, carefully balance the load as you add pennies (add pennies left to right and front to back — or port to starboard, fore to aft, if you are feeling nautical).

You may want to keep track of each boat’s strength on a white board.

Kids can redesign and retest their boat to see if they can make it stronger and hold more mass.

WHAT IS HAPPENING?

Buoyancy is a net upward force caused by displacement. A boat displaces a certain amount of water based on its weight and shape. If the weight of the boat is less that the weight of the water it displaces, it floats! If the boat weighs more than the water it displaces, it will sink.

OPTIONAL:

Have a second tub of water available for kids to continue experimenting with a variety of items to see if they to sink and float.

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Lab

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Why Sharks Don't Sink

GATHER THIS:

- Plastic water bottles
- Vegetable oil
- Large plastic tub
- Water
- Optional: plastic toy shark and black permanent markers

This experiment is a great way to show how sharks float without using a swim bladder like most other fish. A swim bladder is a gas filled organ in bony fish that helps them stay afloat. Some types of sharks use their oil filled liver to stay buoyant.

THEN DO THIS:

1. Take two empty bottles and fill one up with oil, and the other with water. If you are crafty, draw a shark face on each of the bottles to look like two sharks.

2. Put the bottles into the water and observe what happens. The oil bottle should float, while the water bottle sinks.

ASK THIS:

- What will the two bottles do once they are in the water?

WHAT IS HAPPENING?

Oil is lighter than water, so it sits on top of it instead of sinking like the water bottle. The oil in the bottle keeps it buoyant, which is how some sharks such as great whites stay afloat.

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LAB

Candle Extinguisher

TIME:

5-10 Minutes

GATHER THIS:

- Candle
- Lighter
- 2 cups
- 1 tsp. baking soda
- 1 tbsp. white vinegar

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Sarah Springer, Aurora High School Senior

TALK ABOUT THIS:

Central Focus: Get ready to be amazed with this activity! In this activity, students will observe "magic" when an empty cup is able to extinguish a lit candle. Through a chemical reaction, students will be able to observe as the chemical properties of baking soda and vinegar change to form new substances and a gas. Students will be able to compare the physical properties of air and carbon dioxide as the reaction occurs and the candle is extinguished.

Key terms: chemicals, chemistry, react, substances, property

Background Information: A chemical reaction is a process in which substances undergo a chemical change to form a different substance. Mixing baking soda and vinegar will create a chemical reaction because one is an acid and the other a base. Baking soda is a basic compound called sodium bicarbonate while vinegar is a diluted solution that contains acetic acid (95% water, 5% acetic acid). There are five signs that indicate a chemical reaction has occurred: odor, energy change, gas bubbles, precipitate formation, and color change. When any of these changes occur, the reaction is irreversible and cannot be undone. The reaction occurs once the vinegar is added to the baking soda. In this reaction, evidence of a chemical reaction is the formation of carbon dioxide gas and

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gas bubbles. There are two separate types of reactions taking place when mixing baking soda and vinegar. The first is called an acid-base reaction. When the two substances are mixed together, hydrogen ions in the vinegar react with the sodium and bicarbonate ions in the baking soda. This initial reaction results in two new chemicals: carbonic acid and sodium acetate. A decomposition reaction is the second reaction that occurs. The first reaction created carbonic acid which immediately begins to decompose into water and releases carbon dioxide gas (CO2). The CO2 rises to the top of the mixture and creates the bubbles that are a hallmark of the baking soda and vinegar reaction. Oxygen is required for a flame to burn. The carbon dioxide gas produced in this reaction is more dense than normal air, and it sinks to the bottom of the cup. When poured over a flame, the carbon dioxide will push out the surrounding oxygen molecules and extinguish the flame. As the carbon dioxide is colorless, it gives the appearance of an empty cup extinguishing the flame.

THEN DO THIS:

- To begin this activity, first light the candle and put it to the side.
- Measure 1 teaspoon of baking soda into an empty cup.
- Add 1 tablespoon of white vinegar to the baking soda.

This will undergo a chemical reaction and will release carbon dioxide gas.

- Pour only the air from the cup with the baking soda and white vinegar into an empty cup.
- Pour your “empty” cup (with CO2) over the lit candle.
- The candle will extinguish.

ASK THESE QUESTIONS:

1. **Has a reaction occurred? How can you tell?**

Yes, a reaction has occurred. A sign a chemical reaction has occurred is the formation of gas, which can be seen in the form of bubbles. Once the vinegar is added to the baking soda, carbon dioxide is released as a product. The bubbling is the release of CO2.

2. **What is being poured out of the “empty” cup? Why does this pour out differently than air?**

Carbon dioxide is being poured out of the seemingly empty cup. Carbon dioxide is a colorless, odorless gas that forms as a product from the chemical reaction occurs between the vinegar and the baking soda. Carbon dioxide is heavier than normal air. When the reaction occurs and the “air” is poured from one cup to the other, it is actually the CO2 being poured. Although the CO2 is colorless like air, it is much heavier and is able to put out the flame of the candle when poured over it.

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LAB

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Cloud in a Jar

TIME:

15 Minutes

GATHER THIS:

- Glass Jar With Lid
- 1/3 Cup of Hot Water
- Hairspray
- 1/3-1/3 Cup of Ice

THEN DO THIS:

Central Focus:

In this activity, students will create a cloud inside of a glass jar. The benefit to this activity is that students are able to see the cloud forming and moving in the jar due to the hairspray. This activity could be used as an introduction to how clouds are formed and different weather systems.

Keywords:

model, system, atmosphere, demonstration, interactions, interact, formation

Background Information:

What is a cloud made of? A cloud is simply a visible condensation of water that is suspended in the air. Clouds form as warm air rises in the atmosphere and then cools down. The sun heats water, which causes it to evaporate into the air. Warmer air rises and cooler air sinks. As the warmer air containing water vapor rises, it is cooled. As the water vapor cools, it condenses into water droplets onto particles, such as dust, in the air. As more and more air cools, more droplets are formed and create a visible cloud. When a large number of water droplets stick together, gravity pulls them back to earth, creating rain.

1. Pour the hot water into the jar.
2. Swirl the jar around.
3. Place the lid upside down on top of the jar.

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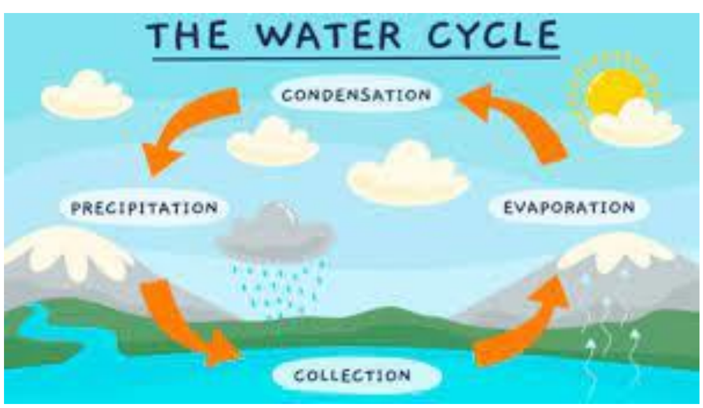
4. Place the ice cubes onto the top of the lid.
5. Wait 20-30 seconds.
6. Remove the lid and quickly spray hairspray in the jar.
7. Put the lid back on the top of the jar, keeping the ice on the top just like before.
8. Watch as a cloud forms inside the jar!

THEN ASK THIS:

1. What temperature change occurred when the ice was placed on top of the hot water onto the lid of the jar?
   Some of the water turned to water vapor (gas) when poured inside the jar. When the water vapor rises, it meets the cooler air near the lid with the ice and condenses onto the hairspray, forming a cloud.
2. What phase change occurred right after the hair spray was quickly sprayed into the jar and the top was placed back on? How do you know?
   Condensation occurred when the hairspray was quickly sprayed into the jar. We know this because the water droplets condensed onto the hairspray, causing a visible cloud to form in the jar. The cloud that we see is evidence of a condensation phase change.
3. What is the cause of the swirling of the cloud?
   The swirling of the cloud that is visible in the jar is caused by the air circulating. Warm air rises and cooler air sinks. When the warm air rises to the top of the jar, it is cooled by the ice on the lid. When the cool air sinks to the hot water at the bottom of the jar, it is warmed. This creates a cycle of warm air rising and cool air sinking, making a visible swirling cloud.
4. Would the cloud still form if the hairspray was not present? Why or why not?
   Yes, the cloud would still form, although it may not be as visible. The water droplets condense onto any available particle- dust, dirt, or in this case, hairspray. The hairspray in this activity helps the cloud to be more visible, but it would work without it!



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LAB

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Sarah Springer, Aurora High School Senior

Eggshell Geodes

TIME:

2 days

GATHER THIS:

- 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

TALK ABOUT THIS:

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: 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.

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

THEN DO THIS:

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!

ASK THESE QUESTIONS:

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.

LAB

Tested, edited & approved by:

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Elephant Toothpaste

TIME:

20-30 Minutes

GATHER THIS:

- Large bowl
- Clear bottle
- 1 packet of dry yeast
- 4 tbsp. warm water
- 4 oz. 20-volume hydrogen peroxide
- Dish-washing liquid
- Food coloring

THEN DO THIS:

Central Focus:
In this activity, students will observe a chemical change by combining a yeast mixture with hydrogen peroxide and dish soap. The resulting foam ("elephant's toothpaste") demonstrates a chemical reaction that can "explode" in student engagement! Keywords: chemicals, demonstration, react, changes, mix, interpret, properties, property, substance, explosion, engaging

Background Information: A chemical reaction is a process in which substances undergo a chemical change to form a different substance. In this reaction, the hydrogen peroxide is catalyzed by the yeast to release the oxygen molecules. The foam is oxygen-filled bubbles that result from the hydrogen peroxide being broken down into water (H2O) and oxygen (O2). This reaction uses yeast as a catalyst. A catalyst is a substance that increases the rate of a chemical reaction. In this case, the yeast helps to separate the oxygen from the hydrogen peroxide. In this reaction, the bottle will feel warm to the touch because it is an exothermic reaction. This means that the chemical reaction releases heat as it occurs. The opposite also demonstrates a chemical reaction. An endothermic reaction would feel cool to the touch.

Instructions:
1. Fill a large clear bottle with 4 ounces of 20-Volume Hydrogen Peroxide. Then, place the bottle inside a large clear bowl.

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2. Add a squirt of dish-washing liquid to the bottle containing the hydrogen peroxide.
3. Add a few drops of food coloring to the bottle.
4. In a separate container, mix a packet of yeast with 3-4 tablespoons of warm water. Mix thoroughly for a few minutes; the yeast needs time to dissolve and to also to become activated.
5. Pour the yeast/water mixture into the bottle and watch the foam as it rises over the top of the bottle and out into the bowl!

TALK ABOUT THIS

1. **How is the final substance different from its starting ingredients? What are some signs that show it is different?**

The starting ingredients (hydrogen peroxide, yeast, water, and dish soap) are separate ingredients that can be identified. The final substance is unable to be separated into distinct parts. The physical appearance, texture, and color are all signs that the final substance is different from its starting ingredients.

2. Has a chemical or physical change taken place here? How do you know?

A chemical change has taken place. One way that we know that is because bubbles are formed. These bubbles indicate that the hydrogen peroxide has been broken apart into water and oxygen. Another reason we know that a chemical change has occurred is because there is a change in temperature. Endothermic and exothermic reactions are indicators of a chemical change.

3. How does this reaction occur?

This reaction occurs when the yeast acts as a catalyst to separate the oxygen from the hydrogen peroxide. The foam is a result of oxygen-filled bubbles from the hydrogen peroxide being broke into water (H2O) and oxygen (O2).

4. Is the reaction endothermic or exothermic? How do you know?

The reaction is exothermic. We know this because the bottle will feel warm to the touch when the chemical reaction occurs.

LAB

Floating Ball/Hover Activity

Tested, edited & approved by:

Sarah Springer, Aurora High School Senior

TIME:

20- 30 minutes

https://youtu.be/wFCdCRx_IPs (check out this video to show process)

GATHER THIS:

- Cardstock to copy circles on
- 4 -5" Plastic lids/CDs to trace
- Bendy flexible straws
- Pencils
- Foil to make into balls
- Cotton balls or small balloons
- Scissors
- Scotch tape
- Markers and scrap paper to decorate hover catchers

THEN DO THIS:

1. Kids trace lid/CD and cut out a circle from cardstock. Then cut a slit from the outside to the center.
2. Roll the circle into a cone shape and staple together.
3. Cut a small hole out of the point of the cone.
4. Decorate the catcher cone with eyes and teeth, etc.
5. Tape a bendy straw into the hole and seal completely with tape.
6. Put a cotton ball/foil ball into the cone. Use the straw to blow and make the cotton ball hover.

Additional challenges for the kids to try:

- How long can you make the pom hover?
- Can you and a partner blow and catch one cotton ball back and forth?
- Switch out the pom for a ball of foil…which is easier to make hover?

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LAB

Lego Zip Line Engineering

Tested, edited & approved by:

Sarah Springer, Aurora High School Senior

TIME:

30-45minutes

GATHER THIS:

- Legos
- Lego People
- Cord, yarn or thick string
- Step stool

THEN DO THIS:

The STEM Challenge: to create the best zip lining "cage" they can in 20 minutes so their Lego guy can make it safely to the bottom of the zipline.

First – **Show the video below** giving the kids a glimpse into zip lining so they can see how a zip line works and so they can plan and design their zip lining cage.

https://www.youtube.com/watch?v=9m5v1clafEs **"Kids Ride GIANT ZIPLINE in HAWAII on Family Adventure!!"**

Directions:

1. Build a Lego cage – this should be a structure that can hold the LEGO minifigure with a hole on the top where the zip line will go through.
2. Put the LEGO minifigure in the cage.
3. Tie one end of the string to a doorknob, back of a chair, or any place that is stationary and off the floor.
4. Thread the string through the hole in the Lego cage.
5. Pull the string so that it's taut and hold the loose end tightly and on a decline (Kids may use a step stool/chair to experiment with a greater slope).
6. Push the cage all the way to the highest point of the string.
7. Before each experiment, ask kids to predict what their cage will do to develop critical thinking skills. (see next page for science concepts)
8. Let go of the cage watch it slide down the zip line!

OPTIONAL - set up multiple zip line with varying thickness of string/yarn for the kids to experiment with.

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Kids can test their cage and then go back and redesign to make their cage better. Or start again and design a completely different cage. (trial and error)

Discuss the following science concepts as each cage is tested:

- speed up the lego man by increasing the angle of the slope
- slow down or stop the lego man by evening out the angle of the slope
- return the lego man by decreasing the angle of the slope
- gravity works to pull the LEGO man down the zip line but the angle of the slope can slow gravity
- tension on the cord is needed to maintain travel

TALK ABOUT THIS:

While the LEGO zip line may seem like just a simple, fun activity, there are so many science concepts that you can teach your kid. As the kids experiment with different designs, talk about:

Gravity: Why do the minifigure and the cage go downward on the zipline instead of sliding upward? Gravity is the force that pulls objects toward the center of the Earth. In this case, gravity is pulling the LEGO pieces to the ground.

Friction: Why do some cages slide down smoother than others? Friction occurs when one object rubs against another. Friction works against and acts in the opposite direction of motion.

Slope: How can you make the same cage design slide down the zipline faster or slower? The slope describes how steep a straight line is, and you can change the slope of the zipline by moving the end of the string that's touching the ground.

Speed: How fast does the cage move down the zip line? Speed is the measure of how fast something is moving or the distance that an object moves in a certain amount of time.

Weight: Do heavier cages slide down the zipline faster? Weight is the force gravity applies to an object and has an impact on speed

LAB

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STEM Ski Challenge

TIME:

35-40 Minutes

https://youtu.be/Zg5scW15kLc

GATHER THIS:

- 1 12" x 12" sheet of foil
- Masking Tape
- Scissors
- Craft sticks

A simple ramp made from cardboard or any flat surface the skier can run down.

- Optional -hot chocolate, marshmallows in styrofoam cups to serve kids at the conclusion of the activity.

THEN DO THIS:

Challenge - Create a skier that will get to the bottom of a hill on his/her skis.

Share the following story with the students to make the challenge more motivating.

Perry is on a ski trip in the mountains called the Swiss Alps. Perry has a problem. When he got to the top of the hill, his skis broke! Perry just found out that there is a hot chocolate sale at the bottom of the mountain. (show the ramp = the mountain)l. The kids need to help Perry get to the bottom of the hill by building him new skis so he can get his hot chocolate.

1. Kids will need to decide if they are creating/engineering a skier, a sled or snowboarder. (Skiers and snowboarders need two craft sticks, sled will need three).

Then demonstrate the following. Kids will create their own Perrys and ski equipment to try on the mountain.





2.) Start by bending a piece of tin foil in the shape of an upside-down U. Then tape it down onto two craft sticks.
3.) Bend the next piece of tin foil in the shape of a J. This will be our body. Hook the bottom of the j around the legs and make sure it's tight.
4.) With the next piece of tin foil, roll it up. This will be our arms. Place them on the middle of the body and crisscross the arms around the body.
5.) With a small piece of tin foil, ball it up, then place it at the top of the body!
Have kids create Perry's skis, sled or snowboard and use tape to connect Perry to it. (sleds and snowboards can be hooked together with tape).
6.) Before you let Perry go down the hill, have the students predict how Perry will ski. Will it fall over or stay up straight? Will it go slow or fast? Once predictions are made Perry is finally ready to go down the hill! Find a flat slanted surface and take Perry to the top and let them go! This is also a perfect time to introduce **trial and error**t. At first, Perry may fall over, check to see if the skis are uneven? What if Perry is really slow? Try taping a penny to each ski and see if the weight will change the outcome.

Kids can come to the slope and give their 'Perry' a trial run. Encourage them to make adjustments to their skier and then try it again. Have fun!.

vocabulary words:

Prediction– the act of saying what might happen.

Trial and error– The process of experimenting with something to find the best option. Things may fail but try, try again!

At the end of the session, serve your students hot chocolate!!! With all the thinking and engineering- they've earned a sweet treat!

ART LINK

Kids can use markers to decorate their skis/skeds/snowboards.