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Ohio Valley Museum of Discovery

OHIO VALLEY MUSEUM OF DISCOVERY

SUMMER CAMP STEAM BOXES

Hands-on summer fun at home!
(+ a museum Zoom session with every box)

Week 5:

Kitchen Chemistry

- Molecule Models
- Vinegar and Baking Soda Reaction
- PH testing and Invisible Ink
- Penny Chemistry and Verdigris
- Crystals
- Slime and DIY Bouncy Ball

Bouncy Ball (adapted from thoughtco.com)

1. Get out two small bowls or cups. Label one "Borax Solution" and the other "Ball Mixture."
2. Measure and pour 30mL (2 tbsp) of warm water and 2.5mL (½ tsp) of borax into the cup labeled "Borax Solution." Stir well to dissolve the borax. Add color if you would like (use either the cabbage pH indicator solution or food coloring).
3. Measure and pour 15mL (1 tbsp) glue into the cup labeled "Ball Mixture." Add 2.5mL (½ tsp) of the borax solution you just made. Add 15mL (1 tbsp) cornstarch. Let the ingredients sit for 10-15 seconds, then begin stirring. Once the mixture becomes impossible to stir, take it out of the cup and start molding it into a ball with your hands.
4. The ball will start out sticky and messy but will solidify as you knead it.
5. Once the ball is less sticky, go ahead try bouncing it.
6. You can store your plastic ball in a sealed bag when you're finished playing with it.
7. If you need to dispose of it, make sure you put it in the trash. Do NOT pour it down the drain.

Welcome to
Summer Camp @OVMoD
Summer 2020

Thank you for choosing Summer Camp @OVMoD Summer 2020!

Session 5: Kitchen Chemistry
Zoom Session Tuesday, August 4, 9:30-11:00am

Here's how it works:

- **Summer Camp Kits:** Kits are collected during a no-contact pickup at the Ohio Valley Museum of Discovery (67 Columbus Rd, Athens) or can be delivered.
- **Start exploring the kit!** You may begin exploring the activities on your own or wait for the Zoom session.
- **Video/telephone meetups via Zoom:** Live Zoom sessions with OVMoD staff and special guests occur ***on scheduled Tuesdays from 9:30am-11:00am.***
- **This booklet contains information for projects that will be covered during the fifth Summer Camp Session.**
- **Books shared during the camp session include:**
  Amber's Atoms by E.M. Robinson, illustrated by McAliley

Let's Begin!

Before our first Zoom session, you should:

- Find your best way to join Zoom. If joining by video, sign up for a free account on the website (zoom.us) or app (search "Zoom" in your app store). When it is time for our meeting, you can
    - Click the link in the Summer Camp introduction email
    - Click "Join a Meeting" in the website or app and enter our Session 1 **meeting ID 856 5359 3083** and **password 851418** (if prompted)
    - Call in by **dialing 1 (929) 205-6099** and entering the meeting ID and password when prompted.

- Set up your camp area. You'll need a little bit of space to attend virtual summer camp:
    - A smooth, flat work surface that you can sit at comfortably.
    - Some space to move your body and make some music.
    - A place to store your camp bag and works in progress.
    - A place to display your completed projects.

Slime

1. Start by putting on your goggles and gloves and protect your work area with the table covering and tray.
2. Place a large bowl on the tray, and measure 120mL (½ cup) water and pour it into the bowl.
3. Measure 120mL (½ cup) glue and add to the water in the bowl.
4. Stir them together well.
5. If you want to add color to your slime, stir it in now. You can use a little bit of your cabbage or turmeric pH indicators from activity 3, or you can use food coloring if you have some at home.
6. **With an adult's help,** measure and heat 120mL (½ cup) water. You can heat it in a microwave, on the stove, or in a kettle to almost boiling.
7. Carefully measure 5mL (1 tsp) borax, and start adding it slowly to the hot water and stir until it dissolves. There might be some that doesn't dissolve; that's okay. Let the liquid cool. This is your **borax solution**.
8. Slowly pour the borax solution from step 7 into the glue solution (step 4) in the large bowl, while stirring. It will quickly thicken. Keep stirring and adding borax solution until it is as thick as you like. You've created a non-Newtonian fluid!
9. What happens as you play with your slime? How far can you stretch it before it breaks? Can you see through it? Does it bounce? What else do you notice about your slime?
10. Store your slime in a jar or container with a tight-fitting lid.
11. When you are done playing with your slime, you can turn it into a window cling suncatcher. Find a shallow plastic container or lid, and fill it with a thin layer of slime. Let it dry for two days, then stick it to the window and admire the sun shining through it! If you plan ahead, you can make several different colors of slime and create a multi-colored design for your suncatcher. When you want to remove the suncatcher from the window, you may need to soften it with a little bit of vinegar.
12. When you are all done with slime and suncatchers, be sure to throw it away in the trash. Do NOT pour the slime down the drain.

Activity 6: Slime and DIY Bouncy Ball

Supplies:
(items with * are NOT included in the kit)
Goggles
Gloves
*Table cover
*Tray to catch spills
*Large bowl
Beaker
*Water
Glue
Spoon
A few drops of the pH indicators from activity 3, or *food coloring, optional
*Small heatproof bowl or cup
5mL measuring spoon
Borax
Jar or container with tight-fitting lid
2 small bowls or cups
Cornstarch
Small zip-top bag

You've probably already made or played with slime. But what is it? Slime is a special type of chemical called a polymer. Polymers are made of molecules that are layered together in a repeating pattern. Lots of everyday items are types of polymers, like rubber bands, nylon, or glass. Slime is a type of polymer called a non-Newtonian fluid, which means that it can get thicker and thinner depending on how much pressure you put on it. When you play with slime, it gets really thick and you can even break it if you pull it apart quickly. When you let it sit and don't put any pressure on it, it becomes thin and flows easily, which you can see if you leave it out in a wide bowl or plate for a few minutes - it spreads out to fill the dish.

In the Kitchen Chemistry STEAM box, you will find several household chemicals, measuring spoons and cup, safety goggles and gloves, and supplies for each of the following activities:

Activity 1: Molecule Models **begins on page 4.**
We will create some molecule models together during our Zoom session, but feel free to build more using the images shared on our website.

Activity 2: Vinegar and Baking Soda Reaction **begins on page 8.**
Create a chemical reaction by combining molecules with different properties.

Activity 3: PH Testing and Invisible Ink **begins on page 10.**
Test the properties of acids and bases and put them to use as an invisible ink decoder.

Activity 4: Penny Chemistry and Verdigris **begins on page 13.**
Explore how metals react with air and why our Statue of Liberty looks green.

Activity 5: Grow Your Own Crystals **begins on page 16.**
Ask for adult help on this one because hot water and borax are used. You'll be able to create some beautiful crystals.

Activity 6: Slime and DIY bouncy ball **begins on page 18.**
Ask for adult help on this one because hot water and borax are used. Create your own non-Newtonian fluid (slime) and another version of it that becomes a bouncy ball.

Activity 1: Molecule Models

Supplies:
(items with * are NOT included in the kit)
*Table covering
Toothpicks
Mini marshmallows
Large marshmallows

Everything around us is made up of *atoms*. These are extremely tiny particles that can combine together to form *molecules.* Molecules are made of different types of atoms to create things like oxygen, carbon dioxide, water, baking soda--in fact, atoms and molecules make up everything around us, including all living things! Different types of molecules have specific structures, just like you can imagine how different types of buildings have different types of structures. Think of what an office building looks like, for example, and compare it to what a gas station usually looks like. Both are structures, but they are very different because they do different things. It's the same with molecules. We can create models of what molecules look like using marshmallows as atoms that we will combine by connecting them together with toothpicks.

Molecule models

1. Lay out your table covering to protect your work area. Marshmallows can get sticky!
2. Let's start by thinking about the gases we breathe in and out. We breathe in lots of molecules of oxygen, and we breathe out lots of molecules of carbon dioxide. Have you ever wondered what these molecules look like?

Crystals

1. Place the wooden skewer across the top of the container so that the pipe cleaner shape is in the borax solution.
2. Now it's time to wait - until tomorrow! Leave your container with the solution in a spot it won't be bumped or shaken.
3. While you wait, you can watch your pipe cleaner shape to see if it's growing crystals.
4. Once the shape is completely covered in crystals, you can take it out of the borax solution and let it dry. Trim off the string and enjoy!
5. If you want to make more crystal shapes, simply pour the water out of the now crystal-lined container (the water can go down the drain). Boil fresh water and pour it into the container to re-dissolve the borax and place a new pipe cleaner shape in it.

Activity 5: Grow Your Own Crystals (adult help needed)

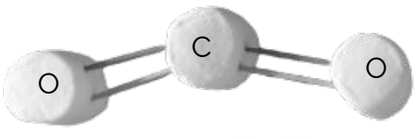
Supplies:
(items with * are NOT included in the kit)
Pipe cleaners
String
*Scissors
Wooden skewer
*Glass or plastic container large enough to hold your shape or letter
Borax
15 mL measuring spoon
Beaker
*Large stirring spoon

Create your own crystal shapes (adapted from playdoughtoplato.com)
When borax (sodium tetraborate) is dissolved in water a suspension is created. A *suspension* is a mixture that has solid particles (the borax) that are large enough to settle out (*precipitate*). As the borax begins to precipitate, it starts to crystalize on all the surfaces it comes into contact with. As the borax continues to settle out, it builds crystals on top of other borax crystals, creating a thick layer.

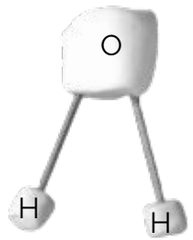
1. Use the pipe cleaners to create interesting shapes. Try flowers, snowflakes, stars, or try making the letters of your name. Tie the string onto the top of the shape, and wrap the other end of the string around the wooden skewer.
2. Put on your safety goggles and gloves.
3. Measure 90mL (6 tablespoons) of borax into the glass or plastic container.
4. **With an adult's help,** measure 480mL (2 cups) of water and boil it. When it reaches a boil, pour it slowly into the container with the borax.
5. Stir carefully to dissolve the powdered borax.

3. The oxygen molecule is made of up two oxygen atoms, so its chemical name is O_2 (O is for Oxygen). Choose two large marshmallows to be the O atoms. In the molecule, these atoms are tightly connected, so use two toothpicks to connect the marshmallows. You've just made your first molecule model!

4. Carbon dioxide molecules are made of one Carbon atom (C) and two oxygen atoms (O), so its chemical name is CO_2. Its atoms are also tightly connected, so use two toothpicks to connect your two oxygen atoms to the single carbon atom, like you see in the picture.

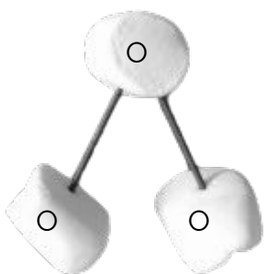


5. Can you copy the structure of the molecules for these other common things? Some atoms are larger than others, so you can use large and small marshmallows to show different atoms in a molecule.
6. Water (H_2O) is made up of two hydrogen (H) atoms and one oxygen (O) atom.

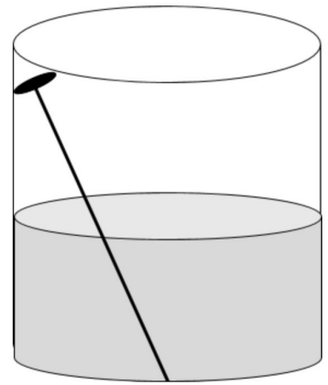


7. Salt (also called sodium chloride, or NaCl) is made up of one sodium (Na) atom and one chlorine (Cl) atom.

8. Ozone (O_3), that smell we notice right after a thunderstorm, is made up of three oxygen (O) atoms.



1. While your pennies are drying, take the nail or screw and place it so it is sitting half in and half out of the salt and vinegar solution that you used with the pennies.



2. Do you notice anything happening with the screw?
3. Let it sit for 10 minutes and check it again. Has anything changed? What do you think is happening?
4. If you don't notice any changes, place the nail or screw back into the solution (in the same half-way position) and let it sit for one hour. Do you see any changes between the part that was in the solution and the half that was out?

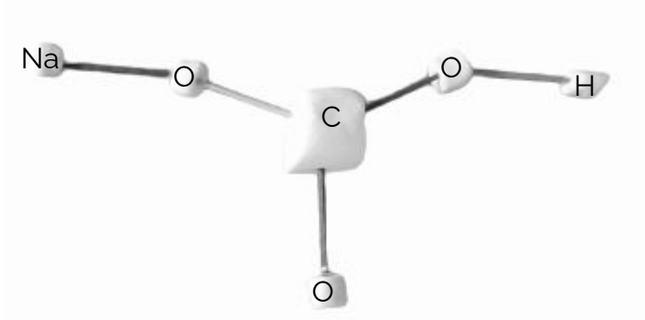
Nails and screws are usually made of steel - an *alloy* (combination of metals) mostly made of iron. In the salt and vinegar **solution**, positively charged copper *ions* (molecules with an electrical charge) stayed in the liquid, even when we took the pennies out. The salt and vinegar solution also *dissolves* some of the iron on the nail and *oxidizes* on its surface - causing a negative charge. What happens when negative and positive charged ions meet? They **attract**! Those positive copper ions are strong, so they really stick to the surface of the nail. Another reaction going on at the same time produces hydrogen gas - if you saw any bubbles, this is what they were!

Pennies get dull because the oxygen in the air reacts with the copper in the pennies to form *copper oxide*. That's why new pennies are so shiny but older pennies are darker - oxide makes pennies look greenish and dull. The acetic acid in vinegar dissolves copper oxide, making pennies look brighter.

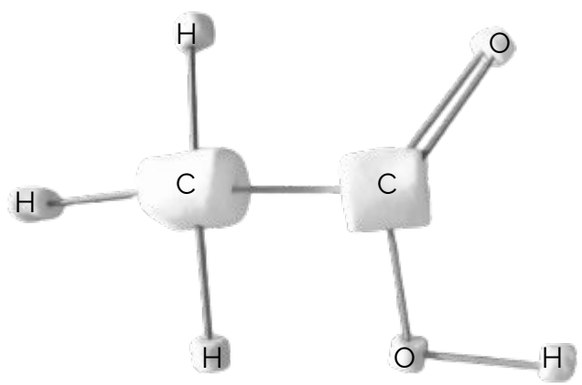
7. Save the liquid from your experiment. After 5 minutes, take half of the pennies out and place them on a paper towel to dry.
8. Take the rest of the pennies and rinse them in fresh water. Place these on a separate paper towel to dry. Label this paper towel "Water".
9. Let the pennies sit for about an hour. What do you notice? Record your observations again:

When you rinse the pennies with fresh water, the *reaction* stops. They will get dull again, but that takes some time. The salt and vinegar reaction on the pennies that are not rinsed causes a reaction between pennies and oxygen in the air. This bluish-greenish color is called "*verdigris*". You might see this as a *patina* (thin layer) on architecture. This chemical reaction is also why the Statue of Liberty looks green!

9. In some of our other Kitchen Chemistry activities, we'll be using vinegar and baking soda. The baking soda molecule has one sodium (Na), one hydrogen (H), one carbon (C), and three oxygen (O3) atoms, which we shorten to NaHCO3.



10. The vinegar molecule, also called CH3COOH or C2H4O2, is a little bit more complicated. See if you can assemble this molecule. Notice that one of the carbon atoms is tightly connected to the single oxygen atom (use two toothpicks).



Now that you've made these bigger molecules, carefully pick one of them up. See how it doesn't always stay flat? Molecules are often found in different shapes, and that can cause them to work in different ways, just like different types of structures have different purposes.

Activity 2: Vinegar and Baking Soda Reaction

Supplies:
(items with * are NOT included in the kit)
*Table covering
*Tray to catch spills
Empty water bottle
Vinegar
Balloon
*Marker (optional)
Paper
Baking Soda
15mL measuring spoon

1. Put on your safety goggles.
2. Place the empty plastic water bottle on the tray. Measure and pour 60 mL (¼ cup) of white vinegar into the bottle.
3. If you'd like to decorate your balloon, you can draw on it with a marker. (Water based markers might wipe off, so give it a few moments to dry).
4. Stretch the balloon a little bit. Roll the paper into a funnel shape and place it into the open end of the balloon (you may need help from someone in your home). You may use a plastic funnel instead if you have one.

Activity 4: Penny Chemistry and Verdigris

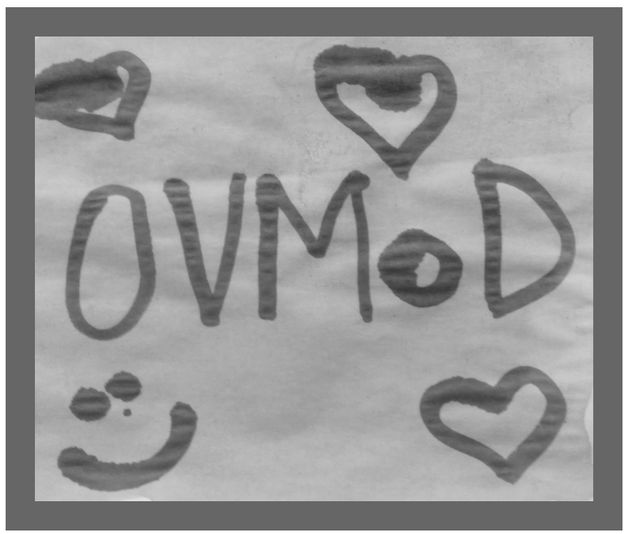
Supplies:
(items with * are NOT included in the kit)
*Table covering
*Tray to catch spills
Salt
5mL measuring spoon
Beaker
Vinegar
Spoon
6 dull pennies (or more if you'd like to add some from home)
Paper towel
*Water
Screw or nail
*Timer

(Adapted from
https://www.thoughtco.com/chemistry-fun-with-pennies-602055)

1. Don't forget to wear your safety goggles.
2. Measure 5mL (1 tsp) of salt into a beaker.
3. Measure 60 mL (¼ cup) of white vinegar into the beaker. Stir until salt *dissolves*. (You should not be able to see any more grains of salt).
4. Hold a penny and dip it into the *solution* while you slowly count to 15. Remove the penny from the liquid. What do you notice?

5. Place all of the pennies into the liquid and leave them there for 5 minutes.
6. Record your *observations* here:

4. Measure 15mL (1 tbsp) of baking soda with your large measuring spoon and add it to the water. Stir to mix. Keep stirring as you use it to keep the baking soda dissolved in the water.
5. Lay out a piece of white paper on the tray and start drawing, using a q-tip and the baking soda solution. It will be hard to see what you are drawing! Try writing words, or just draw some doodles. Let it dry. It will look like a plain piece of paper!
6. Now place your bottle of turmeric solution on the tray, and, with the paintbrush, paint the solution over your invisible ink drawing. What happens?
7. Just as when you tested chemicals with the pH indicator, your baking soda drawing reacted to the indicator, turning red. Is the baking soda solution an acid or a base?
8. When your artwork is all done (and dry), glue it to the construction paper and hang it up! You've made art with chemistry!



5. Measure and pour 30 mL (2 tbsp) of baking soda through the funnel and into the balloon.
6. Carefully open the mouth of the balloon and secure it onto the top of the plastic bottle. Try not to let any of the baking soda escape yet!
7. After the balloon is completely secure on the top of the bottle, gently lift the balloon so that the baking soda falls into the liquid. Watch carefully - what happened?

Baking soda and vinegar make an acid-base reaction. The two chemicals interact to form a gas - in this case, *carbon dioxide* (CO_2). That's one carbon atom and two oxygen atoms bonded together. Carbon dioxide is the same gas that we humans breathe out. Our balloon captures that carbon dioxide and prevents it from escaping into the atmosphere.

Activity 3: PH testing and Invisible Ink

Supplies:
(items with * are NOT included in the kit)
*Table covering
*Tray to catch spills
*4 medium-sized glass cups (drinking glasses or jelly jars works well)
Beaker
*Water
Safety goggles
Vinegar
Measuring spoons (5 mL and 15 mL)
Baking soda
Spoons
pH indicator solution (red cabbage, water)
Pipette
Paper
Q-tips
Paintbrush
Turmeric solution (turmeric, rubbing alcohol)
Construction paper
Glue stick

PH testing
PH tells us how *acidic* or *basic* something is. You can think of acidity as being how sour something is, like a lemon, and basicity as how soapy something is, like dish soap. We can test if something is acidic or basic with a special chemical called a pH indicator. Adding the pH indicator to an acid or base causes a chemical reaction that we can see because it can cause the color to change. If the color doesn't change much, then the item you're testing has a neutral pH, meaning it's in the middle, not too sour or too soapy.

1. To set up your experiment area, lay out a non-absorbent covering (such as a plastic bag or tablecloth) with a plastic or metal tray on top of it to use as your workspace. Place 3 glasses (or jars) on the tray. Place your 3 beakers on the tray. Put on your safety goggles.
2. Make a solution using the washing soda and water. Measure 40 mL of warm water and 1 tsp (5 mL) of washing soda into one beaker. Stir until the soda is dissolved in the water.
3. Use a clean beaker to measure 40 mL of pH indicator into all three glasses. Don't forget to wash your beaker!
4. Measure 40 mL of water into one beaker and 40 mL of vinegar into the other beaker. You can label these to help you keep track.
5. Pour the water into one glass of pH indicator. What did you notice?
6. Pour the washing soda solution into the second glass of pH indicator? What changed?
7. Pour the vinegar into the third glass of pH indicator. What happened? Why do you think it's the same or different from the others?
8. The pH indicator turns reddish-pink in an acid and blue-ish green (sometimes yellow) in a base. If you didn't label the containers, how can you tell which is which?

Make Art with Invisible Ink
Experiment with invisible ink! First you will make invisible ink and draw with it. When you're all done, you can reveal what you've drawn with another pH indicator!

1. Use the same experiment area as you did for the pH testing and set your 4th (unused) cup on the tray.
2. Remember to put on your safety goggles!
3. Use your beaker to measure 120mL (½ cup) of water and pour it into the cup.