



C5ISR CENTER STEM@Home

Welcome to STEM@Home!

As we maneuver the challenges of the COVID-19 epidemic, we strive to continue to make STEM accessible to all.

The STEM@Home Newsletter is intended to be a resource to provide engaging and educational activities that can be done with minimal materials and a whole lot of imagination.

In this Issue...

Water Water Everywhere
(Grades K-2)

The Tower of Density
(Grades 3-5)

All About the Base
(Grades 6-8)

Shine like a Penny
(Grades 9-12)

Issue 4



eCYBERMISSION, part of the Army Educational Outreach Program (AEOP) portfolio, is a web-based STEM competition for students in **grades six through nine**. Students are challenged to explore how STEM works in their world, while working as a team to solve problems in their community.

Learn about Army Educational Outreach Program (AEOP), eCYBERMISSION, and how these programs can help you on your STEM Journey.

Hear from students and young professionals who have participated with the AEOP portfolio of programs:

- Watch the 2020 AEOP Alumni Panel Live

June 18
2:00 - 3:00

<https://www.youtube.com/watch?v=XvjJdcV3Pd4&feature=youtu.be>

Be a part of the 2020 National eCYBERMISSION Event

Check out the incredible work of the 2020 finalists:

- Watch the 2020 National Showcase Live to see the projects completed by this year's national finalists and to vote for your favorite:

June 19
9:00 - 12:00

<https://www.youtube.com/watch?v=p594KHSRTe0&feature=youtu.be>

- Cheer on your favorite teams at the National Awards Presentation Live:

June 19
1:00 - 2:00

<https://www.youtube.com/watch?v=nXC45ImrgmY&feature=youtu.be>

SHARE YOUR STEM...



Visit the C5ISR Center on Facebook to post a photo or video of your child completing one of the STEM@Home Activities.

<https://www.facebook.com/CCDC.C5ISR/>

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Water Water Everywhere (Grades K-2)



Understanding Density

Vocabulary:

Mass is the amount of matter in an object. This is different from your weight. If you were to travel to the moon, your *weight* would be different, but your *mass* (how much “stuff” you’re made of) would be the same.

Matter is anything that has mass and takes up space.

Density is the amount of matter contained in a given space.

Materials for Experiment 1:

- 1 egg
- 4 tablespoons of salt
- Water
- Two cups the same size
- Spoon

Materials for Experiment 2:

- 2 glass or plastic jars with lid (bottles will work)
- 2 cups of water
- ½ cup of salt
- Red and blue food coloring
- Spoon

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Why is it easier to float in the ocean?

Have you ever noticed that floating in a pool and floating in the ocean feel different? Did you know that it is actually easier to float in the ocean with salt water than in a swimming pool that has non-salt water? Salt makes ocean water **denser**, and that higher **density** makes it easier to float.

Experiment 1: Salt Water Egg Experiment

Instructions:

1. Fill both cups about half full of water.
2. Add about 4 tablespoons of salt in one cup and stir it until the salt has completely dissolved in the water.
3. Place the egg in the cup of water without salt and observe.
4. Take the egg out of the plain water, and place it in the cup with the salt water.
5. Take a moment to compare your observations from both cups of water.
 - What happened when the egg was put in the cup with the fresh water?
 - What happened when the egg was put in the cup with salt water?

Why Does this Work?

You may have observed that the egg placed in the plain water sunk to the bottom, while the egg placed in salt water floated. This is because of density. The egg is denser than the plain water, which caused it to sink. Salt water is denser than plain water, allowing the egg to float. Objects only sink when their density is larger than the liquid’s density.

Experiment 2: What is the difference between water and salt water?

Instructions:

1. Pour and mix blue food coloring into one of the cups.
2. In the second cup, pour and mix the red food coloring, and add salt until it dissolves.
3. Pour half of the red water into one of the jars and half of the blue water into the other jar.
4. Slowly add the rest of the red water in the cup to the jar containing the blue water.
5. Add the rest of the blue water in the cup to the jar containing the red water.
6. Let the two jars sit for 10 to 15 minutes.
7. Observe what happened in both jars.
 - Are both jars the same?
 - How are they different?
 - What do you think happened?

Why Does this Work?

Adding salt to the red water changed its density, making it heavier than the blue, non-salt water. As a result, the red water sank when it was poured on top of the blue water. When you pour the opposite way, with the red water on top, it causes the blue water to float on top of the red water, because the blue water is lighter than the red water.

The Tower of Density (Grades 3-5)

Vocabulary:

Buoyancy is the ability of a liquid to push up on an object immersed in it.

Volume is the amount of space occupied by a substance.

Mass is the amount of matter or substance that make up an object.

Density is how much space an object or substance takes up (its volume) in relation to the amount of matter in that object or substance (its mass).

Materials:

- Tall, straight glass
- Water with food coloring
- Corn syrup or honey
- Dishwashing soap
- Dishwashing liquid
- Vegetable oil
- Aluminum foil crumpled to a small pea size ball
- Steel nut
- Eraser

Why don't oil and water mix?

Have you ever heard the expression "it's like oil and water"? When things don't get along well, people use this expression to mean two things can't be mixed together. That's because oil and water will not naturally mix together. You can try putting some oil in a glass of water, you can stir them together, and they may *look* like they mixed, but eventually, they will separate. That is because they have different density.

Density is how much space an object or substance takes up compared to the amount of matter it has. Liquids of different densities, such as oil and water, do not mix and will float on top of one another. Liquids that are denser will stay towards the bottom, and the less dense liquids will float to the top. Use materials that you have at home to explore liquids of different densities, and make an impressive tower in a glass by layering colored liquids.

Experiment

Instructions:

Part 1:

1. Use the back of a spoon to help pour each liquid, and make sure not to stir or shake the tower to prevent the liquids from mixing.
2. Pour about $\frac{3}{4}$ inch of either honey or corn syrup to into the glass.
3. Add in about $\frac{3}{4}$ inch of the dishwashing liquid.
4. Pour in about $\frac{3}{4}$ inch of water. Change the color by adding a few drops of food coloring.
5. Add about $\frac{3}{4}$ inch of vegetable oil for the top later.
6. On a scrap piece of paper, make a list of the liquids from the least to the densest.

Part 2: Now that you figured out the order of the densities for all the liquids, see what effect density and buoyancy have on different objects.

1. Drop in each of the suggested small objects (aluminum foil ball, steel nut, eraser, etc.), and drop them into the glass one at a time.
2. Observe where each property settles. What happens to each object?

Something Extra:

Try the experiment again with different liquids such as milk, salt water, and laundry detergent. Then try to add other objects (cherry tomato, bean, cork, pennies, etc.) to test their buoyancy. .

Why Does this Work?

The density of water is relatively low even though the molecules crowd closely together. When substances dissolve in water, the molecules sneak in between the water molecule, which increase the density. Oil molecules are bigger and do not cling together tightly, leading it to have a lower density. Therefore, when there is an oil spill in the ocean, all the oil floats on top of the water.

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It's All About the Base... and the Acid (Grades 6-8)

Acids & Bases

Everything in the universe contains atoms, molecules, and ions. The types of ions a substance has will determine the properties of that substance.

For example, if something has a large number of hydrogen ions, it is an acid. On the other hand, if something has a large number of hydroxide ions, it is a base.

Materials:

- Measuring cup
- ½ red cabbage
- 2 tablespoons of baking soda
- Scissors
- Spoon
- Small bowl
- Distilled water
- Tall glass
- Vegetable or sunflower oil

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Why are lemons sour? Why is soapy water slippery?

When we think about acids and bases, it helps to think in terms of foods:

- Foods and liquids with lots of hydrogen ions (**acids**) will be sour
- Foods and liquids with lots of hydroxide ions (**bases**) will be bitter



Working with Acids and Bases

Create a chemical reaction in your own kitchen between an acid and a base. An acid is a substance with many hydrogen atoms and tastes sour, such as vinegar and orange juice. A base is any substance that, in water solution, is slippery to the touch, tastes bitter, and reacts with acids to form salt such as baking soda and soapy water. Observe with your eyes as bubbles rise through the tower and then fall back down. You will also be making an indicator, which is a color changing solution that turns red in acids and a blue-green in bases.

Experiment

Instructions:

1. Fill the small bowl half-full of warm water and cut the red cabbage into thin strips. Leave the cabbage in the water until it turns a deep purple color. Ask an adult for permission when cutting the cabbage.
2. Drain the cabbage out of the water.
3. Pour about 2 fl oz. of the purple mixture into the measuring cup. This will be your pH indicator.
4. Add 2 fl oz. of vinegar to the purple mixture. What color does the solution turn?
5. Use a spoon to add baking soda into the glass.
6. Pour oil into the glass with the baking soda until it is about two-thirds full.
7. Slowly pour the pink vinegar solution into the glass.
8. Observe what happens over the next few minutes.
 - What do you see?
 - What material is the acid?
 - What material is the base?

Why Does this Work?

The vinegar solution is acidic, and it is denser than the oil, causing it to sink to the bottom of the glass to react with the baking soda. The reaction produces bubbles of carbon dioxide gas, which is less dense than the oil, causing them to rise to the top of the glass. The bubbles burst when they reach the surface of the glass, and any vinegar solution that was inside drops down.

More Experimentation:

Try mixing your red cabbage indicator with other substances around your home to see if it will change other colors. Some suggestions you may find in your own home are bottled water, lemonade, juice, liquid soap, and lemon juice. Make sure to get permission from a parent before using other items.

Shine Like a Penny (Grades 9-12)



Why do pennies lose their shine?

Pennies start out shiny, but as they circulate, they begin to lose their shine. This is largely due to the way metals react with air. Copper atoms react with oxygen atoms to form a compound called copper oxide which creates a coat of around the outer layer of the coin.

Materials:

- 5-10 pennies
- Steel nail or screw (make sure to get permission from parents)
- Teaspoon
- Table salt
- Measuring cup
- 3 small bowls
- Distilled vinegar
- Paper towel

Experiment

Using just 2 ingredients from your kitchen and some pennies, you will be able to strip the copper oxide and make the pennies shiny again.

Instructions:

Part 1: Make your pennies shiny again.

1. Place all your pennies in one of the small bowls.
2. Pour enough vinegar in the bowl to cover all the pennies.
3. Add half a teaspoon of salt and stir. Set aside for 10 minutes.
4. Take the shiny pennies out of the vinegar and salt mixture.

Why does this work?

Vinegar is an acetic acid that splits water to release positively charged hydrogen atoms. The vinegar is what strips the copper oxide from the pennies to make them shiny again, and the salt helps to speed up the reaction.

Part 2: Using the vinegar and salt solution that contains copper from the pennies, you can now copper plate a steel nail.

1. Place the steel nail into the solution from the above experiment.
2. Leave the steel nail in the solution for 20 minutes.
3. Observe what happened to the nail.

Why Does this Work?

Steel is mostly made of iron. When the steel nail sits in the solution, some of the iron atoms dissolve into the solution and some of the copper items from the solution attach to the nail, giving the nail a copper-coated look.

Part 3: Copper Chloride Reaction

1. Place a piece of paper towel into a small bowl and soak it with vinegar.
2. Place one penny into the bowl.
3. Pour salt on top of the penny until it is covered.
4. Leave the penny for about an hour.
5. Observe what happened to the penny.

Why does this work?

When you leave a penny in salt and vinegar for a long time, a chemical reaction occurs. Salt, which has chlorine in it, reacts with the copper, producing the chemical compound copper chloride which has a green color.



Standards: C5ISR Center STEM Outreach Activities Align with the Next Generation Science Standards

ACTIVITY ONE: 2-PS1-1 Matter and Its Interactions: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

ACTIVITY TWO: 5-PS1-2 Matter and Its Interactions: Make observations and measurements to identify materials based on their properties. Interactions: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserve.

ACTIVITY THREE: MS-PS1-2 Matter and its Interactions: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

ACTIVITY FOUR: HS-PS1-2 Matter and its Interactions: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.