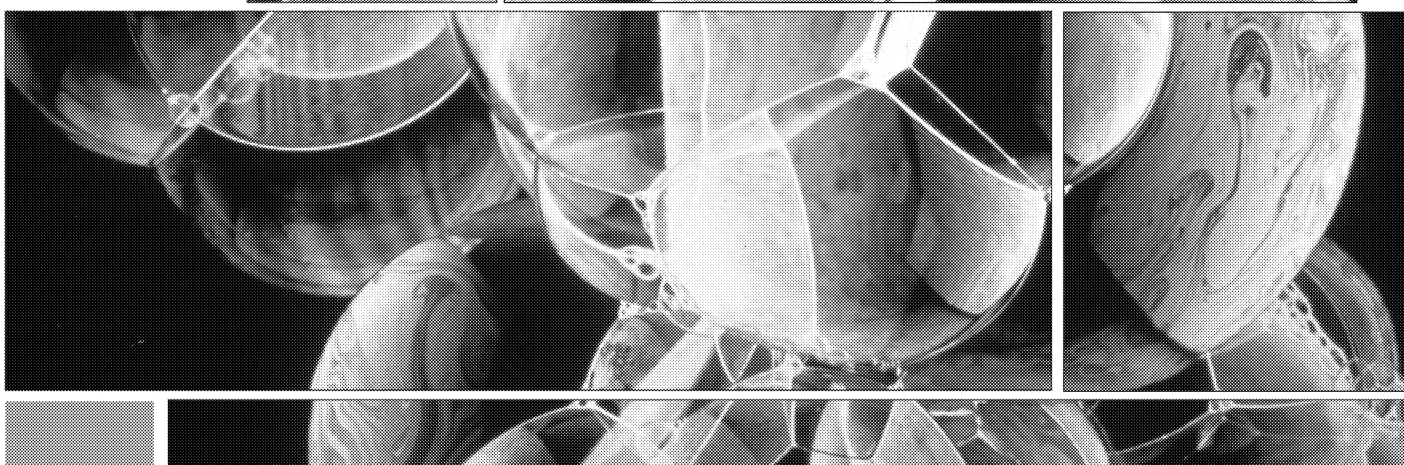
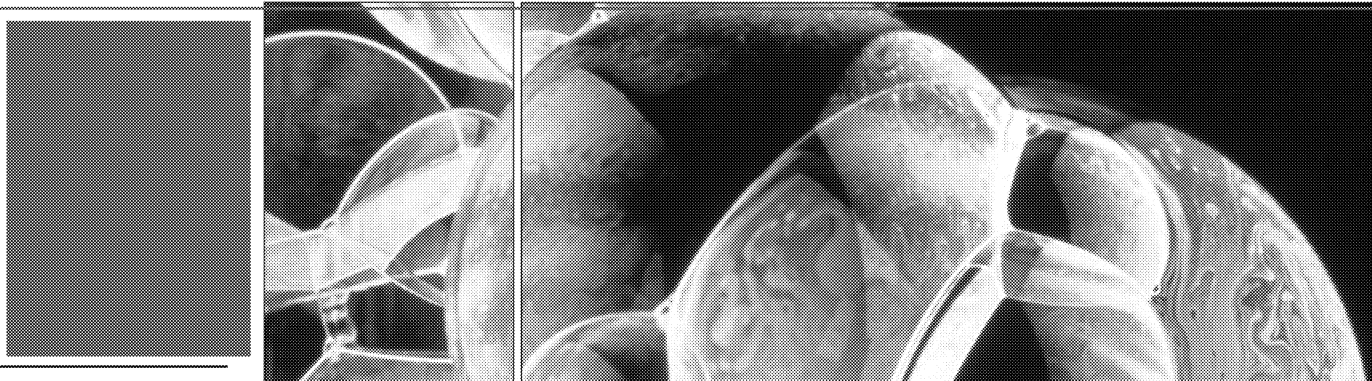
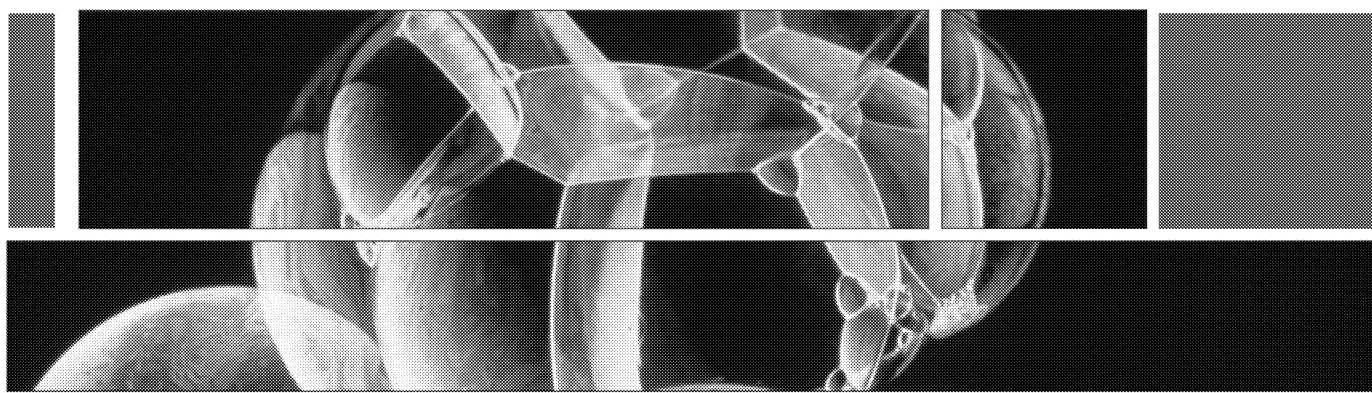


J. WESTON
WALCH
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Portland, Maine

EASY

Science Demos & Labs

Chemistry



Thomas Kardos

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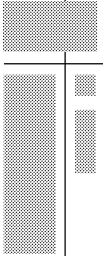
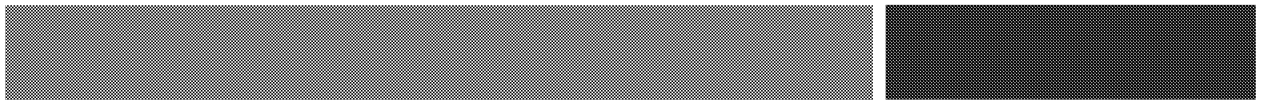
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Demos and Labs



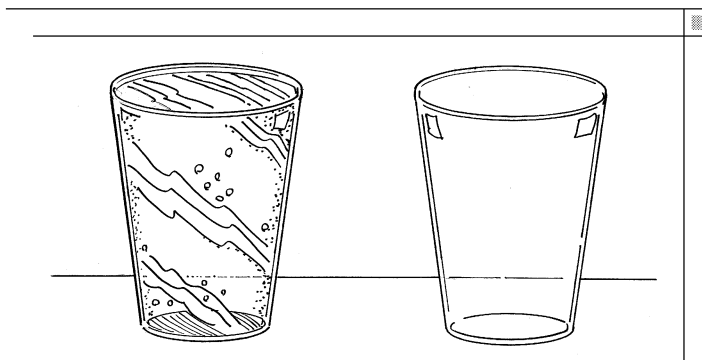
Demo 1

Matter, Mass, and Weight

Mass is the property of being a material object. Solids, liquids, and gases are made up of molecules, the building blocks of all matter in the universe. If one combines mass with the pull of gravity—a force—one has weight. Scales measure the pull of gravity on mass. Mass does not change; however, depending on location, weight may change. An orange has the same mass at sea level on Earth, on the moon, or in orbit. On Earth, the orange has a certain weight, but owing to the lesser gravitational pull of the moon, it would have only $\frac{1}{6}$ its “Earth weight” on the moon. In orbit, the orange has no weight, because in the free-fall conditions in orbit, the gravitational force of the earth is not felt. That explains how a couple of astronauts can pick up and move large satellites in space that would take large cranes to move on Earth. While the satellite has mass, it experiences only an “inertial gravity” in space.

Materials: two glasses or beakers, enough water to fill one of the glasses or beakers, bathroom scale

- Matter takes up space and has mass. Take two glasses and fill one with water. Have students lift both glasses. Have them comment on the difference in glass masses. The one that is full of water has more mass and feels heavier.
- Have your students step on a scale. Observe that the scale shows an increase in weight. This shows that humans are made of matter and have mass.

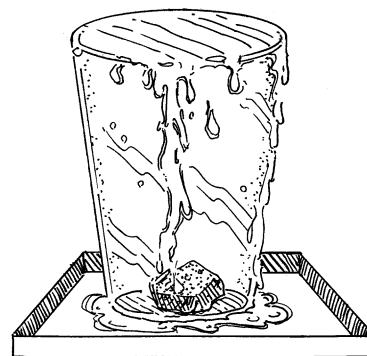


Demo 2

Matter Takes Up Space (Volume)

Materials: cup or glass, flat pan, water, small rock or other object, balloon

- Place a cup or a glass in a flat pan and fill the glass to the brim with water. Place an eraser, rock, or other small object in the glass. The water will overflow. The object occupies space and displaces its own volume of water.
- Blow air into a balloon and observe how it appears to grow. Even though air is invisible, it occupies space and is made up of matter.



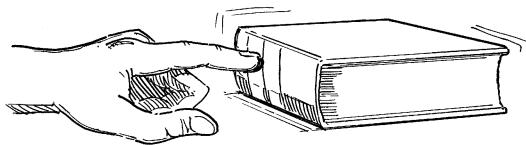
Rock in Water

Demo 3

Matter Can Be a Solid

Matter can be in **solid** form. Material objects are solid, have volume (take up a certain amount of space), and have a defined shape irrespective of their containers.

- Have students touch any object around them, such as a pencil, a table, or a book. Push a book with a pencil or finger. Notice that two material objects cannot occupy the same space at the same time. The results of a car crash prove this basic law of matter.



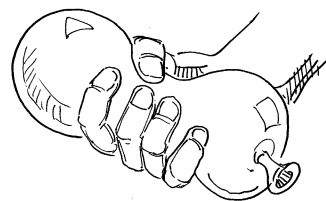
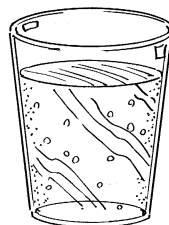
Demo 4

Matter Can Be a Liquid

Matter can be a **liquid**. In liquid form, molecules slide over one another. Liquids have a definite volume but will take the shape of a container.

Materials: glass or beaker, balloon, water

- Fill a glass with water. Fill a balloon with water and tie a knot at the end. Squeeze the balloon. Notice how the water takes the shape of its container.



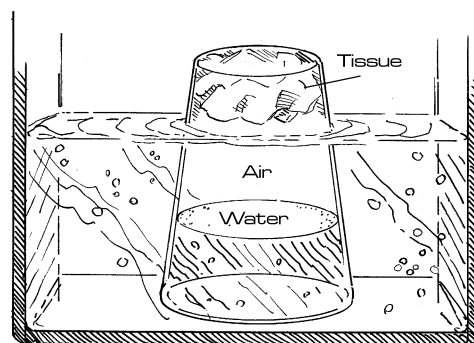
Demo 5

Matter Can Be a Gas

Matter can also be a **gas**. The molecules of a gas are very energetic and capable of escaping from the surface of the matter when the liquid state is being converted to a gas. Gases escape their containers when possible. The volume of a gas can only be defined precisely when the gas is confined within an enclosed container.

Materials: balloon, glass, piece of tissue, fish tank, water

- Blow air into a balloon. The balloon size will increase. Air does occupy space, as all matter does. Bend and twist the balloon. Notice how the gas inside it takes the distorted shape of the balloon.
- Pour some water into the fish tank. Place a piece of tissue inside the bottom of a glass. Invert the glass and place it in the fish tank. Lift the glass from the tank and observe that the tissue is dry. Air displaced the water, and the tissue did not get wet.



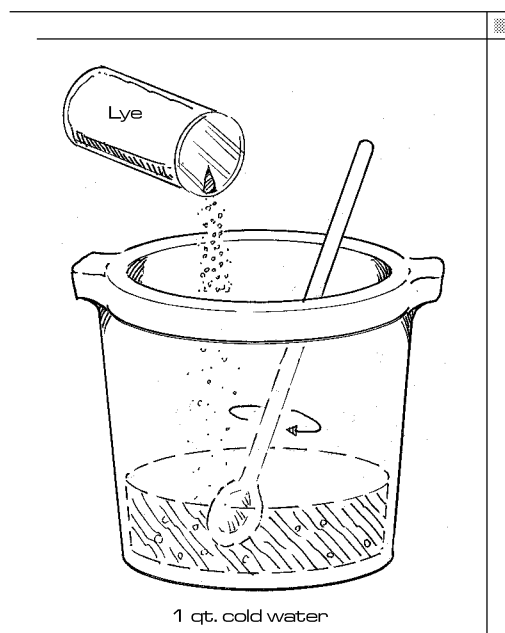
Demo 50

Making Soap

Soap was made at home during the Colonial period. Here is a chance for you to do something that links your students to the past.

Materials: can of lye (sodium hydroxide, NaOH), fat and grease, vinegar, hot plate, 10-quart or larger pan, stirring spoon (wooden, plastic, or stainless steel), 2-gallon electric cooking pot or enamelware, water, measuring cup, perfume, color, Pyrex dishes or boxes, wax paper, knife

- For several days, collect enough fat and grease to half-fill the pan. Then do the following steps in order:
 1. Clean the grease: Melt it in the pan with 2 to 3 quarts of water. Bring it to a boil and stir frequently. Let it cool until you can lift out the fat. Repeat the procedure several more times to remove salts and other sediments.
 2. To dissolve the lye, use the electric cooking pot. Place the container on the ground for all to observe from a safe distance. Carefully read the label on the lye container. *Slowly* stir the lye into 1 quart of cold water. In this process the lye will react with the water and get very hot. Stir *very slowly* to avoid any splatter.
 3. As soon as the lye solution feels lukewarm on the bottom of the pot, slowly add to it the melted lukewarm grease. Continue stirring until the mixture stiffens to the consistency of honey.
 4. At this time, add coloring and perfume (if desired).
 5. Continue stirring the pot for 20 to 30 minutes, or until the soap becomes the consistency of fudge.



(continued)

6. Pour the soap into forms lined with wax paper—Pyrex dishes or boxes. Let it stand until it is hard enough to be cut into 4-inch squares.
7. Let the squares dry in sunshine for a couple of weeks. Turn them over daily so that they harden.
8. When ready, cut the soap into smaller bars and give them to your students to take home.

Special Safety Consideration: Use extreme caution. Lye is caustic. Wear goggles, gloves, and a labcoat or apron. Keep students at a distance. Should any lye touch skin, neutralize it immediately with vinegar and rinse generously with cold water. Discuss adding perfume with your students to be sure none of them is allergic to perfumes.

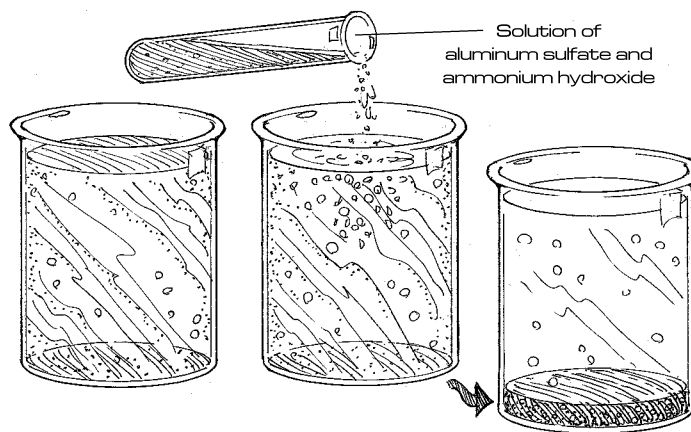
Demo 51

Coagulation

Coagulation (flocculation) is the process of adding chemicals to suspensions to get suspended particles to clump together and settle faster. Larger particles settle faster than smaller ones. Coagulation is a common method used by water treatment plants to purify water and remove residual sediments after the water has been filtered through a bed of sand and gravel.

Materials: aluminum sulfate $\text{Al}_2(\text{SO}_4)_3$ (alum), ammonium hydroxide NH_4OH , test tube, stirrer, two beakers, water, clay or plain soil, teaspoon

- Mix together a small amount of alum and ammonium hydroxide. Fill two beakers nearly to the top with water and add some clay or plain soil to them. Stir both of them well, so that the clay is in suspension. Add a small amount of the chemical mix to one beaker. While standing, the one with the coagulating chemicals settles faster. The one without chemicals will need at least overnight to settle.



Demo 52

Acids

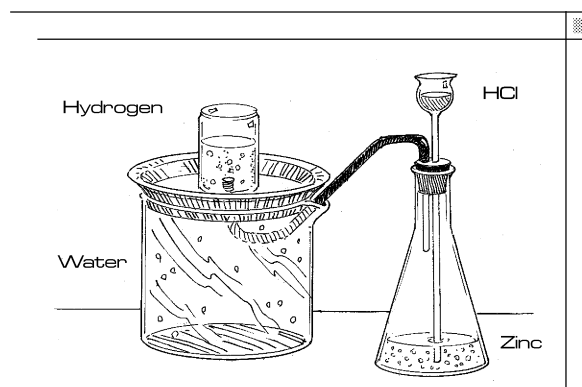
Acid is a substance that, if added to water, increases the concentration of hydronium ions—an ion group made up of a water molecule and a hydrogen ion. Acids react with metals, producing hydrogen gas. Acids turn litmus blue to red. Litmus is an indicator that turns different colors in the presence of acids and bases. Acids are found in citrus fruit, in sour milk, in vinegar, in the stomach, etc. Acids are sour to the taste and a few can cause severe body tissue damage. Here are a few important acids:

Acid	Formula	Where Found, Uses
Hydrochloric acid	HCl	In stomach, aids digestion
Sulfuric acid	H ₂ SO ₄	Industry, for metals, plastics, etc.
Boric acid	H ₃ BO ₃	Eyewash, insect control
Acetic acid	HC ₂ H ₃ O ₂	Vinegar, photography
Carbonic acid	H ₂ CO ₃	Soda water, beer, sparkling wines
Nitric acid	HNO ₃	Used in making jewelry, explosives, medicines

Materials: thistle funnel, rubber stopper with two holes, glass tubing, flat-bottomed flask, glass jar, pie tin with hole, water dish, water, diluted hydrochloric acid, graduated cylinder, zinc pellets, splint, matches

In this activity, you will assemble the necessary apparatus for water displacement to collect hydrogen gas. (See illustration.) Place the zinc pellets on the bottom of the flask. Pour in 50 mL of hydrochloric acid. Add more if needed, until you have sufficient hydrogen gas to test. Perform the pop test: Light a splint and place it inside the jar. You will hear a loud pop.

Special Safety Consideration: Many acids, including hydrochloric acid, are corrosive. Set a good example for your students, and get in the habit of using gloves and goggles, as well as protective clothing, when working with any acids or bases.



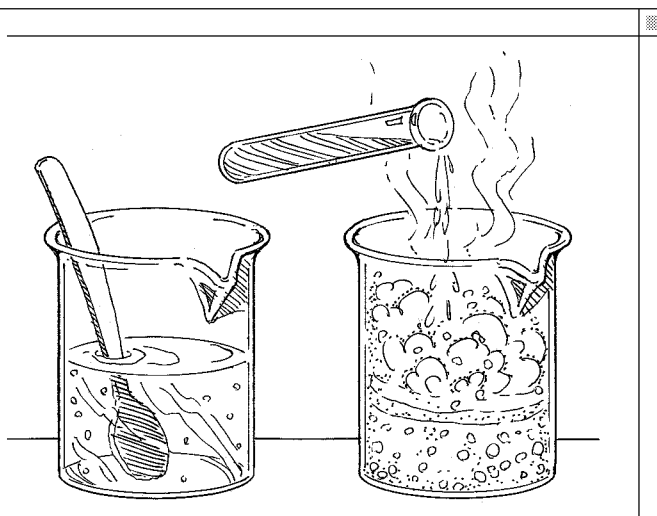
Demo 53

Bases

Certain metals react with water and form **bases** and hydrogen. Bases are substances that contain the hydroxyl ion OH^- . Bases are bitter to the taste, slimy (at times), and slippery, and they react with acids. Bases turn red litmus to blue. Soap, baking soda, milk of magnesia, ammonia, and most detergents are examples of bases. Drano™, the powder or liquid used to unclog drains, contains sodium hydroxide (NaOH), a very strong and caustic base. Sodium hydroxide is known as lye and is used to make soap.

Materials: beaker, water, baking soda, vinegar, test tube, teaspoon, basin

- Perform the following over a sink or a basin. Fill the beaker halfway with water and add two teaspoons (10 mL) of baking soda. Stir the soda so that it is well mixed. Fill the test tube about halfway with vinegar. Pour the vinegar into the baking soda. Notice the reaction and the bubbles. This is the typical reaction by bases to acids.



Special Safety Consideration: Although this particular demonstration is harmless, many bases are extremely caustic. Set a good example for your students, and get in the habit of using goggles and gloves when working with any bases or acids.