Aspirin Tablets Can Differ

Stuff You'll Use:

▸3 regular aspirin tablets, such as Bayer® or Anacin® ▸3 buffered aspirin tablets, such as Bufferin® or Bayer Plus ▸3 enteric aspirin tablets, such as Ecotrin® or Bayer Enteric ▸3 clear, colorless glasses ▸water ▸1½ to 3 cups vinegar ▸3 teaspoons baking soda ▸teaspoon measure

What to Do:

1. Half-fill three glasses with water. Drop one regular aspirin tablet into the first glass, one buffered aspirin tablet into the second glass, and one enteric aspirin tablet into the third glass. Note any changes that occur for each tablet at 1-minute intervals for 5–10 minutes, or until you see no further changes.
2. Repeat step 1 using vinegar instead of water in the glasses. Note any significant differences in the tablets' behavior compared to step 1. If a chemical reaction occurs, identify an obvious product.
3. Empty and rinse the glasses and half-fill them again with water. Add 1 teaspoon baking soda to each glass and stir to dissolve. Drop one regular aspirin tablet into the first glass, one buffered aspirin tablet into the second glass, and one enteric aspirin tablet into the third glass. What do you observe with the different types of aspirin? How do these results compare to those from steps 1 and 2?

How It Works:

The principal ingredient in aspirin is acetylsalicylic acid. Manufacturers have developed several techniques to make aspirin easier on the stomach. "Buffered" aspirin includes a buffer to lessen the effect of aspirin's acidity in the already acidic environment of the stomach. Enteric aspirin is coated aspirin with a substance that prevents the tablet from dissolving until it reaches the basic environment in the small intestine.

In step 1, you'll notice that regular and buffered aspirins readily "break up in water," but the enteric aspirin does not. In step 2, the behavior of the tablets is similar, except that the buffered aspirin bubbles. The bubbling results from the acetic acid ($HC_2H_3O_2$) in the vinegar reacting with the buffered tablet. The gas produced is probably carbon dioxide (CO_2) because of a carbonate buffer. In step 3, bubbles are also observed. Because baking soda is sodium bicarbonate ($NaHCO_3$), it forms a basic aqueous solution that reacts with the acetylsalicylic acid in the tablets to form gaseous CO_2. The enteric tablet now breaks apart more readily because its coating is designed to dissolve in a basic solution.

More Fun?

Learn more about aspirin products and other pharmaceuticals. Terrific Science Press offers the following book that includes activities with aspirin and other activities related to the chemistry of pharmaceuticals:

▸▸ [*Strong Medicine—Chemistry at the Pharmacy*]

The Many Faces of Chemistry
National Chemistry Week 2007

Find more fun activities at www.terrificscience.org.

Capturing Carbon Dioxide

Stuff You'll Use:

‣2 large-diameter candles ‣limewater (available from scientific supply companies) ‣2 wide-mouth glass jars with lids ‣long matches ‣plastic drinking straw

What to Do:

⚠ *The calcium hydroxide in limewater is caustic. Wear appropriate eye protection. Exercise proper fire safety: Work on a flame-resistant surface and remove unnecessary flammable materials from the area. Use care when handling hot wax as it can cause burns and damage clothing.*

1. Add limewater to a depth about 1 inch (2–3 cm) to each of the jars. Place a candle in each jar.
   NOTE: One jar is used for the actual candle experiment. The other is a control.
2. Light one of the candles with a match and allow it to burn for at least 30 seconds. Place a lid on the jar and allow the flame to go out.
3. Gently shake the jar. What happens?
4. Cover and gently shake the second jar containing the unburned candle. What happens?
4. Using a straw, blow air through the limewater in the second jar. What happens? What do your results suggest about the identity of at least one of the products produced when a candle burns.

How It Works:

A white precipitate should form in the limewater in the jar that contained the burning candle. No precipitate should form in the jar with the unburned candle. However, a precipitate will form in the second jar after you have blown air into the limewater.

Limewater is used to test for the presence of carbon dioxide gas. The gaseous carbon dioxide reacts with limewater in the following way:

$$Ca(OH)_2\ (aq) + CO_2\ (g) \rightarrow CaCO_3\ (s) + H_2O\ (l)$$

The formation of solid white calcium carbonate ($CaCO_3$) causes the limewater to turn white. No gas other than carbon dioxide will produce a solid in limewater. Carbon dioxide is also present in human breath, which is why the limewater turns white after you blow through it. The limewater in the control jar does not turn white before breath is blown through the jar because air contains only a small amount of carbon dioxide, not enough to form appreciable amounts of white solid.

More Fun?

Terrific Science Press offers the following book that includes more activities with candles and other activities related to the chemistry of waxes and lipids:

▸▸ *Fat Chance—The Chemistry of Lipids*

The Many Faces of Chemistry
National Chemistry Week 2007

Find more fun activities at www.terrificscience.org.

Hand-Boiler Distillation

Stuff You'll Use:

▸commercial Hand Boiler or Passion Meter (available through online merchants) ▸plastic cup ▸crushed ice ▸rock or table salt (NaCl)

What to Do:

1. If the liquid is not already in the larger bulb, you'll need to transfer the liquid by holding the smaller bulb with your hand and tilting the Hand Boiler back and forth to allow the liquid to run toward the larger bulb. Invert the Hand Boiler as shown in the upper photo.
2. While securely holding the larger bulb, place the empty smaller bulb into a cup and add alternating layers of ice and salt.
3. Allow the apparatus to sit for 20–30 minutes as shown in the lower photo. Periodically hold the upper larger bulb but do not remove the unit from the ice/salt bath. What do you observe?
4. After about 30 minutes, remove the Hand Boiler from the ice/salt bath, keeping it in its inverted position. What do you observe?

How It Works:

In this activity you use the Hand Boiler to explore distillation. The liquid in the Hand Boiler is a solution of ethanol (colorless) with a colored dye. When you place the empty smaller bulb in the ice/salt bath, the rapid temperature drop causes some of the ethanol vapor in the smaller bulb to condense. The condensation reduces the pressure in the smaller bulb, causing more of the ethanol in the larger bulb to evaporate. When you place your hand on the larger bulb during the distillation process, it will feel cold. This is because evaporation is endothermic.

Over time, ethanol begins to collect in the lower bulb, and the color of the remaining solution in the larger bulb becomes more intense. The process that is occurring is called distillation. Distillation is complete once all the ethanol has been collected within the bottom cold bulb and only the dry residue of dye remains in the larger bulb. However, the complete process may take more time than you are willing to give.

More Fun?

This activity is adapted from a demonstration by Bob Becker, Kirkwood High School, Kirkwood, MO. You can learn more about the Hand Boiler distillation by visiting chemmovies.unl.edu/chemistry/beckerdemos/BD055 or by reading "Toys in the Classroom" by J.L. Sarquis and A.M. Sarquis in the October 2005 (Vol. 82 No. 10) issue of the *Journal of Chemistry Education*.

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National Chemistry Week

Inky Elevators

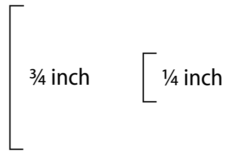

Figure 1

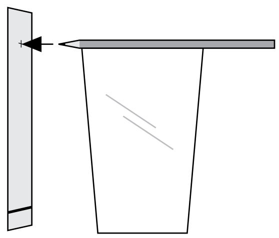
Figure 2

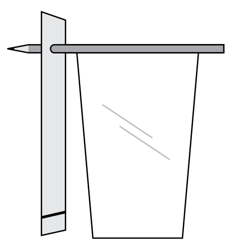
Figure 3

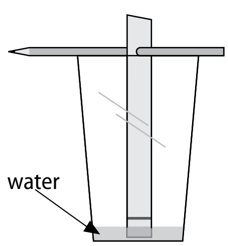

Figure 4

Stuff You'll Use:

▸coffee filter or filter paper ▸scissors ▸black water-soluble marker (such as overhead projector marker or watercolor marker) **NOTE:** washable markers do not work ▸clear plastic cup ▸water ▸paper towels ▸(optional) water-soluble markers in different colors

What to Do:

1. Cut a coffee filter or filter paper into a strip about 1 inch wide and 1 inch longer than the height of your plastic cup. Use a pencil to draw a horizontal line about ¾ inch above the bottom edge of the strip. (Use Figure 1 as a guide.) Trace along the pencil line with a black, water-soluble marker.
2. Hold the strip next to the plastic cup so that the bottom edge of the strip almost reaches the bottom of the cup. Push the point of a pencil through the top of the strip exactly even with the rim of the cup. (See Figures 2 and 3.)
3. Lift the pencil from the cup and push the strip to the middle of the pencil. Pour about ¼ inch (see Figure 1) of water into the cup.
4. Set the pencil across the rim of the cup so that the bottom of the strip is in the water. The marker line should be above the water. (See Figure 4.) If the marker line accidentally dips below the water level, discard the strip, rinse out the cup, and start over.
5. Observe the water and the black line. When the water gets near the top of the cup, remove the strip from the water and lay it on a paper towel to dry.
6. Try repeating steps 1–6 with fresh strips and different-colored markers.

How It Works:

While the ink appears to be a single color, it is actually a mixture of several different pigments, which you separated in this activity. Scientists call this technique chromatography. Depending on what scientists are trying to separate, they use different materials for the chromatography process. The paper used is porous, which means it has many tiny openings throughout it. Water moves up these openings, which scientists call "capillaries." When the water reaches the marker line, it dissolves the ink and continues to travel up the paper, carrying the ink with it. As the water-ink mixture moves through the capillaries, the pigments in the ink begin to separate because the different pigments have different amounts of attraction for the paper and the water. The ones with the strongest attraction for paper and the weakest attraction for water move the least amount. What properties would the farthest-moving pigments have?

More Fun?

Terrific Science Press offers the following books that include activities related to chromatography:

- *Science Night Family Fun from A to Z*
- *Classroom Science from A to Z*

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National Chemistry Week 2007

Find more fun activities at **www.terrificscience.org**.

Kool-Aid® Dyeing

Stuff You'll Use:

▸packet of unsweetened Kool-Aid drink mix ▸8-ounce plastic cup ▸4 ounces hot water ▸stick or spoon for stirring ▸unrolled cotton balls ▸paper towels ▸old newspapers

What to Do:

1. Mix together about 4 ounces hot water and the Kool-Aid in the plastic cup.
2. Stir and observe the color change that takes place in the water.
3. Place a unrolled cotton ball into the cup and allow it to stand for several minutes.
4. Remove the cotton ball from the Kool-Aid and place it on some paper towels on top of a stack of old newspapers to dry. Look at the cotton ball carefully. Is it dyed uniformly? Is the color as dark as you would have expected? What changes in the dyeing process would make it darker?
5. Try using the Kool-Aid to dye strips of white fabric made of 100% natural fibers, such as linen, silk, or wool. Then try dyeing 100% synthetic fabric or blends. How do the results differ?

How It Works:

Did you ever wonder how color gets on clothing? This activity explores the concept of changes in materials through the process of dyeing. Most people (particularly parents) are all too familiar with the permanent dyeing properties of Kool-Aid from experiences with spills on carpets, clothing, and furniture.

Fabric dyeing can be traced back thousands of years. The early use of indigo-dyed fabrics has been found in Egyptian tombs and in the graves of the Incas of Peru.

More Fun?

Learn more about how dyeing works. Terrific Science Press offers the following books that include numerous activities related to dyeing:

- *The Chemistry of Food Dyes*
- *The Chemistry of Natural Dyes*
- *The Chemistry of Vat Dyes*

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Find more fun activities at www.terrificscience.org.

Look at One Part Per Million

Stuff You'll Use: ▸dry, clear jar with a capacity of about 16 ounces (500 mL) and lid ▸½ cup (about 125 mL) salt ▸½-cup dry measuring cup or other volume measure ▸dark-colored particle (such as grain of colored sugar, grain of colored sand, or very dark flake of black pepper) ▸watch or clock with second hand ▸(optional) static-reducing dryer sheet or spray

What to Do:

1. If the jar you plan to use is plastic, reduce static cling by rubbing its inside with a dryer sheet or static-reducing spray. Be sure the inside is completely dry before doing step 2.
2. Put ½ cup (125 mL) salt in the dry jar.
3. Add one dark-colored particle to the jar. Tightly close the lid and shake.
4. Time how long it takes you to find the dark-colored particle that is "one in a million." If you'd like, shake the jar and time your search several more times.

How It Works:

The most effective search method for finding the dark-colored particle is to slowly roll the jar on its side. Generally the dark-colored particle can be found within a few minutes.

Scientists measure air pollutants using special instruments that are sensitive enough to detect parts per million (ppm) concentrations. In this activity, you use your vision to look for the "target" substance, the dark-colored particle. Its contrasting color makes the particle unique when compared to the white salt grains in the jar. In the same way, environmental scientists can find a rare "one in a million" very easily by using specialized equipment designed to take advantage of a unique characteristic of their "target" substance. For example, a magnet will find a steel bead among 999,999 nonmetallic beads without difficulty. There are many other ways to isolate a target substance. In all cases, the method should concentrate on a property (unique characteristic) of the target substance that makes it different than other substances, therefore making it easy to isolate.

More Fun?

Terrific Science Press offers the following books that include activities related to indoor air pollution:

- *Breathing Room! Indoor Pollution Activity Handbook*
- *Camp and Club Science Sourcebook*

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National Chemistry Week 2007

Find more fun activities at www.terrificscience.org.

Marbling with Shaving Cream

Stuff You'll Use:

▸newspaper to cover work area ▸aerosol shaving cream (standard white type) ▸paper plate ▸craft stick ▸food colors in dropper bottles ▸toothpicks ▸2 pieces of nonglossy, sturdy paper (such as index cards, copy paper, or art paper) ▸dropper or straw

What to Do:

1. Squirt a pile of shaving cream roughly the size of your fist onto the paper plate. Smooth out the top of the shaving cream with a craft stick.
2. Apply a drop or two of several different food colors to various locations on the shaving cream. Observe how the color spreads.
3. Drag a toothpick through the colored drops on the shaving cream to create patterns with the color.
4. Press a piece of paper onto the surface of the shaving cream as shown. Lift the paper and scrape off the shaving cream that is stuck to it using the craft stick as shown. Return the excess shaving cream to the original pile.
5. Now let's do another cool marbling trick. Using the craft stick, mix the pile of colored shaving cream until it is one uniform color. If the color is very pale, mix in a few more drops of food color.
6. Apply a single drop of water to the surface of the colored shaving cream and observe what happens. Try this again at several different places on the surface. Now repeat steps 3–4 using another piece of paper.

How It Works:

The soap in shaving cream has a water-loving (hydrophilic) "head" and a water-hating (hydrophobic) "tail." The water-based food color is attracted to the hydrophilic head of the soap and repelled by the hydrophobic tail. These factors combine to limit the motion or spreading of the food color drops in step 2. The soap immobilizes the food color until the design is captured on the water-absorbent paper in step 4. When water is dropped on the surface of the tinted shaving cream in step 6, a white spot immediately forms. This spot results from the lowering of the surface tension of the drop of water at the point of contact. The food color originally present in the area is repelled (pushed out of the way) as the surface tension is lowered.

More Fun?

Terrific Science Press offers the following books that includes activities related to how soap works:

- *Lather Up! Hand Washing Activity Handbook*
- *Camp and Club Science Sourcebook*

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National Chemistry Week 2007

Find more fun activities at www.terrificscience.org.

Recycling Paper

Stuff You'll Use: ▸mixing bowl ▸water ▸toilet paper (single-ply paper will break down faster) ▸metal fork or blender ▸rectangular cake pan ▸wire mesh screen smaller than the cake pan ▸paper towels ▸rolling pin ▸(optional) newspaper

What to Do:

1. Fill mixing bowl ¾ full with warm water. Tear toilet paper into small pieces to equal about 4 cups and place them into the water. Beat the mixture with either a fork or blender until the paper is broken down into fibers. Pour the water/fiber mixture into the cake pan.
2. Fold over each edge of the wire mesh to create a firmer surface. Slide the screen into the pan so that it slips under the water/fiber mixture. Lift the screen straight up through the water. The screen should be covered in fibers.
3. Hold the screen over the pan while it drips. Then, place the screen on paper towels or newspaper. Place additional paper towels over the screen so that the fibers are covered, and press with a rolling pin to squeeze out the water.
4. Take off the paper towels and allow your new paper to dry on the screen.
5. Gently peel the dried paper from the screen. What other materials could you use to make paper? Why would you want to make new paper from existing paper?

Important...
Do not pour leftover pulp mixture down the drain, as it may cause a blockage. Instead, flush the leftover mixture down the toilet.

How It Works:

Most papers are made from a combination of hardwood and softwood trees. The trunks of these trees contain about 50% cellulose fibers. Paper is made by chemically or mechanically separating the cellulose fibers to create pulp. The pulp is then pressed together into sheets.

Production of recycled paper (whether handmade or in a paper mill) begins with the pulping process. The used paper is pulped by wetting and mixing, then pressed into sheets again. Recycled paper can be made from paper products such as newspaper, copy paper, and construction paper.

Making and using recycled paper has the advantages of reducing waste and not requiring the destruction of more trees. The challenges involved with the production of recycled paper include fluctuations in the availability of used paper, the extra work required to separate different types of used papers and other material to produce recycled paper of consistent quality, and the shortening of the cellulose fibers as the used paper is reprocessed. Individuals can help solve the first of these problems by regularly recycling their own waste paper.

More Fun?

Terrific Science Press offers the following books that include activities related to making paper and recycling:

- *Science Projects for Holidays throughout the Year*
- *Understanding Garbage and Our Environment*

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National Chemistry Week 2007

Find more fun activities at www.terrificscience.org.

Sense-Fooling Pie

"Apple" Pie Recipe

▸2, 9-inch pre-made refrigerator pie crusts ▸25 Ritz® crackers ▸1½ cups sugar ▸1½ tsp cream of tartar ▸2 cups water ▸1 tsp cinnamon ▸1 tsp butter or margarine ▸measuring cups and spoons ▸9-inch pie plate ▸large saucepan ▸small saucepan for melting butter ▸wooden spoon ▸knife

1. Put the bottom pie crust in the pie plate.
2. Boil 2 cups of water in the large saucepan. When the water boils, slowly add 1½ cups sugar and 1½ tsp cream of tartar. Stir the mixture until the solids dissolve.
3. Add 25 Ritz crackers, one at a time, to the boiling water. Do not break up the crackers. Do not stir the mixture.
4. Boil the cracker mixture for 2 minutes, then remove from heat.
5. Pour the cracker mixture into the crust and sprinkle with 1 tsp cinnamon.
6. Melt a teaspoon of butter or margarine and drip it over the filling.
7. Carefully place the top crust on the pie and press the edges of the crust together. Cut vents in the top crust with a knife.
8. Bake the pie at 425°F (218°C) for 25–30 minutes, or until the crust is golden brown.
9. Let the pie cool for at least 15 minutes or until you can cut it with a knife.

What to Do:

⚠ *Because the product of this activity is meant to be eaten, be sure to mix and bake the pies outside of a school science lab. Use ingredients, measuring utensils, and baking equipment that are not used in a lab or stored among lab chemicals.*

1. Make pie according to recipe.
2. Share pie with friends—Don't tell them what it is.
3. Ask your friends what kind of pie they think they're eating. Are they fooled?

How It Works:

Food scientists are often faced with the challenge of improving the flavor of a food product or finding an ingredient to give food products a certain flavor or texture. This activity shows how different ingredients can be used to simulate the flavor and texture of a familiar food.

Flavors are chemicals and the "flavor" of an apple pie involves our tongue's response to the chemicals present in the pie and the texture of the pie. Our sense of taste also depends on our eyes' response to the color of the food and the nose's response to spices and other aromas. The brain can be fooled if we eat something that resembles an apple pie in appearance, flavor, odor, and texture.

The acidic nature of apples give them their characteristic sour taste. In the imitation apple pie, the sour taste results from the reaction between cream of tartar and water to form tartaric acid. Many of the other components responsible for the natural flavor of apples are volatile. That is why the apples in a pie are blander tasting than uncooked apples. The volatile components evaporate from a real apple pie when you bake it.

More Fun?

Learn more about the senses and food science. Terrific Science Press offers the following books that includes an activity with several types of sense-fooling pies and more activities related to senses and the chemistry of food:

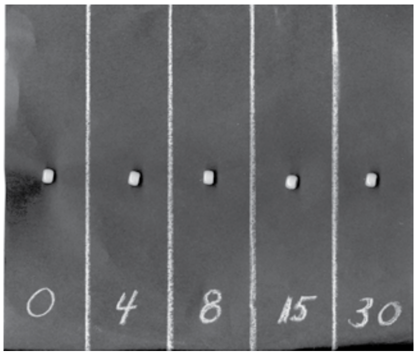
- *Science Fare—Chemistry at the Table*
- *Exploring Matter with TOYS: Using and Understanding the Senses*

The Many Faces of Chemistry
National Chemistry Week 2007

Find more fun activities at www.terrificscience.org.

Sunscreens and SPF Ratings

Important...
Sunscreens protect people with all skin shades from UV exposure.



Example of data table

SPF of Product	UV Bead Shade: Start	UV Bead Shade: After UV Exposure
0 (control)		
Time and Weather:		

Stuff You'll Use:

- 3–5 UV detection beads (all the same color)
- black construction paper
- scissors
- gallon-sized plastic bag
- glue
- cotton swabs
- 2–4 sun protection products having a wide range of SPF ratings (include at least one with an SPF rating of 8 or below)

What to Do:

1. Place the UV detection beads in direct sunlight and observe what happens. Then, remove the beads from the sunlight. What happens?
2. Working indoors, cut black paper to fit inside a gallon-sized plastic bag. Evenly space UV detection beads on the black paper, one bead for each sun protection product you will test and one bead for the control. Glue the beads to the paper, making sure not to get glue on the tops of the beads. Let dry.
3. Label the paper next to each bead with the SPF rating of the sun protection product you are going to test. The control bead will get no sun protection product (0 SPF). Slide the black paper into the gallon-sized plastic bag.
4. Using a clean cotton swab for each sun protection product, spread a small amount of the appropriate product on the bag over each bead in a circle about 1½ inches (about 4 cm) in diameter. Apply the same amount of product evenly over each bead.
5. Create a data table like the example at left. Record the SPF of each product, the starting shade of each bead, and the time of day and weather conditions.
6. Take the bead setup outside in direct sunlight. Without removing the plastic bag, observe and record the shade of each bead (such as white, nearly white, light, medium, and dark.) If you can't see through the plastic, take the setup indoors, open the bag, and immediately observe the beads. What is the trend between the shade changes of the beads and the SPF ratings?

How It Works:

UV detection beads turn dark when exposed to direct sunlight. The SPF ratings of the products correlate with how quickly and how deeply the beads change shade. Beads covered with no sun protection product or low SPF product quickly change to a deep shade, while those covered with a maximum protection (SPF 30 or higher) product remain white or nearly white. Beads covered with intermediate levels of SPF show a change somewhere in between. You should see the general trend from low SPF (darker bead shade) to high SPF (lighter bead shade).

More Fun?

Terrific Science Press offers the following books that include more activities related to staying safe in the sun:

- *More Than Skin Deep! Skin Health Activity Handbook*
- *Camp and Club Science Sourcebook*

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National Chemistry Week 2007

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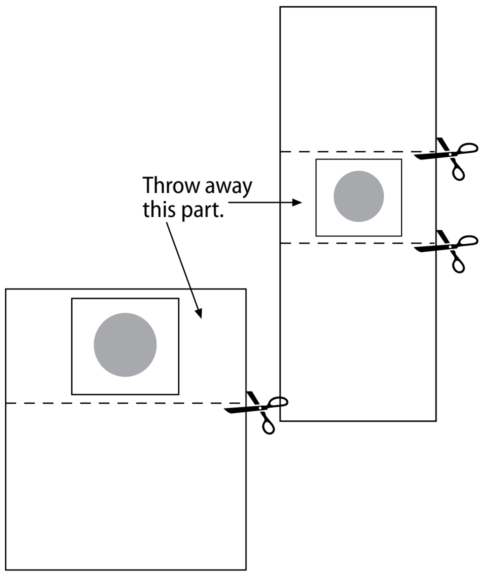
Trapping Particles



Example of data table

Brand		
Performance Claim		
Cost per Bag		
Bag Construction		
Measure of Powder Retention		

Stuff You'll Use:

▸disposable vacuum cleaner bags with different efficiency ratings (try some filters advertising allergen or HEPA filtration and some filters that do not) ▸scissors ▸sales receipt from vacuum cleaner bag purchase ▸white fine powder (such as cornstarch or powered sugar) ▸teaspoon ▸tape ▸dark-colored paper or other materials to run your test

What to Do:

1. Cut the attachment opening off each vacuum cleaner bag so that you are left with bag-like filters having one opened end. (See figures at left.)
2. Make a data table like the example at left. Be sure to include rows for performance claims printed on the package (such as "stress tested," "allergen reduction," or "HEPA filter"), cost per bag, and bag construction (such as thickness and type of material).
3. Add 1 teaspoon fine powder to each bag. Fold the tops of the bags down twice to make the seals powder tight. Tape the folds closed.
4. Design a procedure to determine which bag does the best job of trapping very fine powder. Run your test. Considering the cost and filtering abilities of the different bags, which bag would you buy and why?

How It Works:

For a filter to be called High-Efficiency Particulate Air (HEPA), it must be 99.97% efficient at filtering particles having a particle size of 0.3 µm. Most biological indoor air pollutants are likely to be trapped by a HEPA-rated bag or filter and removed from the environment. However, plain vacuum cleaner bags that don't make specific filtration claims may eventually become loaded with contaminants, allowing these contaminants to go through the sides of the bags and back into the room.

More Fun?

Terrific Science Press offers the following books that include activities related to indoor air pollution:

- *Breathing Room! Indoor Pollution Activity Handbook*
- *Camp and Club Science Sourcebook*

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