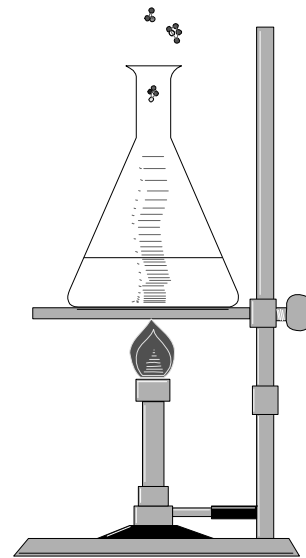
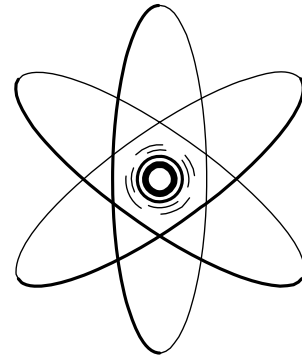


1. Balloon Attraction
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# Balloon Attraction



## Materials

- 2 or more balloons
- String
- A sweater with wool in it
- A shallow pan of water
- Small torn pieces of paper

## Procedure

1. Blow up the balloons and tie closed with the string, leaving a tail.
2. Charge the balloons by rubbing against the wool sweater.
3. Bring the balloons close to each other and watch the effect.
4. Bring one balloon close to the water in the pan without touching the water. What effect does the balloon have on the water?
5. Bring the other balloon close to the pieces of paper. What effect does the balloon have on the paper?
6. Experiment by bringing the balloons close to other objects. Which objects are attracted, and which are repelled? Remember to recharge the balloons as necessary.

*Rubbing a balloon on a sweater causes it to be charged with electrons, which are negatively charged. The balloon will attract positively charged items like paper or your hair, and will repel other negatively charged items like another balloon. The energy in charged objects is called static electricity.*



# Color Wheels

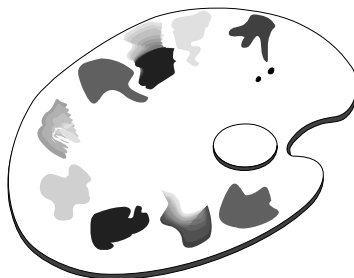
## Materials

Cardboard or stiff paper such as from old file folders  
Crayons, markers, or paint  
Pencils

## Procedure

1. Cut out several circles each about 3 inches across.
2. Divide the circles into 3 or 4 equal parts, and color the parts different colors. For example, have one that is made of three parts, one part being red, one part green, and the third part blue. Make another circle that has two red parts opposite each other and two green.
3. Make a small hole in the center of each circle and push a short pencil through the hole, with the pencil tip pointing down away from the colored side.
4. Amazingly, when you spin the little color "tops", the colors blend, and you see a new color. Can you see white when spinning green, red, and blue?
5. Try mixing different colors on more wheels to see what new colors you can get when you spin!

*Mixing light of different colors (such as this experiment simulates) creates much different results than mixing paints of the same colors. For example, mixing red, green, and blue paint makes a brown mess, yet mixing the same colors of light will produce a near-white light.*



# Craters On The Earth?

## Materials

- Moist sand
- A shallow baking dish
- A marble
- A golf ball



## Procedure

1. Put the sand into the baking dish at least 2 inches deep and smooth out the surface.
2. Hold one ball at a time about six inches above the sand and drop it, allowing it to make an impression. Remove each ball carefully. Measure the width and depth of each impression and record it.
3. Now repeat the above step three more times, increasing the distance the balls are dropped from by about 2 inches each time. Record the widths and depths of each impression made.
4. Compare the measurements you have taken. Does an object falling from farther away make a wider impression, a deeper impression, or both?

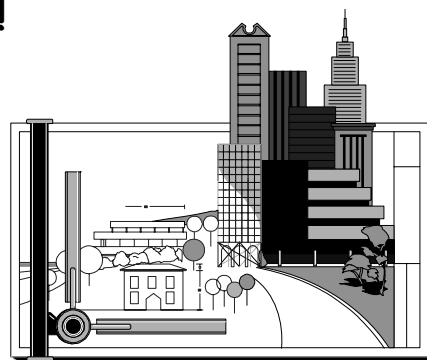
*We all know the moon is covered in craters, but the earth also has several notable craters. The most significant crater in the US is in Arizona. Scientists think a large chunk of rock from space crashed to the earth and made this huge impression about 20,000 years ago.*



# Earthquake Alert!

## Materials

- 20 or more sugar cubes, or other tiny cubes
- A shoe box lid
- 2 books of equal width
- A dark marker to write with



## Procedure

1. On the underside of the shoe box lid, draw a square in the center, about 4 inches on each side. Write the numbers 1 through 4 on the lid, one to the outside of each corner of the square.
2. Set the lid up securely on two books standing on their sides, so that you can easily fit your hand under the lid. Make sure the square and numbers side of the lid is facing up, and that the lid is balanced evenly between the books.
3. By each number on the lid, construct a cube "building". By the 1, set two cubes side by side. By 2, set two cubes one on top of the other. By 3, stack 4 cubes on top of each other. By 4, use twelve cubes to make a pyramid - five cubes on the bottom, four on top of that, two on top of the four, and one on the very top.
4. When your structures are all set up, start flicking the bottom of the lid in the center of the circle. You are simulating an earthquake - watch to see which structure can stand the longest!
5. Try making up your own structure designs and have others test them.

*The shape of a building helps determine how well it can remain standing when forces such as an earthquake act upon it. Other factors are the materials used in the construction (especially the frame) of the building, the soil type it is set upon, and methods used in laying the foundation.*



# Fat In Foods

## Materials

- A large brown paper bag
- Cooking oil
- Water
- Various foods



## Procedure

1. Cut open the bag and lay it flat on a dry surface.
2. Rub some water on a small spot on the bag, label it "water", and allow it to dry.
3. Rub some cooking oil on another spot on the bag and label it "oil". Hold the bag up to the light and notice the difference between the two spots. The transparent effect of the oil spot will not disappear after drying, yet the wetness of the water spot never really gets transparent. These are your reference spots. The oil is mostly all fat, while the water has no fat content.
4. Choose one food at a time and rub it on different spots on the bag, labeling as you go. Which foods have little or no fat, which have some fat, and which have the most? The closer the spot resembles the oil spot, the more fat it contains.
5. Suggested foods to try: bacon, cheese, butter or margarine, chopped nuts, bread, apples, raisins, lettuce, potatoes, hamburger, milk.

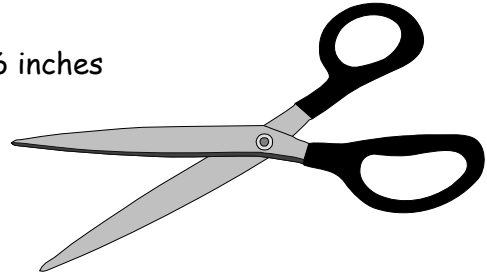
*Fats are a necessary part of our diet. They contain twice as much energy as carbohydrates. Some fats cannot be manufactured by our bodies and we need to get them through our diets to stay healthy. These fats contain essential fatty acids. However, too much fat in our diet can clog our arteries, cause obesity, and produce other undesirable effects. The goal is to be aware of how much fat we are consuming and strive for moderation.*



# Fulcrum Fever

## Materials

- A meter stick or similar long, flat stick
- 2 small paper or plastic cups
- A small piece of cardboard, approximately 4 x 6 inches
- A chunk of modeling clay
- Marbles
- Tape



## Procedure

1. Make the cardboard into a triangle by folding into thirds and taping.
2. Tape one small cup to each end of the flat stick by running a strip of tape under the bottom side of the stick and up onto each side of the cup. Set the stick on top of the cardboard triangle, like a seesaw. Put the triangle as near to the exact center of the stick as possible.
3. Roll the clay into a ball that will fit snugly into one of the cups. Put the clay ball into the cup that is on the side of the stick that is resting on the table.
4. Add one marble at a time to the cup on the opposite end of the stick, stopping when the clay ball cup lifts up. Count how many marbles it took to accomplish this, removing them from the cup.
5. Move the fulcrum (the cardboard triangle) closer to the clay ball cup. Again add marbles one at a time to the other cup. Does it take more or fewer marbles to lift the other side when the fulcrum is closer to it?
6. Repeat the steps as many times as you like, moving the fulcrum to a different position each time. Try to form a hypothesis to explain the relationship between location of the fulcrum and force needed to lift a weight.

*A fulcrum is the resting point of any lever, from the simplest of lifting tools to the most complex machinery. On a pair of scissors or a pliers, the fulcrum is the screw that holds the two levers (such as the blades on scissors) together.*



# Gases Move Faster When Warm

## Materials

- 2 identical bottles of unopened carbonated beverage (pop, etc.)
- 2 identical balloons, with mouths big enough to fit over the mouths of the bottles

## Procedure

1. Place one beverage bottle (unopened) in the refrigerator and leave overnight to cool. Leave the other in a warm place.
2. When there is a significant difference in temperature between the two bottles, you are ready to try the experiment.
3. First open the warm bottle and notice the formation and movement of bubbles in it. Pour some in a clear glass, if you cannot see around the label.
4. As soon as possible, slip one of the balloons over the mouth of the bottle, to trap escaping gas (carbon dioxide).
5. Repeat this process with the cooled bottle, noticing air bubble movement and sealing the mouth with a balloon.
6. Compare the movement of bubbles between the two bottles. Are they moving more rapidly in one of the bottles? Try to form a hypothesis to explain the difference.
7. Watch the balloons on the two bottles. Does one seem to be more upright and stiff, or even larger than the other? Form your hypothesis to explain this phenomenon. How can we use this knowledge in our everyday lives?



*The gas escaping from the bottles is carbon dioxide. All gases move much more quickly, and are thus more quickly lost into the air by diffusion, when heated or kept warm, in comparison to being cooled or kept cool. We can make use of this knowledge by keeping carbonated beverages cool to prolong the desired “fresh” state made by the content of carbonated gas (carbon dioxide). Carbonated beverages go “flat” when too much of the carbon dioxide has diffused into the surrounding air.*



# Glaciers Away!

## Materials

- A large pan
- A book or large block
- Sand or sandy soil
- A block of ice
- Small pebbles



## Procedure

1. Pack damp sand about half full into the pan, heaping part of it into a large "hill" toward the center.
2. Set the pan up on the book or block, so that it is tilted. Lightly push about three of the smallest pebbles into the top of the "hill" and set your ice block on top of those. (An ice block can be made by filling a plastic container with water and freezing, then dipping the bottom into hot water to release the block)
3. Balance the rest of the pebbles onto the top of the ice block (if you made your own ice block, the best thing to do is put pebbles into the bottom of the plastic container so they are frozen in).
4. Now let your ice melt, checking on it occasionally to see the progress it makes. Notice any spots of erosion made by the ice "glacier" or the force of the ice pushing on the rocks. Where do the pebbles on top of the ice end up?

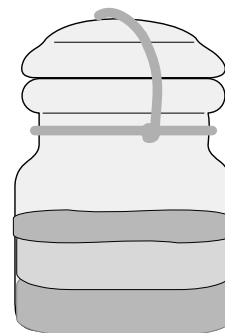
*Glaciers are like rivers of ice slowly advancing down a valley. Sometimes they create their own valleys, and many landmarks were created by the erosive force of glaciers. Even our Great Lakes were carved out long ago by glaciers. In Michigan, we find many areas such as moraines that are attributed to the land-altering power of these long-extinct masses of ice.*



# How Many Layers?

## Materials

Cooking oil  
Water  
Food coloring  
Glass jar or clear drinking glass



## Procedure

1. Make sure the jar or drinking glass is clean and dry.
2. Fill the container about 1/3 full of oil, then add an equal amount of water.  
Note how the oil and water respond to each other, and allow to settle.
3. Have children take a good look at the distinct separation of the oil and water.  
Try to form a good hypothesis as to why one is on top and the other sunk to the bottom.
4. Introduce the idea of adding food coloring to the layers in the container.  
Will the oil, water, or both become colored? Discuss and hypothesize.
5. Slowly add several drops of food coloring to the layers, noticing the reaction it has in the oil, and if it acts differently in the water.
6. After adding the food coloring and watching how the drops move through the layers, shake or stir the container to mix the contents and allow to settle once again. How many layers will there be now?

*Food coloring does not dissolve in oil as it does in water. Instead, it forms little droplets as it passes through the oil to reach the water.*

*Children may wish to test other liquids or even add small solids, to test the strength of layers and how many they can make. Be careful not to include cleaning substances such as bleach and ammonia!*



# How Many Pennies?

## Materials

- A clear drinking glass
- A roll of pennies (or about 50)
- Water
- (optional: dish soap)

## Procedure

1. Fill the glass with water all the way to the rim, until it will hold no more.
2. Have one child at a time estimate how many pennies they can slip into the water without it spilling over. Let them try, adding one penny at a time until the water finally spills over.
3. For an optional activity, try adding a couple drops of dish soap in the water before adding the pennies. Does this change how many pennies can be added?

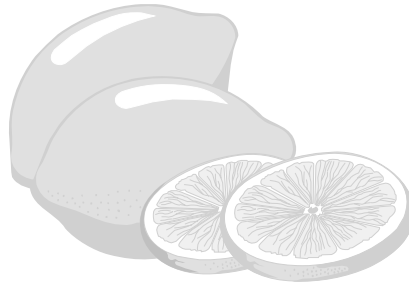
*An amazing amount of pennies can be added to a full glass of water before it spills over, due to the surface tension of the water. All water molecules have a strong attraction for each other, but the molecules at the surface have no more molecules above them, so they are unusually attracted downwards, towards the available water molecules.*



# Lemon Battery

## Materials

- A fresh lemon
- An old penny (mid-70s or earlier)
- A paperclip



## Procedure

1. Push the penny and the paperclip into the lemon, tops sticking out of the rind. They should be side by side but not touching each other.
2. Touch your tongue to the penny and the paperclip simultaneously.  
What do you feel?

*Inside the lemon are electrolytes, free ions that have an electrical charge. A chemical reaction causes electrons to build up on one of the metals and to decrease on the other metal. When you touch your tongue to both, you close the circuit and can feel a slight tingle and taste a metallic flavor. This indicates that electricity is flowing!*



# Make a Rainbow

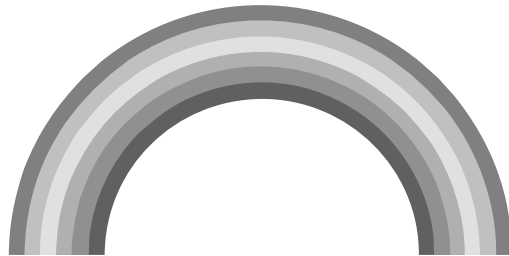
## Materials

- A small mirror
- A flashlight
- A shallow bowl
- A darkened room
- (optional: a mathematical protractor, used to draw angles)

## Procedure

1. Fill the bowl mostly full with water.
2. Have one person hold the mirror in the water at approximately a 30 degree angle to the bottom of the bowl (use a protractor to determine the angle if you wish).
3. Darken the room and shine the flashlight at the mirror. Look for a rainbow! If you don't see one, try tilting the mirror and/or the flashlight until the rainbow appears.

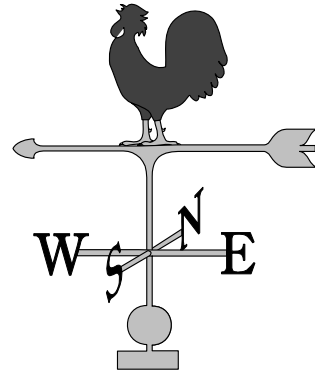
*The water in the bowl acts like a prism, separating the white light from the flashlight into the colors of the rainbow. A similar effect can be achieved by spraying a water hose in an arc on a very sunny day, moving the spray slowly around you until you reach the right angle to see the rainbow.*



# Make A Wind Vane

## Materials

- A sturdy plate
- A small amount of modeling clay
- A new pencil, unsharpened
- A drinking straw
- A straight pin
- An index card
- 2 paperclips
- Tape



## Procedure

1. Make the index card into the two ends of an arrow by cutting out a triangle from one side, going from the two side corners in to the vertical center of the card.
2. Roll the clay into a ball about an inch across and squish it onto the center of the plate. Put the lead end of the new pencil into the clay, standing it upright.
3. Attach the straw to the pencil by driving the pin through the horizontal center of the straw and into the pencil eraser.
4. Slip the paperclips onto one end of the now-horizontal straw, and tape the triangle portion of the index card to this end of the straw, making an arrowhead.
5. Tape the other part of the index card to the other end of the straw with the "tail" pointing outward. Do not put paperclips on this end.
6. Take your wind vane outside and face north. Use a compass if necessary. Let the wind blow the arrow in the direction it is going.

*Try to picture where the wind is coming from (the direction opposite of which direction it is blowing). What states are there? Is the wind probably going to be warmer or cooler coming from this direction? Observe if the wind always blows in the same direction or if it changes often. Are directional changes accompanied by gusts of wind?*



# Make It Roll

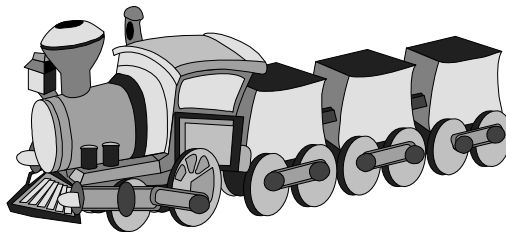
## Materials

Egg cartons  
Paper clips  
String  
Plastic lids  
Rubber bands  
Straws

## Procedure

1. Put all the materials on the table and arrange so that all children can easily access them.
2. Instruct the children that the only "rule" in this experiment is that they have to make an object that has moving parts, preferably one that can roll. Encourage them to plan their design before starting to construct it, even to draw out their design first.

*The object here is creativity, problem-solving, and indirectly experiencing the laws of physics. Allow any good and reasonable ideas, and encourage uniqueness! Children should come up with a variety of different objects or "toys", and may ask for more variety of materials to use. The only limit is what they can think up, and what you will allow!*



# Making the Best Airplane

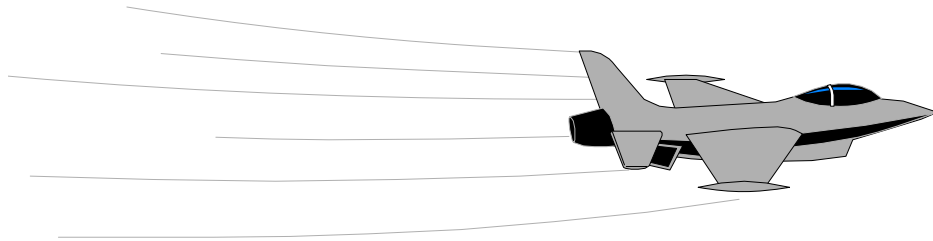
## Materials

Plastic drinking straws  
Strips of paper  
Clear tape

## Procedure

1. Cut strips of paper approximately  $\frac{1}{2}$  inch by  $2\frac{1}{2}$  inches, and the same number of strips approximately  $\frac{3}{4}$  inch by  $4\frac{1}{2}$  inches.
2. Attach one of each size strip of paper to each straw, forming the strips into loops or "chains" and taping them.
3. Experiment to find out which locations and distances of the strips make the best flying "airplane". For example, make one with the strips positioned at the extreme ends of the straw, one with the strips together in the center, and varying distances between. Test each airplane to see which flies the best.

*This experiment allows children to discover some of the physics of aerodynamics for themselves. Beware! Paper plane flying can be addictive, and children may wish to use other materials and weights to make new planes and test new hypotheses!*



# Marbles At Work

## Materials

An old manila file folder  
Marbles or tiny balls of various sizes  
A ruler  
Tape



## Procedure

1. Cut out the bottom of the file folder, leaving about two inches on each side of the fold. Cut an additional piece out of one of the discarded sides, approximately 3 inches by 6 inches. Fold this piece in half to get a small square "book".
2. Place two strips of tape on a table, about 6 inches long and about 4 inches apart.
3. Set the small "book" up with the fold on the far edge of one strip of tape, open side facing the other strip of tape. The bottom side of the "book" should be lying flat on the table and the other side should be standing as straight up as possible, making somewhat of a little "goal" to aim for.
4. Set the file folder up like a tray for the marble to roll down, facing the "goal", with its front side on the inside edge of the other strip of tape.
5. Barely elevate the file folder tray and roll a marble down it, pushing the goal. Measure the distance the goal moves.
6. Reset the goal and the tray, but this time elevate the tray further. Again measure how far the goal moves. Repeat with greater and greater elevations, and try using larger or smaller balls. Try to form a hypothesis as to what determines the amount of "work" a rolling ball can do (in this case measured by how far the goal is moved).

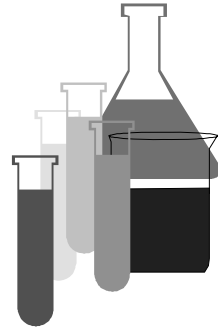
*It takes energy to do work, and anytime an object is moved, work is being done. An object rolled down a steep grade does more work than one rolled down a gradual incline. Also, an object with a greater mass has more force (energy) when it hits a stationary object than one with a lesser mass.*



# Natural pH Tester

## Materials

Red cabbage  
Vinegar  
Ammonia



## Procedure

1. Cut the cabbage into pieces and boil it in about twice as much water as leaves. Turn off the heat and allow to soak 20 minutes.
2. After at least 20 minutes, strain out the cabbage and save the liquid. Set aside to cool.
3. Once the cabbage juice has cooled, you can use it as a natural pH tester. First, mix a small amount of the juice with a small amount of vinegar, a known acid. What color does the juice turn? Have children make careful note of this, perhaps recording the results on paper.
4. Now mix a small amount of the juice with a small amount of ammonia, a known base (alkaline substance). Again, note the color change.
5. Use the established color change patterns to test other liquids in the same way.
6. Attempt to neutralize the pH in the sample by adding equal parts vinegar and ammonia. Does this work? Try adding more of one or the other.

*Acids are substances that contain high amounts of hydrogen ions, and they score below a 7 (which is neutral, like pure water) on the pH scale, which ranges from 0 to 14. Bases are substances that contain high amounts of hydroxyl ions and score above a 7 on the pH scale. For example, lemon juice is a pretty strong acid at a pH of about 2, and milk of magnesia is a moderate base (or alkaline) at a pH of about 10.*

*Note: Violets are also natural indicators. Try putting a blue violet in a small glass of vinegar and wait about 10 minutes. The violet turns red! “Roses are red, violets are... red?”*



# Reaction Time

## Materials

A ruler  
Pencil and paper

## Procedure

1. Have a partner hold the ruler by the very top of it. You put your hand at about the 1 inch mark and be ready to grab it, but do not touch it yet.
2. Your partner drops the ruler straight down without warning you. How fast can you react? What mark did you grab the ruler at? Record it.
3. Try this procedure again four or five more times. Each time, your partner lets go of the ruler without warning you, and each time you try to grab it as fast as you can. After each trial, record at what mark your fingers grasped the ruler. Does your reaction time get quicker?

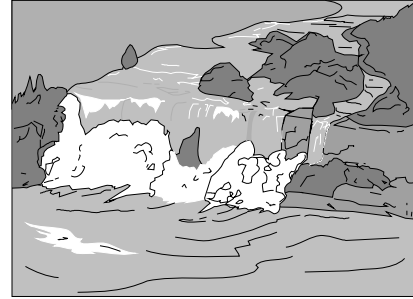
*Reaction time is basically a learned endeavor. If you tried this test several times every week, you would notice great improvement to a point of mastery. This part of our learning capacity serves us well. We need it to be efficient in driving, in working, and in playing games and sports. Life would be more difficult if our bodies could not learn and adapt to what we require of them!*



# Running Water

## Materials

A large shallow pan  
Books or blocks  
A sprinkling can  
Sand or soil



## Procedure

1. Pack the dirt about half full into the pan, leaving some empty space on one end.
2. Set the pan up on the books or blocks so that it is tilted about 45 degrees (half way between flat and straight up). Make sure the dirt is flat and featureless. The empty space should be at the bottom.
3. Slowly sprinkle the water onto the top of the dirt, allowing it to trickle down and create a landscape in the soil.
4. Repeat the sprinkling if you like. Notice how the water erodes the soil and creates valleys and riverbeds.
5. As an optional activity, try the experiment tilting the pan at a greater and then at a lesser angle. Does this change the degree to which the running water changes the landscape?

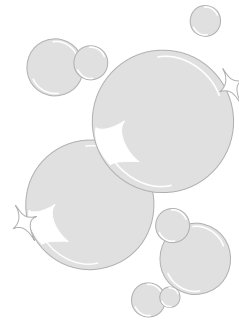
*Moving water is one of the main shapers of the earth. Even the Grand Canyon is said to have been carved by the power of running water. Loose soil is the easiest to be molded, but even rock and mineral slopes are eroded by water. The dislodged particles get transferred to new places, building up a delta at a river's mouth, or just adding to the ocean floor. Mountains dissemble into boulders, which become rocks, which are worn down into pebbles, which eventually break down into sand particles. What a powerful transformational process!*



# Test Your Lung Capacity

## Materials

- A bucket or pail, approximately 2 gallons in capacity
- An empty beverage bottle with label removed (lid not needed)
- A flexible drinking straw
- A towel
- A marker



## Procedure

1. Fill the bucket with water, preferably letting it remain in the sink.
2. Dunk the empty bottle in the bucket, completely filling it with water.
3. Place the straw into the mouth of the submerged bottle, and have one person hold the bottle and straw in place.
4. Let the person being tested exhale (blow) through the straw.
5. Remove the bottle, dry one side with a towel, and mark the water level on the bottle. The air space at the top is how much air was contained in the person's lungs.
6. Repeat the process of submerging and blowing, but this time have the person being tested take a deep breath before blowing into the straw. Compare the two marked levels. Was there more air in the lungs this time? See who can force the most air into the bottle - who has the greatest lung capacity. Have fun!

*The water in the bottle is forced out to make room for the air blown into it. This makes the water bubble up and out of the bottle. Human lungs can hold more than a gallon of air, but the amount flowing in and out varies from person to person and from activity to activity. The more active we are, the more oxygen our body requires at that time, so the more air fills our lungs with each breath.*



# Thumbs Up

## Materials

Two large rubber bands, or masking tape



## Procedure

1. Make a list of everyday things that you do - brushing your hair and teeth, tying your shoes, getting dressed, writing your name, etc. For each one, predict whether or not you will be able to accomplish the task without the use of your thumbs.
2. Strap your thumbs to the palms of your hand in such a way that you could not use them if you tried. Either put a rubber band around the hand catching the thumb, or tape the thumb in.
3. Now try to do your everyday tasks list without the use of your thumbs. Were your predictions correct? Did any surprise you?

*Our thumbs are structured in such a way that they are opposed, or opposite to, the rest of our fingers. It is amazing just how much we use our thumbs in everyday life. This experiment gives us a chance to appreciate the importance of our hand structure.*



# Two Points Or One?

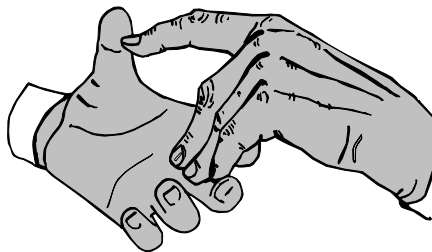
## Materials

Toothpicks

## Procedure

1. Have one person get two toothpicks and the other person hold out their hand and close their eyes.
2. The person without the toothpicks keeps their eyes closed while the other gently pokes both toothpicks onto the palm of their partner's hand, about one inch apart. Ask how many points they feel.
3. Now (with eyes still closed) move the toothpicks progressively closer until only one point is felt. Try moving from one inch to one centimeter to one millimeter, or roughly these.
4. Repeat the procedure on a fingertip. Are the toothpicks held closer or farther away when only one point is felt?
5. Repeat the same steps on other parts of the body, especially the back. Be sure partners trade roles and get a chance to feel this sensation.

*Different parts of the body play different roles in feeling sensations. The hands need a great deal of detailed sensation, so nerve endings are closer together. Points close together can be more easily distinguished than on the back or on the legs, etc. Other, similar experiments can be tried, such as stroking a feather or feeling ice on different parts of the body.*



# Water Cycle

## Materials

- A round pan, such as a cookie tin
- A baby food jar or other small jar
- Plastic wrap
- A large rubber band or string
- A small stone or weight



## Procedure

1. Place the empty baby food jar, without lid, into the center of the pan.
2. Fill the pan with about an inch of warm water.
3. Cover the pan and jar with plastic wrap, and secure in place with the rubber band or string.
4. Place the small stone or weight on top of the plastic wrap over the jar.
5. Leave the pan in a sunny, warm place for a few hours. Observe the changes that occur - check the wrap after a couple hours, and look inside the jar after your experiment is complete.

*As the sun heats the water in the pan, the surface water starts to evaporate. Since the vapor is trapped, it condenses on the plastic wrap. The stone pushes down on the wrap and forms somewhat of a funnel to drip the condensed water into the jar.*

*In this scenario, the water in the pan acts like water in a lake. The water evaporates and goes up into the air and forms clouds (such as the “fog” inside the pan), condenses, and falls back to the earth (in this case into the jar).*



# What Are You Breathing?



## Materials

A piece of stiff cardboard, at least one foot square  
A piece of clear plastic (plastic wrap will do)  
Petroleum jelly  
Tape  
String

## Procedure

1. Make a frame with the cardboard by cutting out a center square, leaving at least an inch on each side.
2. Tape or staple the clear plastic to the cardboard frame, stretching it tight.
3. Coat the plastic wrap on both sides with a thin film of petroleum jelly. Using a spatula may help apply it evenly.
4. Attach a string to the top of the frame and hang it up where it is exposed to the air. Allow to hang for a day or two.
5. Look closely at the plastic. Use a magnifying glass, if available. What is in the air that your nose and lungs filter out for you?

*The air contains many small particles that we do not normally notice. We have small hairs in our noses that trap the larger particles, and most of the smaller ones stick to the mucus membranes lining our nose and airways. We sneeze or cough to dislodge any troublesome particles.*

*Air pollutants such as was trapped in the sticky jelly come from a variety of sources including factories, vehicles, and plants. Most are smaller than the eye can see -- less than 50 microns across -- but they can range from 1 to 1000 microns (1/1000 of a millimeter to one millimeter).*

