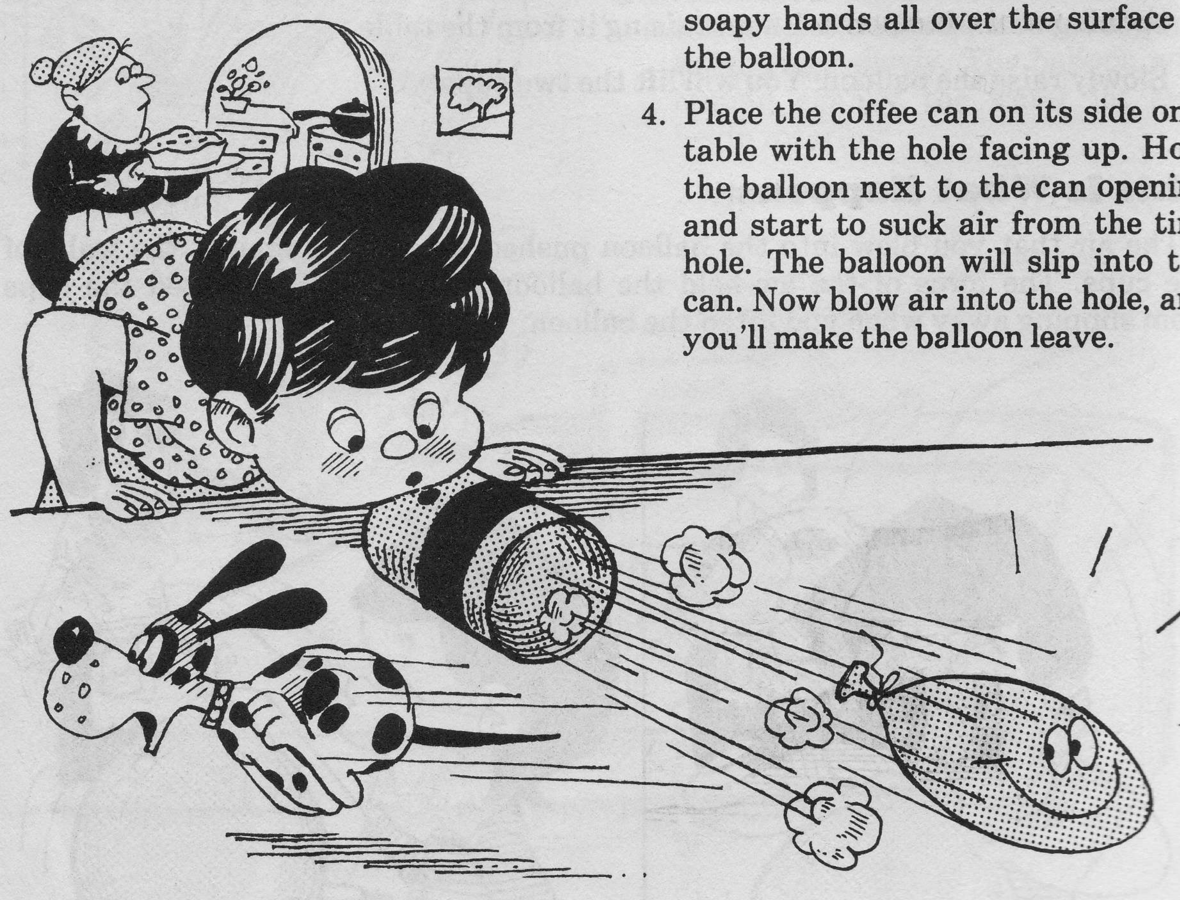
A Hole in One

You Will Need:

Coffee can
Nail
Hammer
Round balloon
Soap
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Ask one of your parents to make a small hole near the bottom of a coffee can by tapping the tip of a nail into the metal can with a hammer.
2. Inflate a round balloon until it is slightly larger than the can opening, then tie the balloon shut.
3. Wet your hands and lather them with a piece of soap. Rub your soapy hands all over the surface of the balloon.
4. Place the coffee can on its side on a table with the hole facing up. Hold the balloon next to the can opening and start to suck air from the tiny hole. The balloon will slip into the can. Now blow air into the hole, and you'll make the balloon leave.



This Is What Happens:

By sucking air from the can, you decrease the air pressure inside. The air pressure outside the can is now greater, and this pushes against the balloon, forcing it into the can. Blowing into the can does just the opposite: The pressure builds up inside and forces the balloon out.

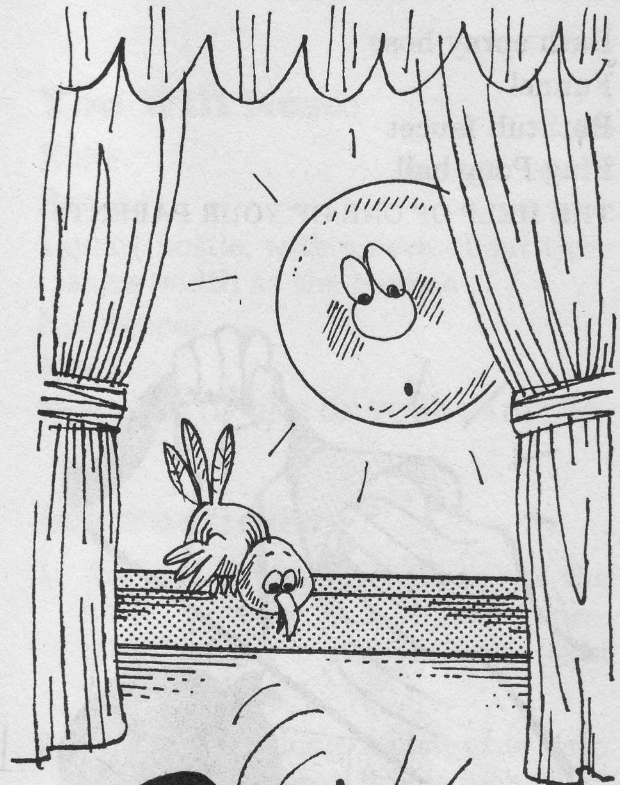
The Clinger

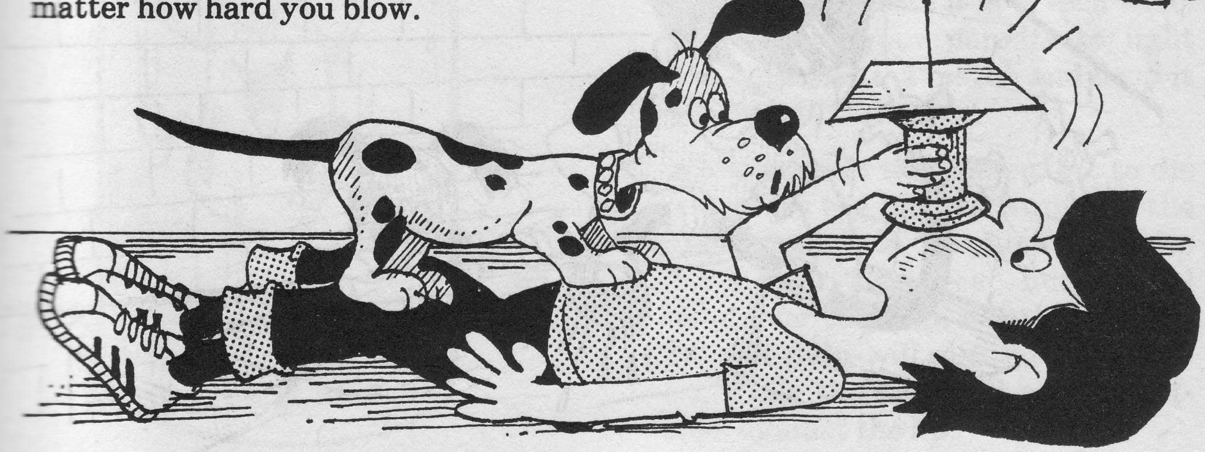
You Will Need:

Cardboard
Scissors
Straight pin
Spool

Instructions:

1. Cut a piece of cardboard about 3 inches square. Push a pin through the center of the square.
2. Place the cardboard on top of a large spool, with the sharp point of the pin inside the hole.
3. Lie down on the floor face up. Hold the spool to your mouth and try to blow the cardboard off by blowing into the hole. The cardboard will cling to the spool no matter how hard you blow.





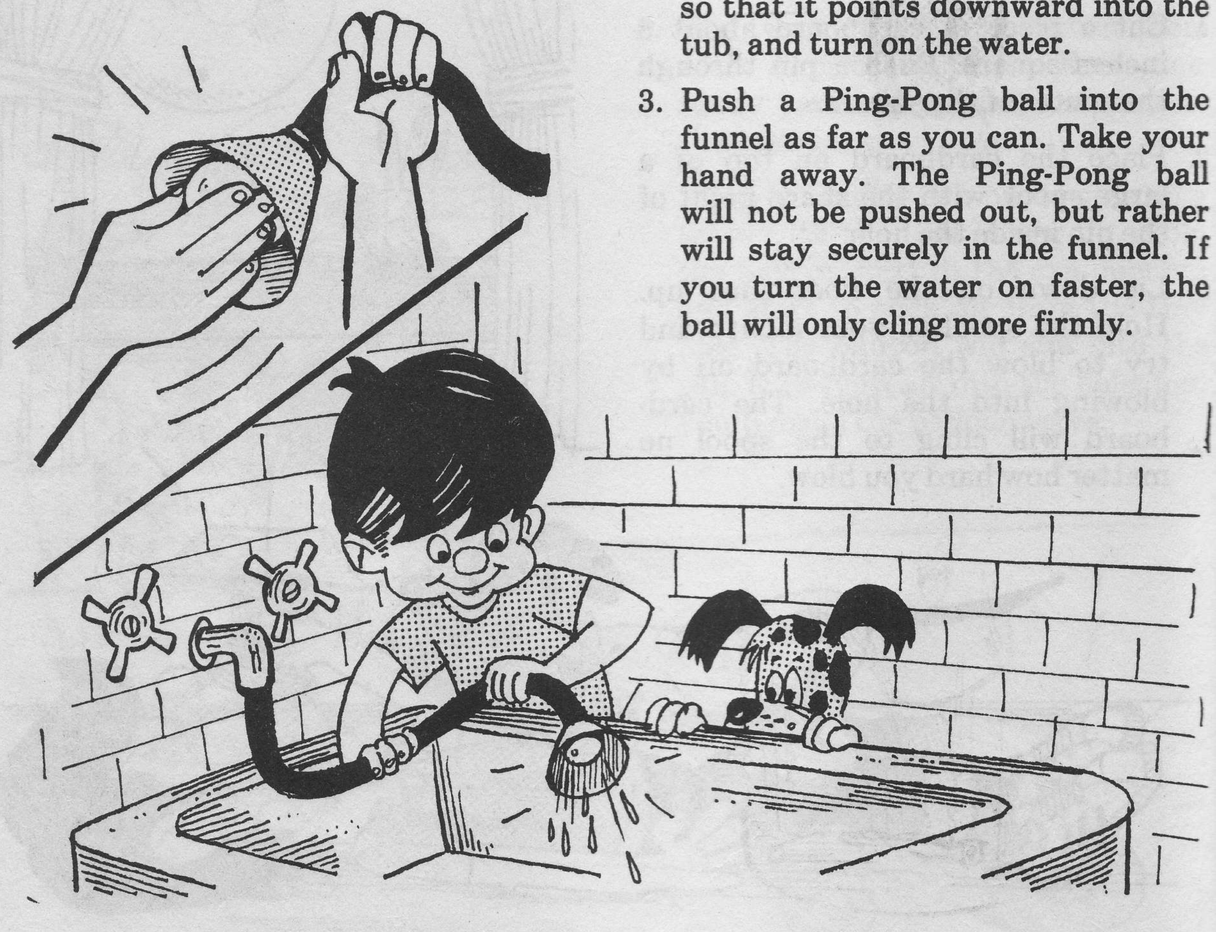
This Is What Happens:

The air coming from your mouth rushes into the hole of the spool and exists between the top of the spool and the cardboard. An area of low pressure is produced in this space. The air above the cardboard pushes down on top of it and holds it firmly in place as long as you blow. In fact, the harder you blow, the tighter the grip becomes between the two surfaces.

Ping-Pong Bath

You Will Need:

Bath spray hose
Funnel
Bathtub faucet
Ping-Pong ball
THE HELP OF ONE OF YOUR PARENTS



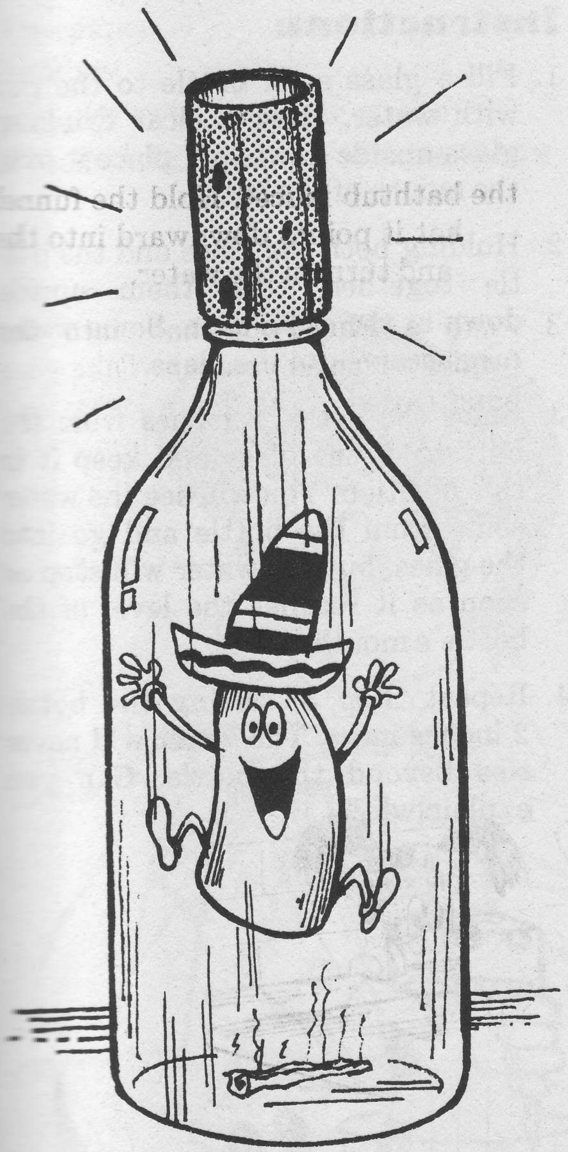
Instructions:

1. Ask one of your parents to remove the spray head from a bath spray hose, then insert the narrow end of the kitchen funnel into the hose opening.
2. Connect the other end of the hose to the bathtub faucet. Hold the funnel so that it points downward into the tub, and turn on the water.
3. Push a Ping-Pong ball into the funnel as far as you can. Take your hand away. The Ping-Pong ball will not be pushed out, but rather will stay securely in the funnel. If you turn the water on faster, the ball will only cling more firmly.

This Is What Happens:

The stream of water rushing from the hose into the funnel produces an area of low pressure between the funnel and the Ping-Pong ball. The air pressure outside the funnel pushes upward on the ball and supports it against the downward thrust of the water. This experiment is a good example of *Bernoulli's principle:* The pressure in a flowing stream of liquid or gas is less than at its sides.

Automatic Banana Peeler



You Will Need:

Knife
Banana
1-quart bottle, with a neck about the same width as the banana
Newspaper
Matches
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Ask one of your parents to use the knife to slice a 1½-inch cross-section from a ripe banana (skin and all).
2. Fold a 6-inch-long, 1-inch-wide strip of newspaper until it is ¼ inch wide. Ask one of your parents to light this paper with a match and drop it gently into the bottle.
3. When you see the flame start to die out, press the banana firmly on the lip of the bottle. (It should not slip down into the neck, but should hang over the edge a little bit.) The banana pulp will slip into the bottle, while the skin will remain outside, against the lip.

This Is What Happens:

The heat produced inside the bottle causes the air to expand, forcing some of it to leave. Then as you block the opening (with the banana), the cooling air occupies less space and has a reduced pressure. The greater air pressure on the outside of the bottle pushes the soft banana pulp into the jar. The skin, however, is prevented from entering by the edge of the glass lip.

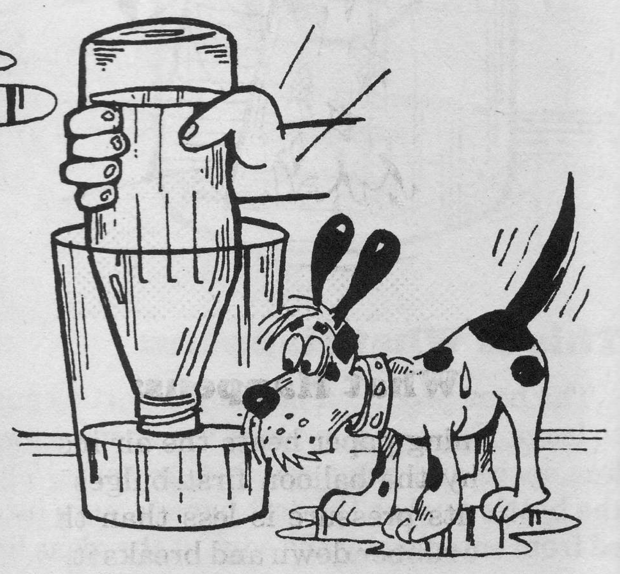
Stop When I Say Enough

You Will Need:

Glass soda bottle
Water
Drinking glass

Instructions:

1. Fill a glass soda bottle to the rim with water. Hold a clear drinking glass upside down and place it over the mouth of the bottle.
2. Holding both the glass and the bottle together, turn them upside down at the same time. Some water may escape into the glass.
3. Raise the bottle 2 inches from the bottom of the glass and keep it in this position. You will see the water come from the bottle and go into the glass, but the water will stop as soon as it reaches the level of the bottle's mouth.
4. Repeat Step 3, raising the bottle 2 inches more. The water will never rise beyond the bottle. Can you explain why?



This Is What Happens:

When you raise the bottle, air blows into it, pushing the water out of it. When the water level in the glass reaches the bottle mouth, the air outside the bottle presses on the water in the glass and prevents any more water from leaving the bottle.

The Big Bang

You Will Need:

Round balloon
Scissors
Newspaper
Matches
Glass jar with a narrow mouth
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Cut off the top half of a round balloon and discard it. You will be left with a solid piece of rubber.
2. Fold a piece of newspaper to approximately 3 by 5 inches. Ask one of your parents to light the newspaper with a match and place the burning paper into the glass jar.
3. Quickly place the piece of rubber over the jar's opening. Use both hands to securely hold the rubber against the glass sides, grasping opposite edges of the balloon and gently tugging with a slight outward and downward motion. You will see the balloon stretch upward at first. Then the rubber will turn inward until it bursts with a loud bang.

This Is What Happens:

The burning paper heats the air inside the jar, which causes the air to expand. This is why the balloon first bulges out. After the flame dies, however, the air cools and its pressure is less than the air outside the jar. The outside pressure pushes the rubber down and breaks it.

Fascinating Rhythm

You Will Need:

Small, glass soda bottle
Freezer
Water
Coin

Instructions:

1. Wash out an empty glass soda bottle and place it in the freezer.
2. After several hours, remove the bottle and moisten the top with water. Set a coin over the opening. The coin should make a seal at the mouth of the bottle.
3. Cup both hands around the sides of the bottle. Soon, the coin will jump up and down, tapping out a fascinating rhythm on the glass surface.

This Is What Happens:

Cold air is trapped inside the bottle. As it begins to warm up, the air expands and forces the coin up. A little bit of air escapes and the coin falls back down. The process is repeated until the air inside the bottle reaches the same temperature as the air in the room.

Trapped!

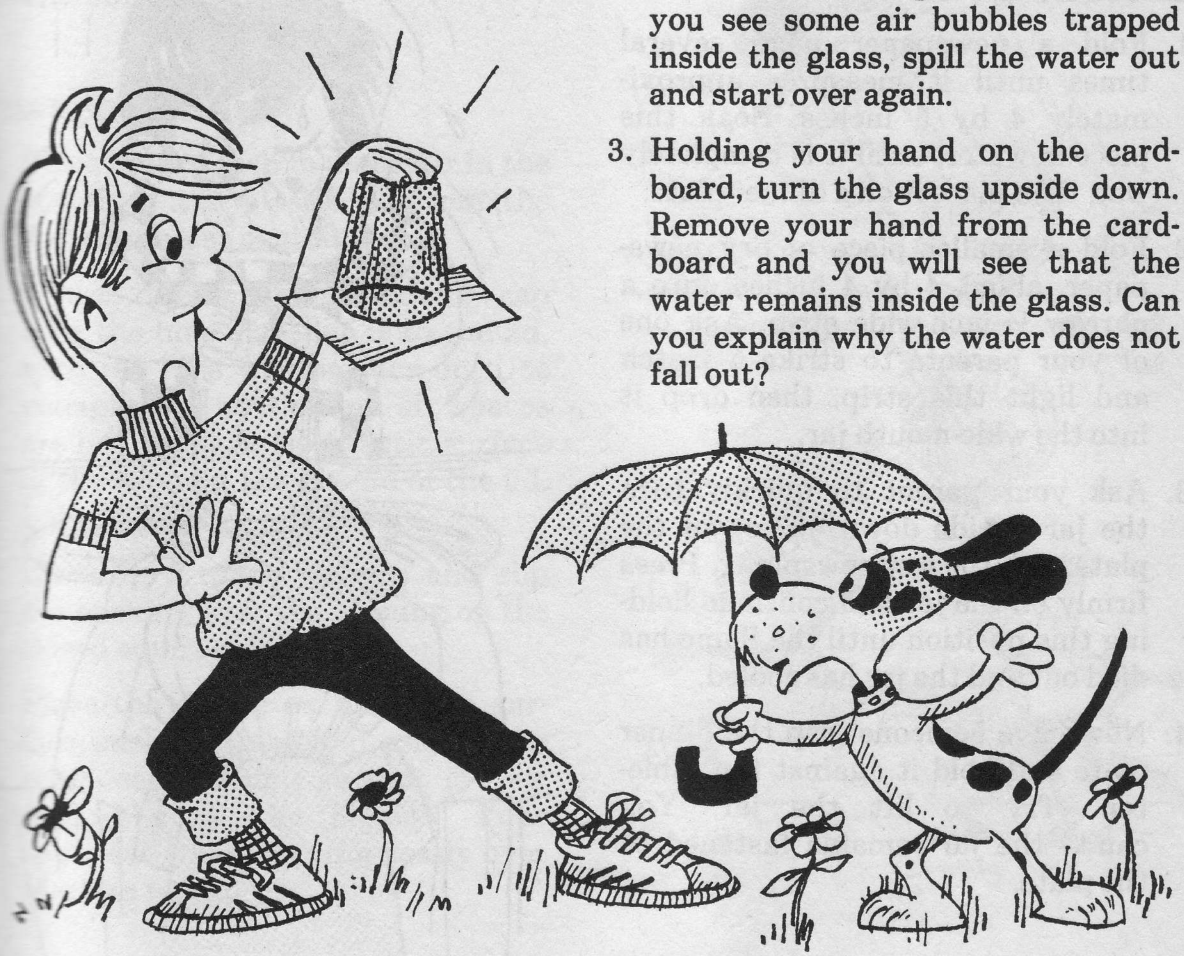
You Will Need:

Drinking glass
Water
Thin cardboard or index card

Instructions:

Do this experiment outdoors or over the sink.

1. Fill the drinking glass with water up to the rim.
2. Set a piece of thin cardboard, or an index card, on top of the glass. If you see some air bubbles trapped inside the glass, spill the water out and start over again.
3. Holding your hand on the cardboard, turn the glass upside down. Remove your hand from the cardboard and you will see that the water remains inside the glass. Can you explain why the water does not fall out?



This Is What Happens:

A tight seal is formed between the cardboard and the rim of the glass. The force of air pressure pushes upward to keep the cardboard in place. The water does not spill out because the force of gravity pulling the water downward is not great enough to break the seal.

Fascinating Rhythm

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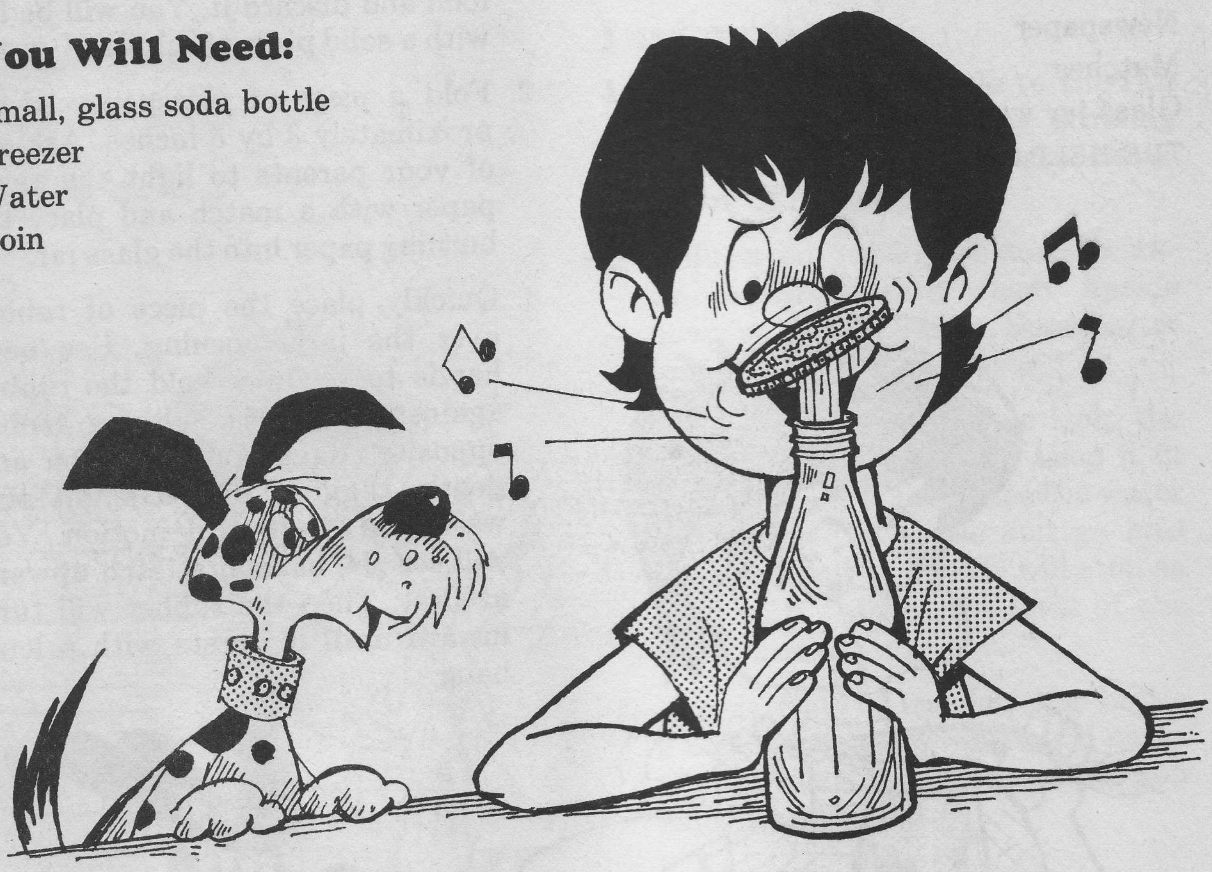
Small, glass soda bottle
Freezer
Water
Coin



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Instructions:

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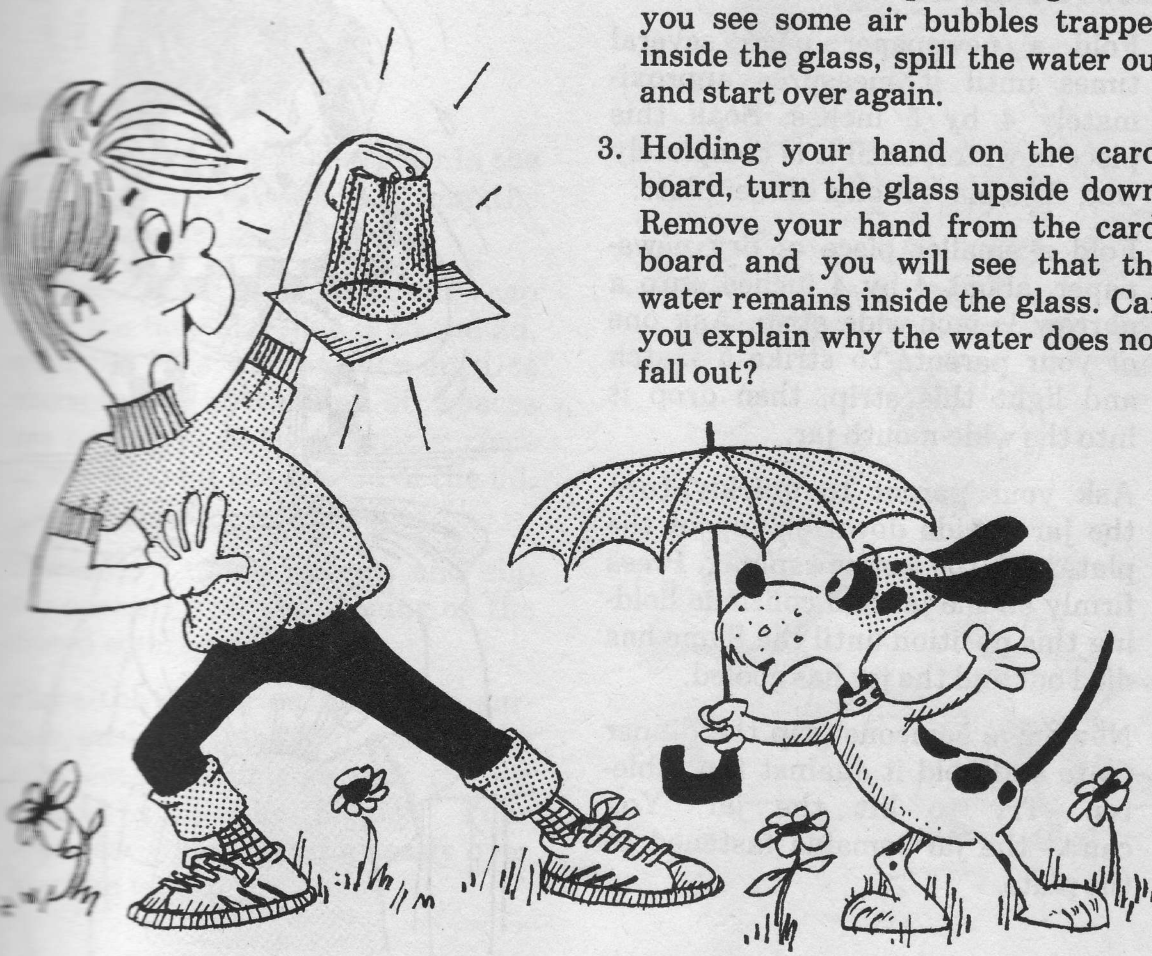

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Stuck Like Glue

You Will Need:

Newspaper
Water
Dinner plate
Matches
Wide-mouth jar
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Fold a newspaper page several times until it measures approximately 4 by 5 inches. Soak this piece in water, until it is completely wet, then place it on a dinner plate.
2. Fold a smaller piece of dry newspaper, about 4 by 4 inches, into a narrow ½-inch-wide strip. Ask one of your parents to strike a match and light this strip, then drop it into the wide-mouth jar.
3. Ask your parent to quickly turn the jar upside down on top of the plate with the wet newspaper. Press firmly on the jar and continue holding this position until the flame has died out and the jar has cooled.
4. Now have someone grip the dinner plate and hold it against the tabletop. Try to lift the jar. You can't—the jar remains fastened to the plate.

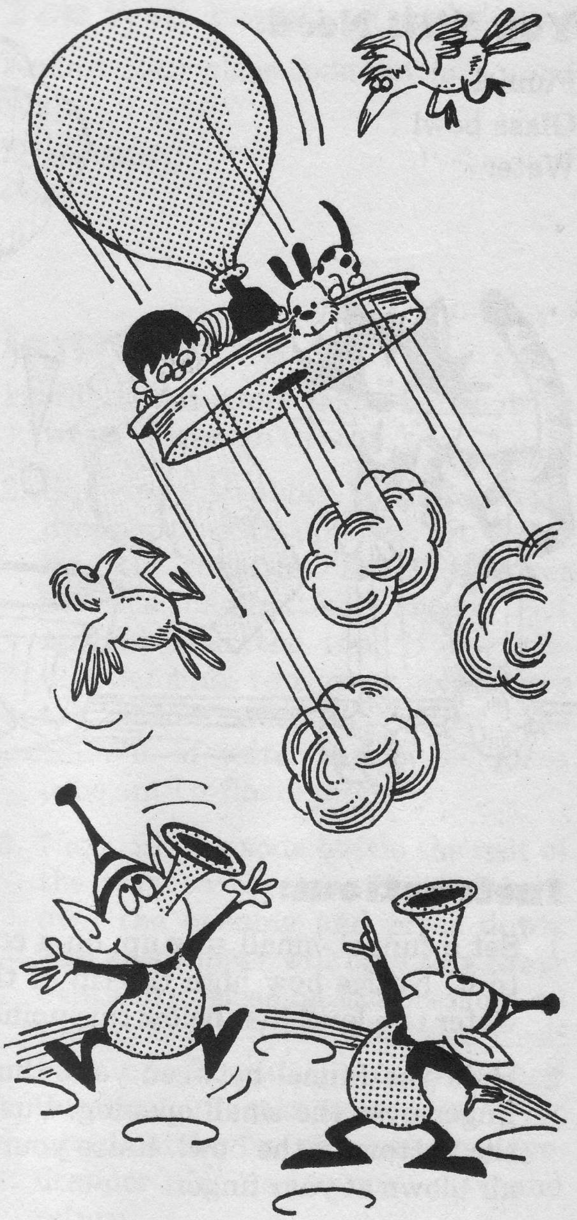
This Is What Happens:

The burning strip of paper heats the air inside the jar. This hot air expands and some of it is forced from the jar. As the air remaining in the jar cools, it contracts and its pressure is reduced. The outside air pressing on top of the jar and underneath the plate is stronger than the inside air and holds the two objects together firmly.

Soaring in Space

You Will Need:

Scissors
Plastic lid from a cottage cheese container
Push-pull squirt cap from a bottle of dishwashing liquid
Glue
Round balloon



Instructions:

1. Cut a hole ¾ inch in diameter in the center of the plastic lid from the cottage cheese container.
2. Center the push-pull squirt cap over the hole and glue it to the lid, with the lid's writing face up. Use enough glue so that no air spaces are left between the plastic surface of the cap and the plastic of the lid. Let the glue dry completely.
3. Blow up a round balloon and slip the opening over the opening on the closed squirt cap.
4. Place the device on a smooth surface, such as a table top, and lift the squirt-cap opening so that the air escapes from the balloon. Your space car will glide effortlessly over Martian territory!

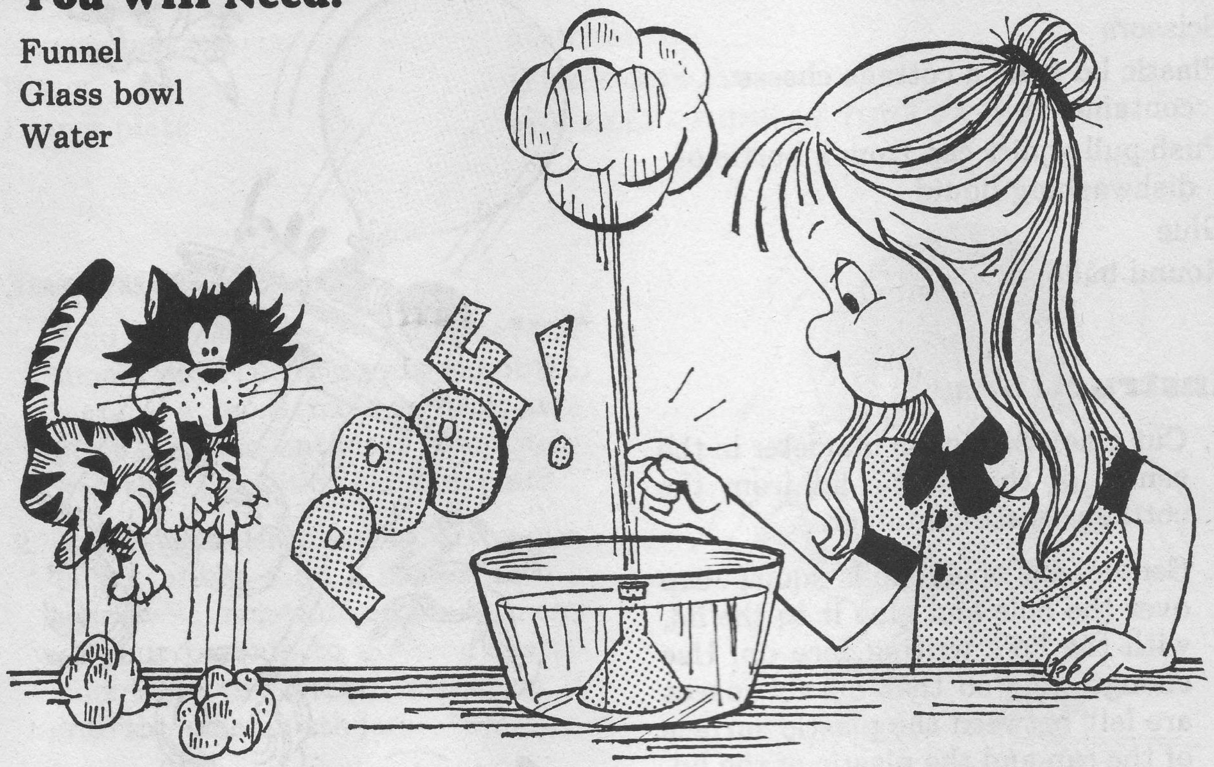
This Is What Happens:

The air you blow into the balloon is under pressure. When you attach the balloon to the squirt cap's opening, you create a seal that prevents the air from leaking out. As the nozzle is lifted, the only path the air can take is through the inner hole in the cap to the underside of the device. Here, a cushion of air spreads along the flat surface of the cottage cheese lid, the entire device is supported by the air cushion, and it appears to be floating on top of the table.

Puffin' Funnel

You Will Need:

Funnel
Glass bowl
Water



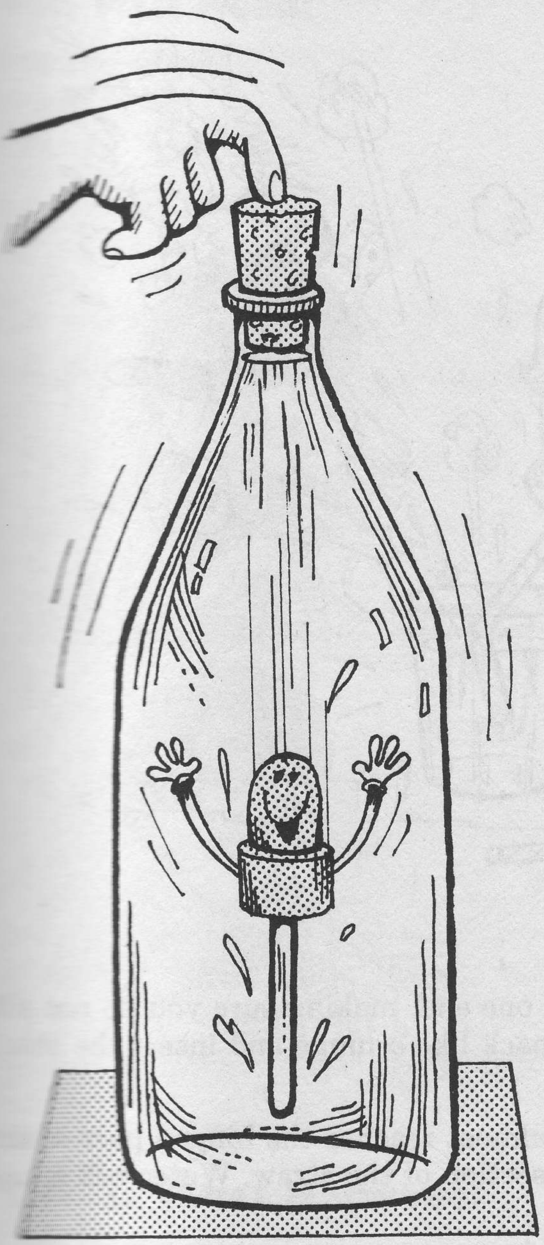
Instructions:

1. Set a funnel, small side up, on a counter top, then set a large glass bowl next to it. Notice how high the tip of the funnel extends. Fill the glass bowl with water to a level just below this point.
2. Hold the funnel between your thumb and middle finger, keeping your index finger over the small opening. Push the funnel into the water until it touches the bottom of the bowl. Raise your index finger slightly. You will feel a puff of air blown at your finger.

This Is What Happens:

When you are holding the funnel with your finger over the tip, a quantity of air is inside the device. As you press the funnel to the bottom of the bowl, this air remains trapped inside the funnel—your finger blocks it from the top and the water blocks it from below. When you remove your finger, the pressure of the water pushes against the air inside the funnel and forces it out through the small hole. If you used a glass funnel, you could see the water level rise inside the funnel as the puff of air hit your finger!

Daring Diver



You Will Need:

1-quart clear glass soda bottle
Water
Eyedropper
Cork

Instructions:

1. Fill the 1-quart soda bottle with water almost to the top.
2. Squeeze the rubber bulb of an eyedropper to draw up some tap water into the tube. Set the eyedropper into the soda bottle. It should float upright near the top. If the eyedropper sinks too low or bobs above the water surface, adjust the amount of water inside the glass tube until it floats properly.
3. Next, fill the soda bottle the rest of the way to the top. Place a cork over the opening and press down. The eyedropper will dive to a lower depth. By releasing the pressure on the cork, the diver will raise itself back up. Repeat the pressing and releasing process over and over again, and you will see the eyedropper dive and return, dive and return. . . .

This Is What Happens:

A small pocket of air remains inside the eyedropper. When you apply pressure by pushing down on the cork, this volume of air is reduced. More water flows into the dropper, it becomes a little heavier, and sinks lower. When you release the pressure, the compressed air expands to its original volume. Water leaves the dropper, and the dropper becomes lighter, and rises to the surface.

Hurray for Spray

You Will Need:

Paper straw
Scissors
Drinking glass
Water

Instructions:

1. Slit a paper straw across, about ⅓ from one end, making sure you do not slit it all the way through. Bend the straw back like a hinge and insert the short end into a drinking glass.
2. Fill the glass with water until the level almost reaches the hinged part of the straw. Now blow hard through the long section of the straw. Water will spray from the glass.

This Is What Happens:

When you blow through the straw, the swiftly moving jet of air reduces the pressure above the hinged opening. The air pressure over the water is now greater, and this pushes water up the short section. When this water hits the stream of air, it is carried away as drops of water. This is the same principle used in many squeeze-type spray bottles. Instead of blowing through a straw, however, you force air through the mechanism with a hand pump.

You Will Need:

Drinking glass
Water
2 straws

Instructions:

1. Fill a clean drinking glass with tap water. Place two straws in your mouth and lower your mouth to the glass. Allow one straw to enter the water, but let the other one hang outside the glass.
2. Try to sip some of the water. You will find that the water will not rise up the straw.
3. Now place the tip or side of your tongue tightly over the end of the dry straw (the one that is outside the glass) and try to sip some water again. This time the water is easily sipped up into your mouth.

This Is What Happens:

Normally, you sip a liquid through a single straw, creating a tight seal between your mouth and the straw. The action of sipping lowers the air pressure inside your mouth to a point slightly lower than the air pressure on the surface of the liquid. It is now this greater pressure that pushes the liquid up the straw. In the experiment, the extra straw was open to the outside air. This did *not* allow a decrease of pressure because more air was entering your mouth when you sipped. But by placing your tongue over the outside straw, you created the necessary airtight seal for lowering the air pressure inside your mouth. Therefore, you could successfully sip!

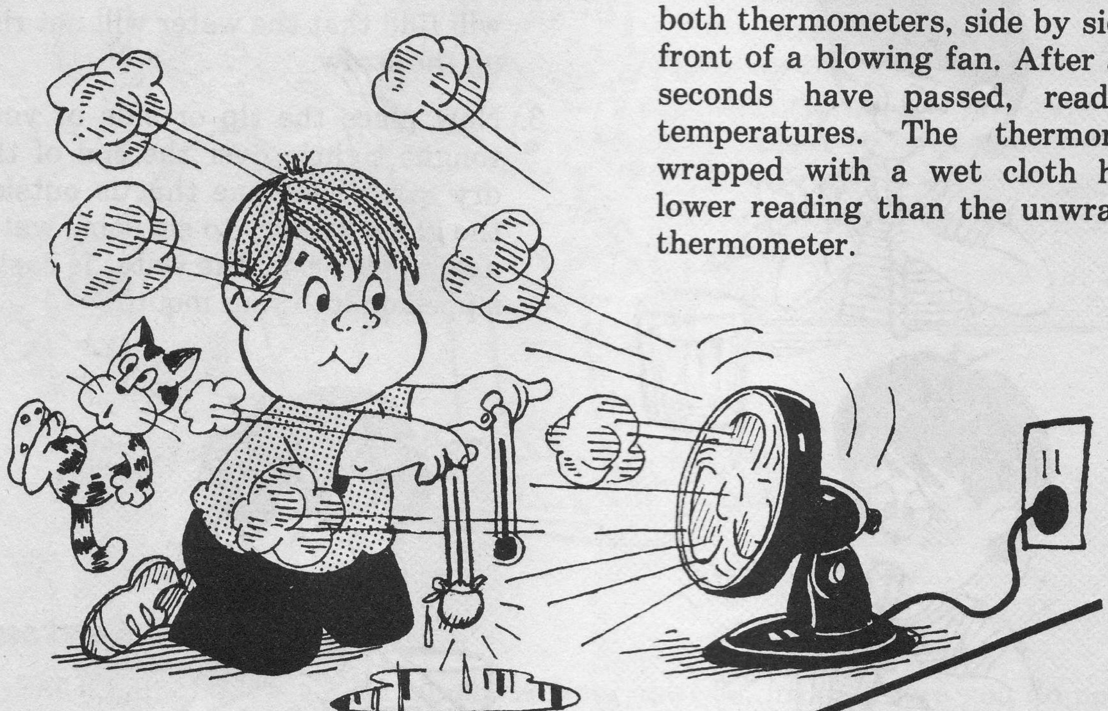
Fan Club

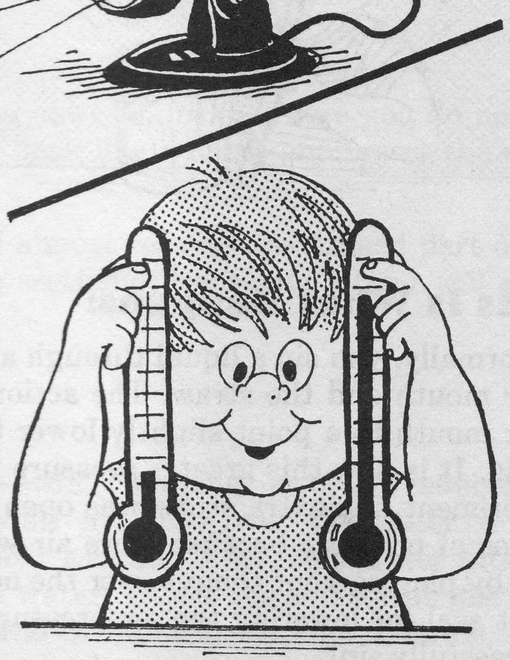
You Will Need:

2 thermometers, 1, or both, with an exposed bulb
Cloth
Thread
Water
Electric fan

Instructions:

1. Make sure the two thermometers give identical readings. Wrap a piece of lightweight cloth once around one of the exposed thermometer bulbs, and tie it in place with thread.
2. Wet the cloth with water, then hold both thermometers, side by side, in front of a blowing fan. After a few seconds have passed, read the temperatures. The thermometer wrapped with a wet cloth has a lower reading than the unwrapped thermometer.





This Is What Happens:

The fan helped to blow moisture from the wet cloth into the air. This evaporation of moisture into the air requires heat. The necessary heat was taken from the thermometer bulb, which caused the liquid inside to become cooler and the temperature to drop. No such forces were acting on the other thermometer, so it did not lose heat.

Shape Up or Ship Out

You Will Need:

Several bottles and jars in various shapes
Pie plate
Glass
Measuring cup
Water

Instructions:

1. In selecting the bottles and jars of different shapes, be sure to include some with narrow and some with wide openings.
2. Using a measuring cup, pour exactly 1 cup of water into each of your jars, plus 1 cup each into the pie plate and glass. If 1 cup is too much or not enough for the containers you have chosen, you can increase or decrease the 1-cup amount, but make sure all the containers hold the *same* amount of water at the start of the experiment.
3. Set the containers in a warm, dry place overnight or longer. Then measure the amount of water in each vessel. You will find that they all have varying amounts of water. Can you explain these differences?

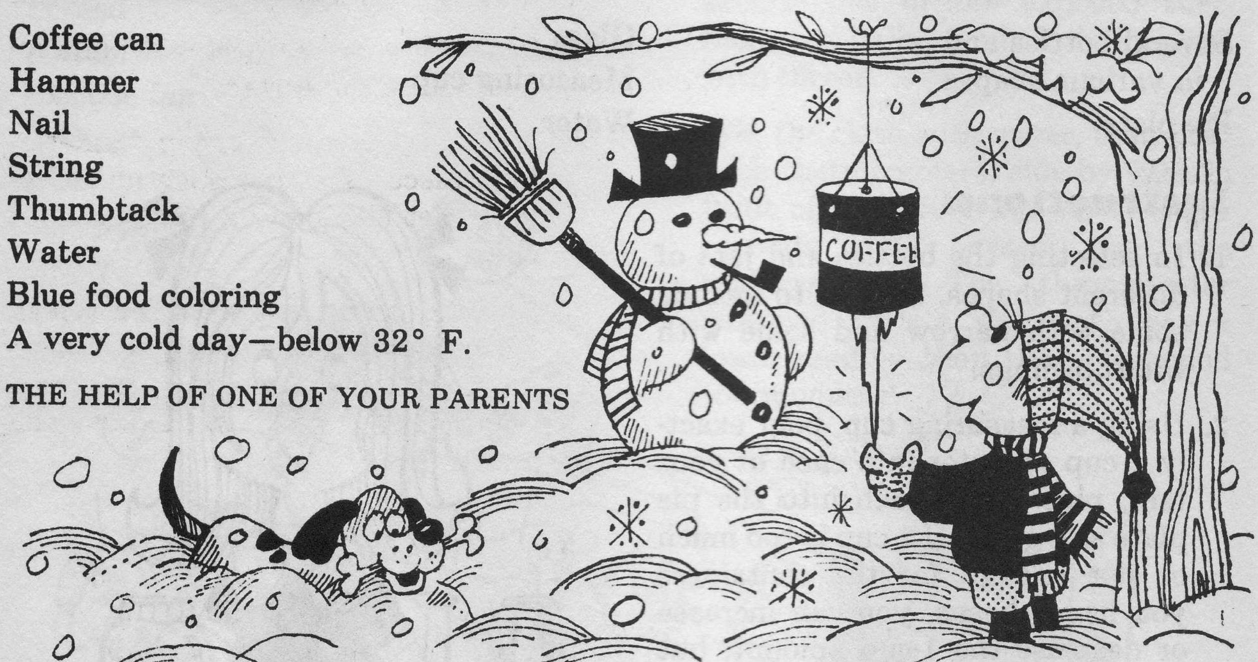
This Is What Happens:

Each of the containers lost water due to *evaporation*—liquid changing to vapor and escaping into the air. The pie plate probably lost the most water because it had the greatest surface area of water (spread out flat) exposed to the air. In other words, there was more water in contact with the air, so there was more water available to escape at the surface. Other containers that were skinny and had small openings lost the least amount of water. Can you imagine how much water evaporates from a large body of water, such as a lake, in a single day?

Things That Go Drip in the Night

You Will Need:

Coffee can
Hammer
Nail
String
Thumbtack
Water
Blue food coloring
A very cold day—below 32° F.
THE HELP OF ONE OF YOUR PARENTS



Instructions:

1. Ask one of your parents to punch 3 holes, equally spaced, around the top edge of the coffee can. A hammer and small nail work well for this.
2. Tie a piece of string through each of these openings, then tie the ends to one long piece of string.
3. Next, punch a tiny hole in the bottom of the can with the thumbtack.
4. On a cold night, fill the can with water and add a few drops of blue food coloring. Then, using the long piece of string, hang the can outdoors. You will find a shimmering blue icicle suspended from the can in the morning.

This Is What Happens:

The hole in the bottom of the can allows water to drip through slowly, one drop at a time. First, some water freezes to the cold can. Then more drops flow out and freeze to this new surface. The icicle grows from top to bottom, each new drop increasing its length, and the next day—behold a beautiful blue icicle shimmering in the morning light!

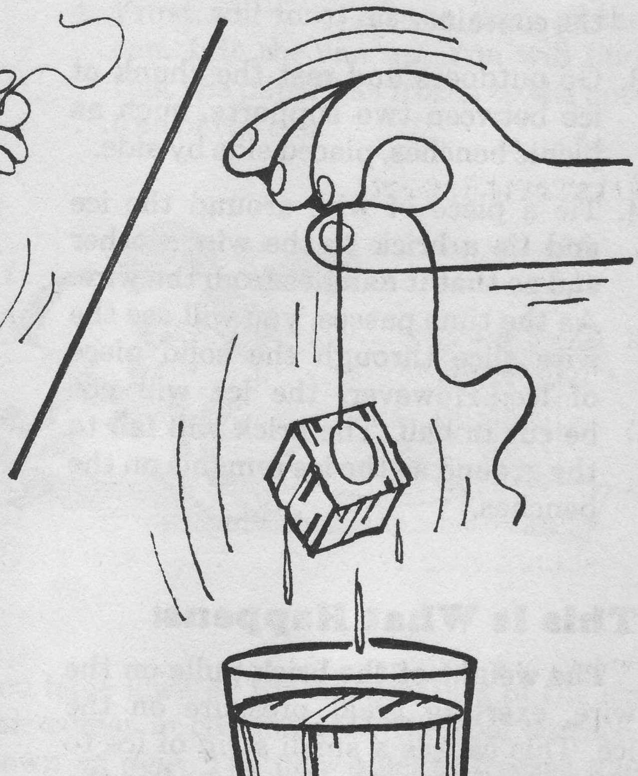
Operation Ice Lift

You Will Need:

Glass
Water
Ice cube
String
Salt

Instructions:

1. Fill a glass with water and place an ice cube on the surface.
2. Tie a loop, about 1 inch in diameter, in a piece of string several inches long. Set the loop on top of the ice cube.
3. Sprinkle some salt over the top of the cube where the loop sits. Wait a few minutes. Gently pull the string up. The ice cube is lifted above the water.



This Is What Happens:

The salt caused the ice cube to melt around the string. Then the water refroze, freezing the string to the ice cube and allowing you to pull it up with the ice cube attached. Salt is used on many roads and sidewalks in the wintertime on ice and snow because it lowers the melting point of water.

Brickwork

You Will Need:

1-quart milk or juice carton
Water
2 outdoor benches
Thin, uncoated wire
Brick
A very cold day—32°F. or colder

Instructions:

1. Fill the 1-quart carton with water and place it in the freezer until it is frozen solid.
2. Take the carton out of the freezer and run a little warm water over it so that you can slide the ice from the container.
3. Go outdoors and rest the chunk of ice between two supports, such as picnic benches, placed side by side.
4. Tie a piece of wire around the ice and tie a brick to the wire's other end so that it dangles from the wire. As the time passes, you will see the wire slice through the solid piece of ice. However, the ice will not be cut in half. The brick will fall to the ground as the ice remains on the benches.

This Is What Happens:

The weight of the brick pulls on the wire, exerting great pressure on the ice. This causes a small strip of ice to melt where the wire sits. But after the wire passes through the melted area, the water refreezes, and the ice remains in one solid piece.

Frosty, the Snow Can

You Will Need:

Plastic bag
Ice
Hammer
1-pound coffee can
Salt
½ teaspoon water
Paper
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Fill a strong plastic bag with ice. Set the bag on a hard surface, such as a concrete garage floor, and ask one of your parents to hit the ice with a hammer until the ice breaks up into tiny pieces.
2. Fill the coffee can about ⅔ full with the crushed ice. Fill the can the rest of the way with salt, and stir completely.
3. Place the ½ teaspoon of water on a piece of ordinary note paper and set the can on top of this.
4. Frost will form on the sides of the can. Lift the can up. You will find that the paper has frozen to the bottom of the can.

This Is What Happens:

By adding salt to the crushed ice, you have lowered the temperature of the ice slightly below the freezing point. As air comes in contact with the cool surface, water molecules condense. This is known as *dew.* The dew quickly freezes, becoming *frost.* The wet paper underneath the can also freezes and sticks to the metal.

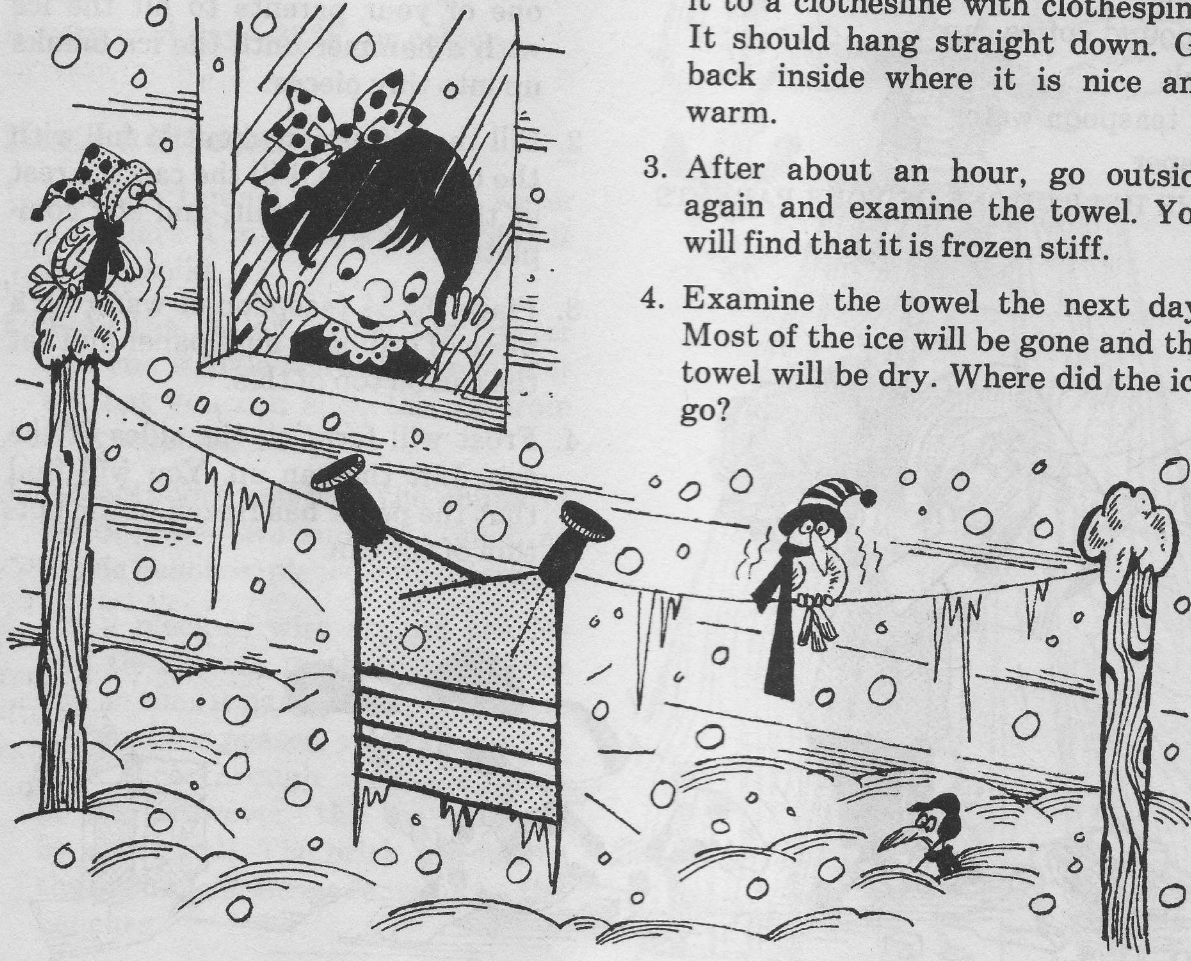
Towel Dry

You Will Need:

Towel
Water
Clothesline and clothespins
A very cold day—below 32°F.

Instructions:

1. Wet a towel with water until it is completely soaked. Squeeze out the excess water by twisting the towel over a sink.
2. Hang the towel outside by clipping it to a clothesline with clothespins. It should hang straight down. Go back inside where it is nice and warm.
3. After about an hour, go outside again and examine the towel. You will find that it is frozen stiff.
4. Examine the towel the next day. Most of the ice will be gone and the towel will be dry. Where did the ice go?



This Is What Happens:

The ice in the towel has a temperature of about 32° F. because it has just froze. Ice at this temperature will evaporate into the air almost as quickly as water at the same temperature. The ice does not have to melt into water first. It can turn into water vapor without becoming a liquid. This process of going directly from a solid to a gas is called *sublimation.* And if there is a strong breeze outside, this will speed sublimation because the wind helps to carry away the moisture.

Rain, Rain, Go Away

You Will Need:

Saucepan
Water
Frying pan
Ice Cubes
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Fill a saucepan about ¼ full with water, and ask one of your parents to boil it over high heat.
2. Fill a frying pan with ice cubes, then give it to your parent to hold several inches above the steam escaping from the saucepan. Remind your parent to hold the frying pan by its handle so his or her hands do not come in contact with the steam—steam is extremely hot and can burn! In a few minutes, you will see raindrops fall from the bottom of the frying pan into the boiling water.

This Is What Happens:

You have just produced rain the same way that nature makes it. The boiling water caused water vapor (steam) to rise from the saucepan. As the steam hit the cold surface of the frying pan, it collected as moisture on the underside. Soon, the moisture became too heavy and fell as drops of water. In nature, a similar cycle takes place. Oceans, lakes, and streams lose water through evaporation. The water vapor rises into the sky. Here, it is colder, so the water collects into clouds. When the clouds become too heavy with water, drops of rain fall to the earth.

Human Thermometer

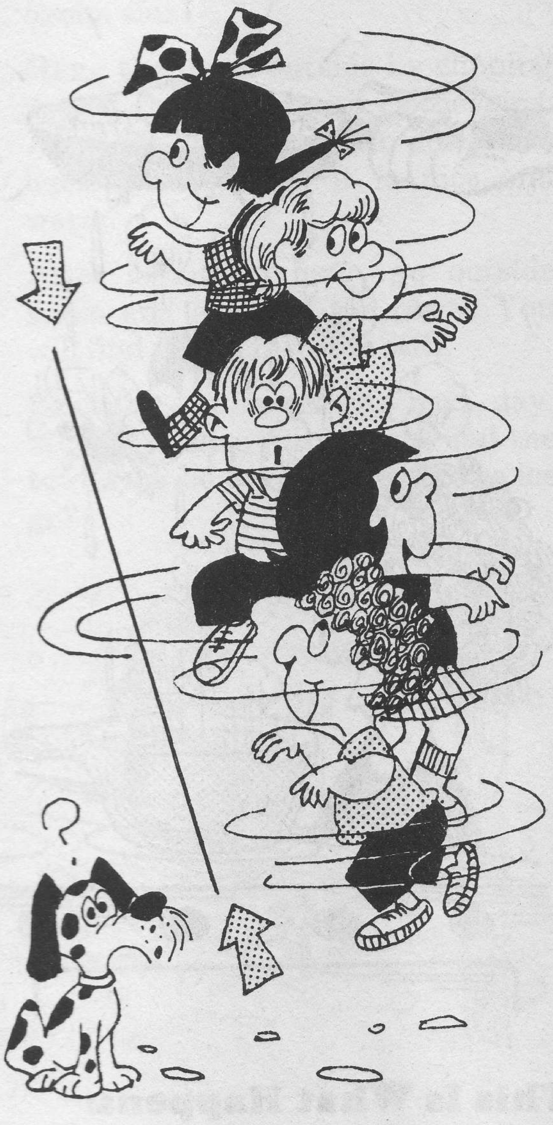
You Will Need:

Yourself
4 or 5 friends
Driveway or sidewalk
Chalk

Instructions:

Did you ever wonder what makes the liquid in a thermometer rise? In this experiment, by making a human thermometer, you will discover the answer!

1. Gather 4 or 5 friends together on a driveway or sidewalk. Stand as close as possible in a straight line. With a piece of chalk, mark the beginning and end of the line.
2. Now try to remain as close as possible while everyone keeps turning around without hitting each other. Look down at the chalk marks. Has the human line grown outside the lines?



This Is What Happens:

Every substance is made up of molecules. When molecules are heated, they move about rapidly and separate slightly, taking up more space. This happened with you and your friends in line. Moving about caused you to take up more space. And it also happens with the substance inside a thermometer. As the temperature increases, the molecules of the thermometer's liquid expand, take up more space, and climb higher in the tube.

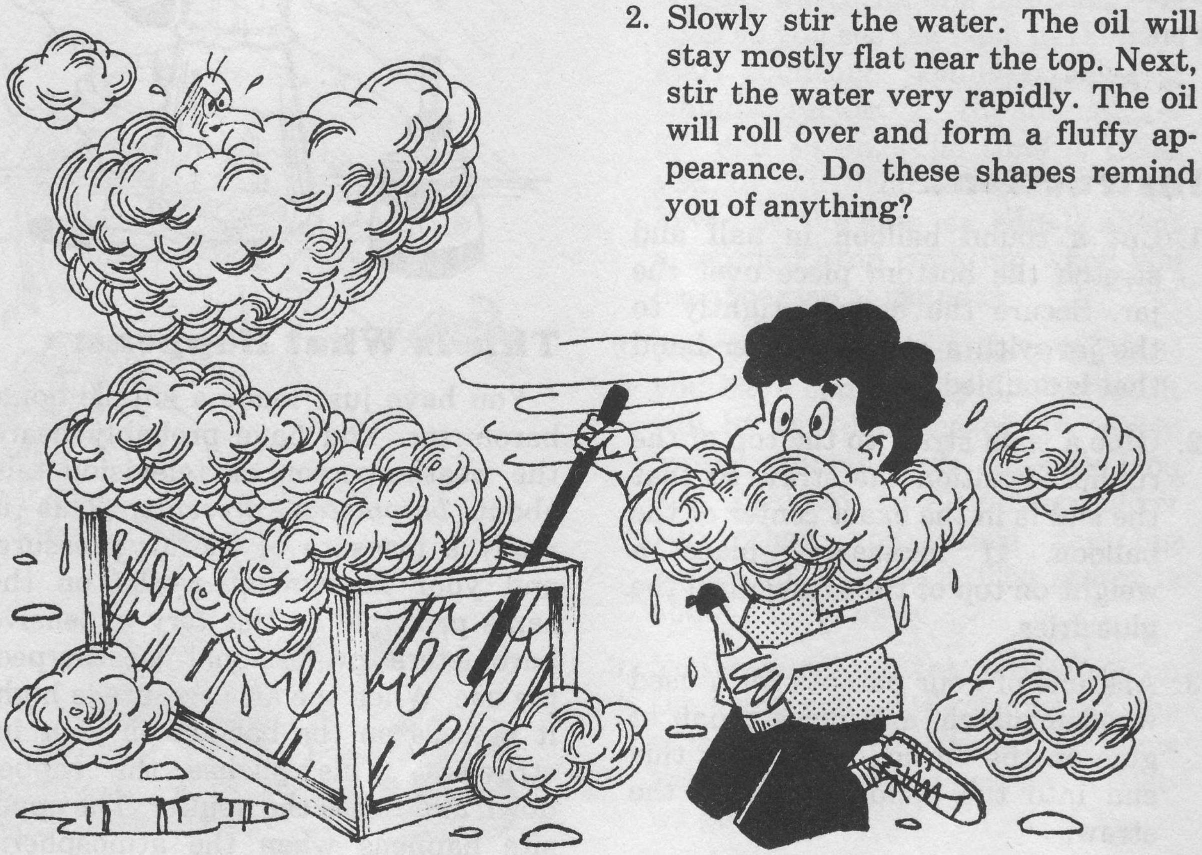
UFO: Unidentified Floating Oil

You Will Need:

Fish tank
Water
Blue food coloring
1 cup vegetable oil
Stirrer

Instructions:

1. Fill a fish tank or other large, clear container about half full with water, and add some food coloring until the water turns to a deep shade of blue. Then pour the oil on top.
2. Slowly stir the water. The oil will stay mostly flat near the top. Next, stir the water very rapidly. The oil will roll over and form a fluffy appearance. Do these shapes remind you of anything?



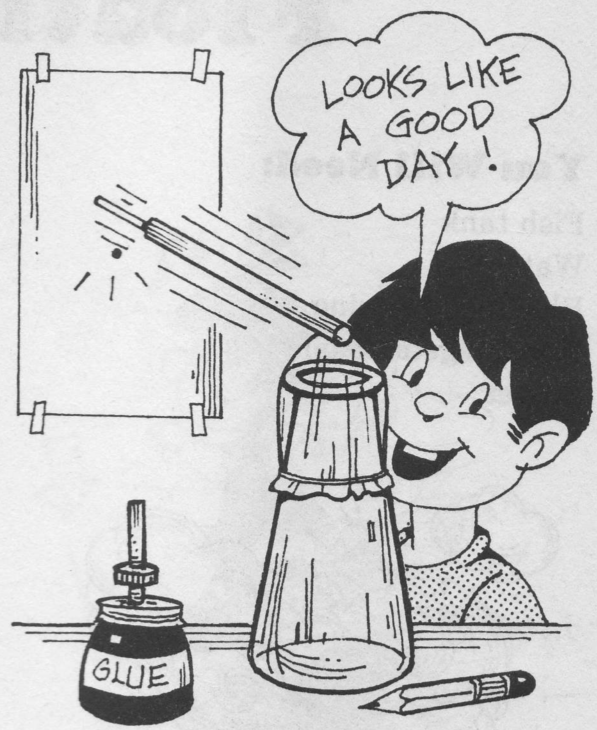
This Is What Happens:

You have just made a model of the formations that clouds make in the sky! When the air is calm, the clouds assume a level shape, like the oil that you first stirred. These kinds of clouds are called *stratus*. When the air is moving fast, however, the clouds roll over themselves, just as the oil did. Clouds like these are called *cumulus*.

Weather Wise

You Will Need:

Round balloon
Glass jar, with
  a 2-inch-wide mouth
Rubber band
Glue
Straw
Wooden match
Tape
Paper
Pencil



Instructions:

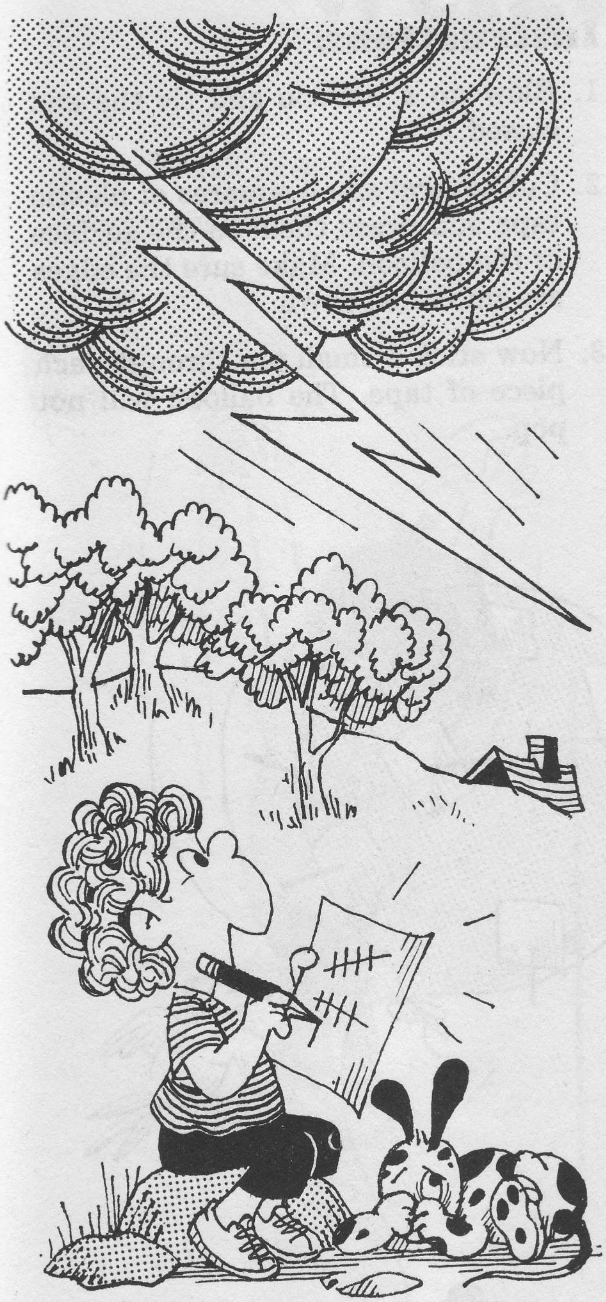
1. Cut a round balloon in half and stretch the bottom piece over the jar. Secure the balloon tightly to the jar with a strong rubber band that is doubled.
2. Glue a soda straw to the top of the rubber. Position the straw so that the end is in the exact center of the balloon. If necessary, place a weight on top of the straw until the glue dries.
3. Ask one of your parents for a used wooden match, and place a dab of glue on the burned tip. Insert this end into the opposite end of the straw.
4. Tape a piece of paper on a wall, then set your device on a table next to it so that the match points to the approximate center of the paper. With a pencil, mark this position on the paper. Check your device each day and note the spot the match points to.

This Is What Happens:

You have just made a simple home barometer. You have probably heard the weatherperson on television talk about *barometric pressure.* This is really a measure of the air pressure, and your instrument works on the same principle as the very expensive barometers professional weatherpeople use. When the air pressure is high, it presses on the balloon on your instrument. This pushes the rubber down and raises the pointer. The opposite happens when the atmospheric pressure is low.

Watch the weather forecast and see if your barometer pointer is high when the television says that the air pressure is high. A "high" usually means nice weather, while low pressure—a falling barometer—means stormy conditions.

Thundercrackers



You Will Need:

A thunder and lightning storm

Instructions:

Can you tell how far away a storm is? Here is a simple way to find out.

1. The next time a big thunderstorm occurs, watch for the lightning. As soon as you see the flash in the sky, start counting, "thundercracker 1, thundercracker 2, thundercracker 3," and so on. (The time it takes you to say "thundercracker," followed by the number, equals about a second.) Stop counting when you hear the clap of thunder.
2. Now divide the number of seconds you have counted by 5. The result will be the distance of the storm center. For example, suppose you had counted to "thundercracker 10" when you heard the big boom: $10 \div 5 = 2$. The storm is about 2 miles away.
3. You can repeat the procedure on the next bolt of lightning. If the storm is closer this time, you know that it is traveling toward you. Better get inside!

This Is What Happens:

Light travels at a speed of 186,000 miles per second, so you see a bolt of lightning almost instantly when it occurs. Sound, however, travels much more slowly—at a speed of only $^{1}/_{5}$ mile per second. When you see a bolt of lightning, you know that the sound has just started to travel. By determining how long it takes to reach your ears, you can figure out how far away it was.

Pop-Proof Balloon

You Will Need:

Balloon
Cellophane tape
Scissors
Small straight pins

Instructions:

1. Blow up a balloon and tie the end closed.
2. Cut several small squares of plastic tape and press them to the surface of the balloon. Make sure the edges are smoothed down.
3. Now stick a small pin through each piece of tape. The balloon will not pop.

This Is What Happens:

As you press a pin into the balloon, the adhesive compound on the tape clings around the pin. This forms a seal where the point is inserted, and no air can escape. A balloon pops when air is allowed to escape, and so you have a pop-proof balloon!

Instant Weight Loss

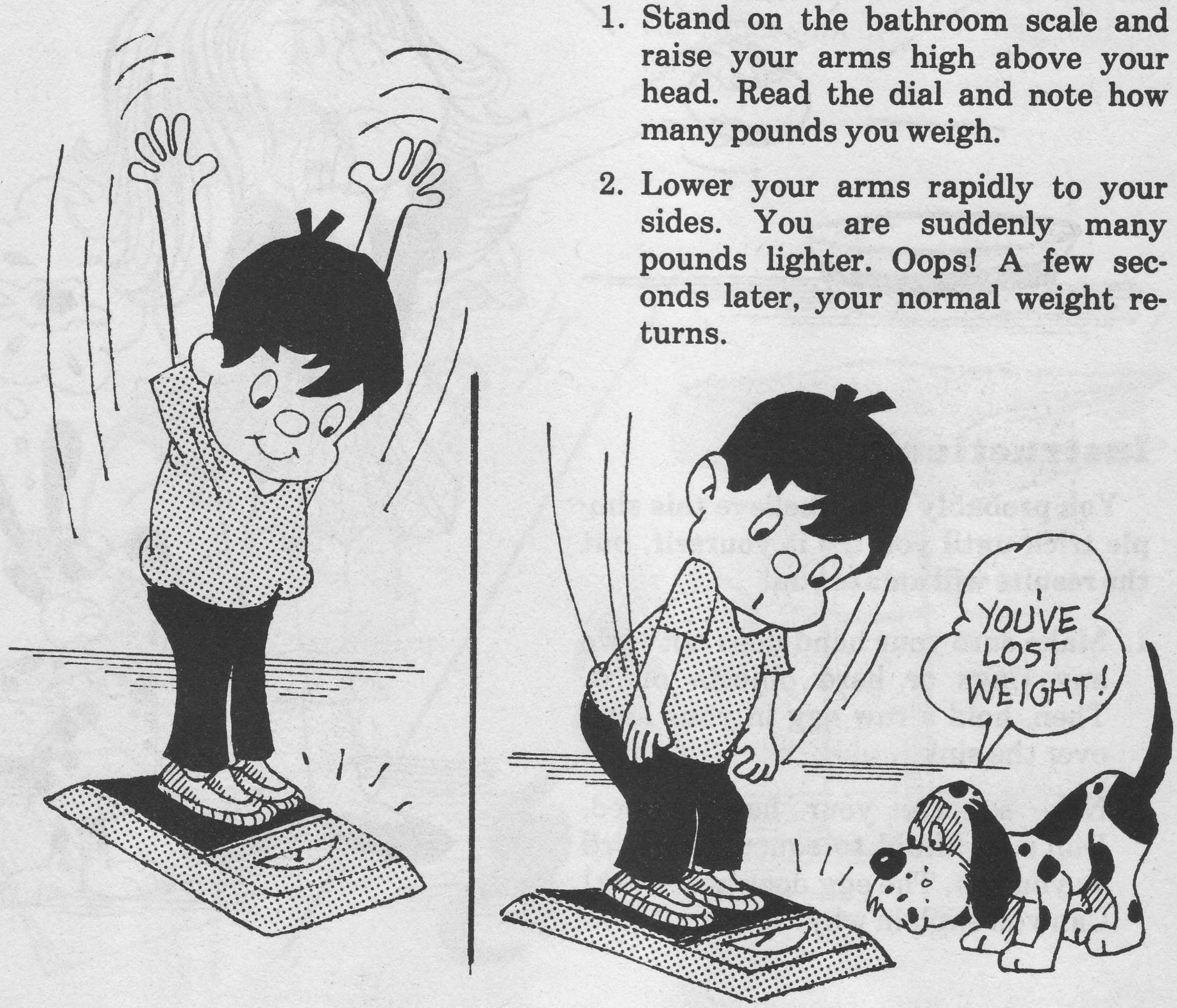
You Will Need:

A bathroom scale

Instructions:

Here's an easy way to lose several pounds instantly.

1. Stand on the bathroom scale and raise your arms high above your head. Read the dial and note how many pounds you weigh.
2. Lower your arms rapidly to your sides. You are suddenly many pounds lighter. Oops! A few seconds later, your normal weight returns.



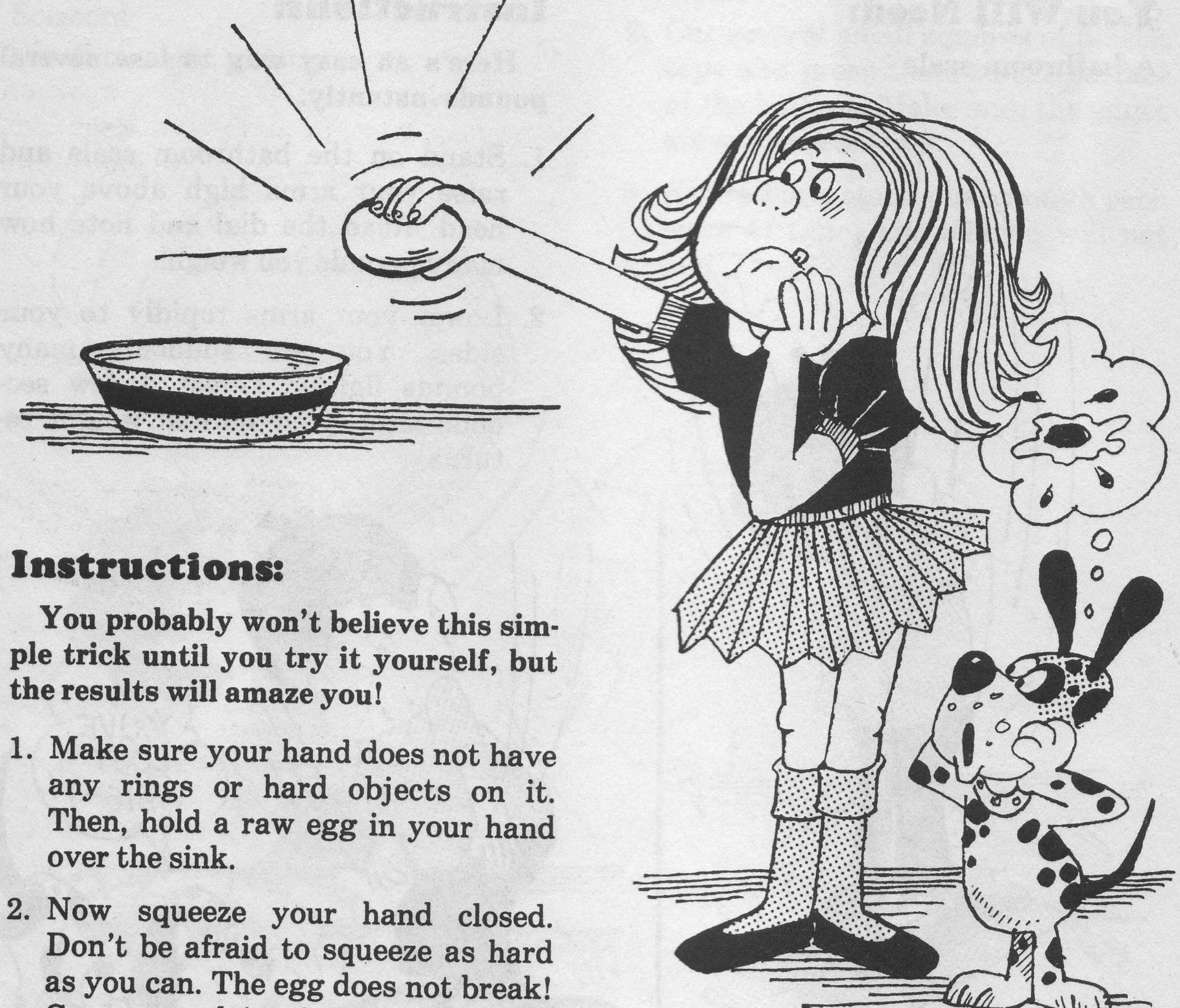
This Is What Happens:

For every action, there is an equal and opposite reaction—this is one of Sir Isaac Newton's famous laws of physics. Bringing your arms *down* is an action that you created. The opposite reaction is a force that pushes *up,* and this was created by the scale's platform. The mechanical components of the scale detected the temporary upward force, and this was recorded as a weight loss.

Please Squeeze

You Will Need:

Your hand
Raw egg



Instructions:

You probably won't believe this simple trick until you try it yourself, but the results will amaze you!

1. Make sure your hand does not have any rings or hard objects on it. Then, hold a raw egg in your hand over the sink.
2. Now squeeze your hand closed. Don't be afraid to squeeze as hard as you can. The egg does not break! Can you explain why?

This Is What Happens:

When you crack open an egg the normal way, you usually hit it against something hard. The force is concentrated on only one area, and this spot in the shell breaks. However, squeezing the egg in your hand spreads the force over a much larger area. The egg can withstand this pressure because it is shaped like an arch, and an arch is extremely strong. Builders know this fact and use the arch in many kinds of construction.

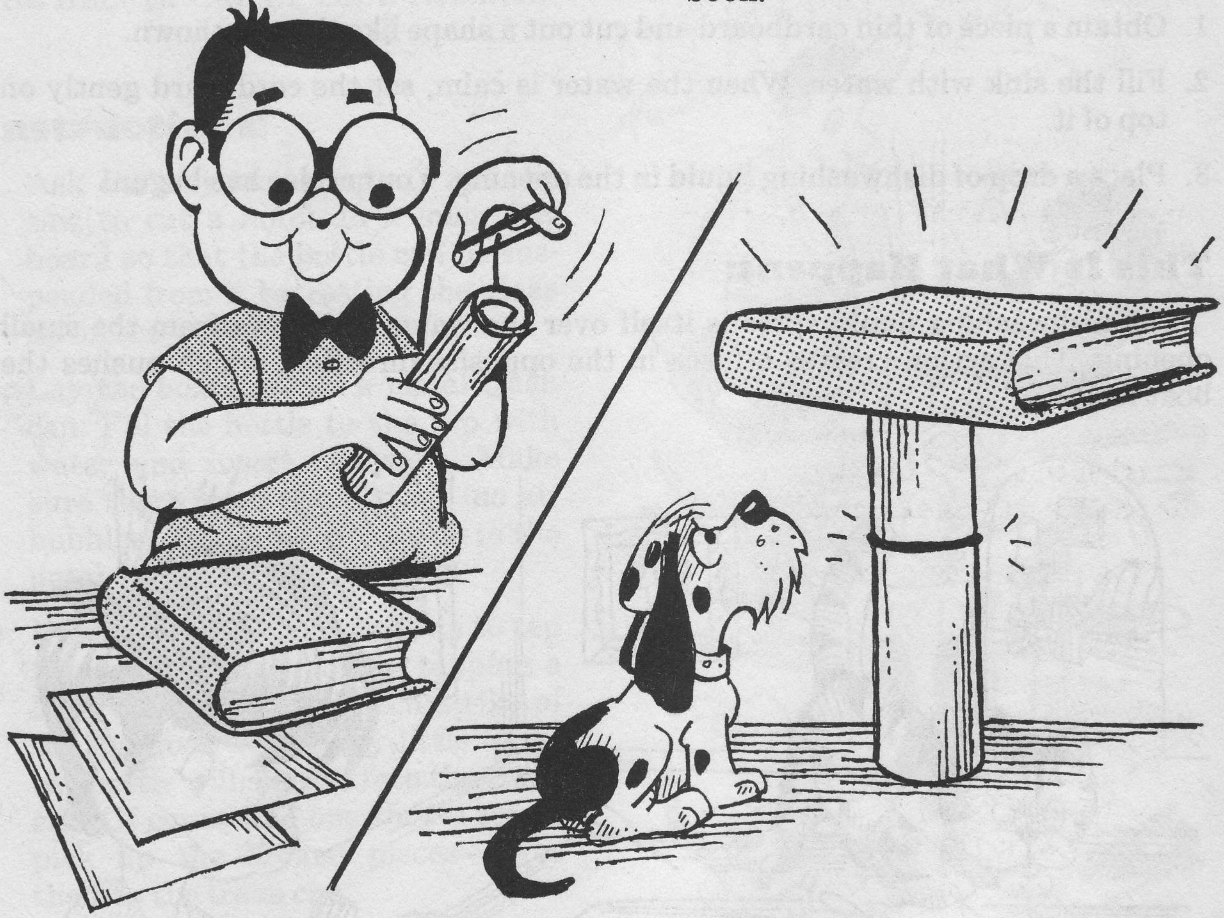
Tube Strength

You Will Need:

Sheet of typing paper
Rubber band
Book

Instructions:

1. Roll a single sheet of typing paper into a tube and slip a rubber band around it.
2. Stand the tube on end on a flat surface. Carefully place a book on top of the tube and you will see that the paper supports the weight of the book.



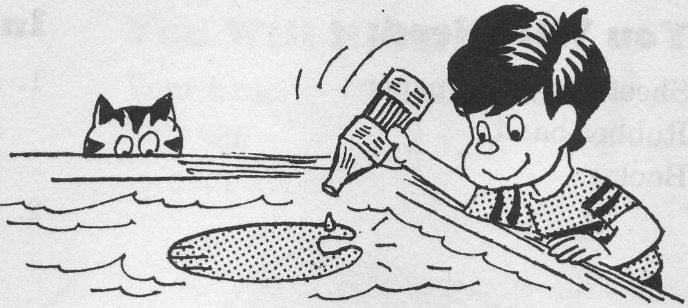
This Is What Happens:

A tube is a shape that has much more strength than a flat object. This allows you to place the book on top of the paper without crushing it. Pillars are a type of tube shape, and they are used in some buildings to hold up their great weight.

Anchors Away

You Will Need:

Thin cardboard
Scissors
Water
Dishwashing liquid

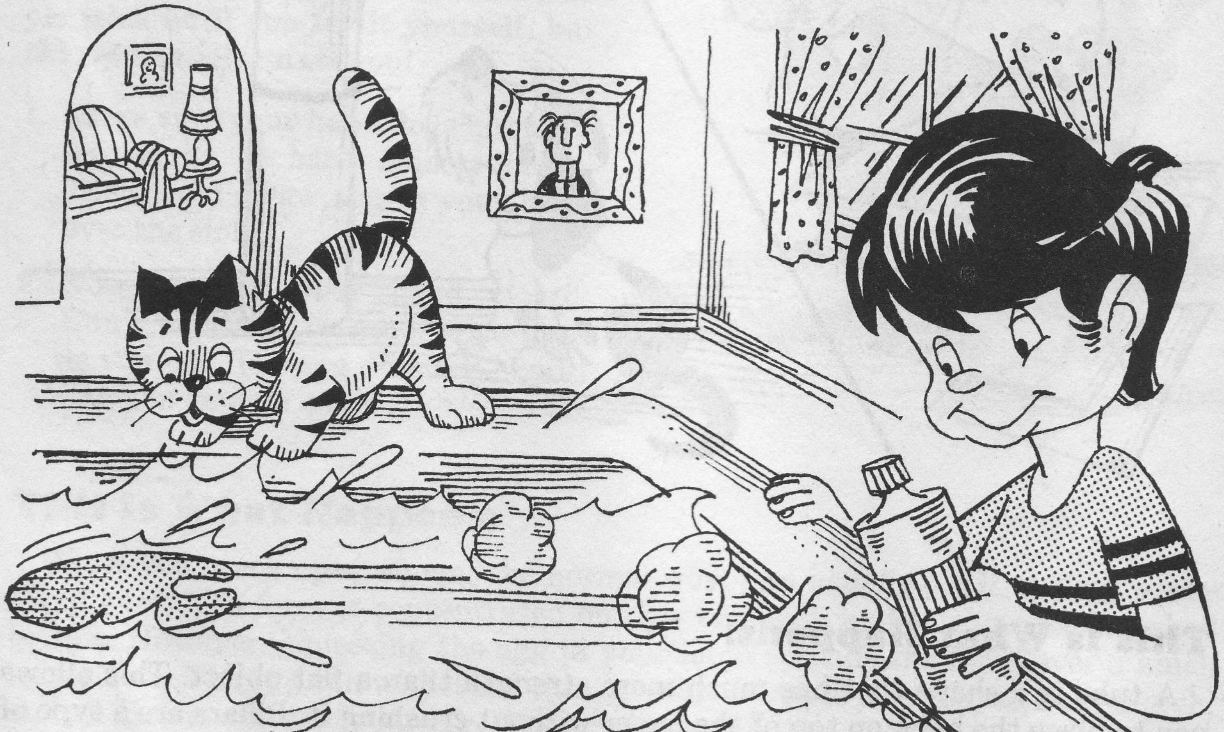


Instructions:

1. Obtain a piece of thin cardboard and cut out a shape like the one shown.
2. Fill the sink with water. When the water is calm, set the cardboard gently on top of it.
3. Place a drop of dishwashing liquid in the opening. Your cruise has begun!

This Is What Happens:

The dishwashing liquid spreads itself over the water and flows from the small opening. This action creates a force in the opposite direction, which pushes the boat forward.



A Smashing Good Time

You Will Need:

Saw
Board
Small glass bottle with a protruding lip
Metal trash can
Water
Cork
Hammer
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Ask one of your parents to use the saw to cut a notch in a long, flat board so that the bottle can be suspended from it by resting the glass lip on the wood.
2. Lay the board across a metal trash can. Fill the bottle to the top with water and insert the cork. Make sure there is no trapped air (no air bubbles) inside. Set the bottle in the notch.
3. Now, ask one of your parents to tap the cork with a hammer, tapping a little bit harder with each strike of the hammer. With very little force, the bottle will shatter into the trash can. Of course, no one should try to pick up the broken pieces—leave them in the trash can.

This Is What Happens:

When the cork is hit with the hammer, a force is created that is transmitted into the water. Since the water is confined in a single area, the force is scattered throughout the substance in all directions. The walls of the glass bottle cannot withstand this great pressure, and they break.

Tube Test

You Will Need:

Paper tissue
Cardboard tube
Rubber band
Salt
Broomstick

Instructions:

1. Wrap a paper tissue around the opening of an empty cardboard tube, and secure it with a rubber band.
2. Pour salt into the tube, about 3 or 4 inches high.
3. Holding the cardboard tube in one hand, try to rip the tissue by pushing the broomstick into the open end of the tube and into the salt. No matter how hard you push, the tissue won't break.

This Is What Happens:

The layer of salt is composed of many tiny crystals that are free to move against each other. As you push the broomstick into the salt, the crystals send the force in many directions, and the small amount of pressure that finally reaches the tissue is not strong enough to rip it open.

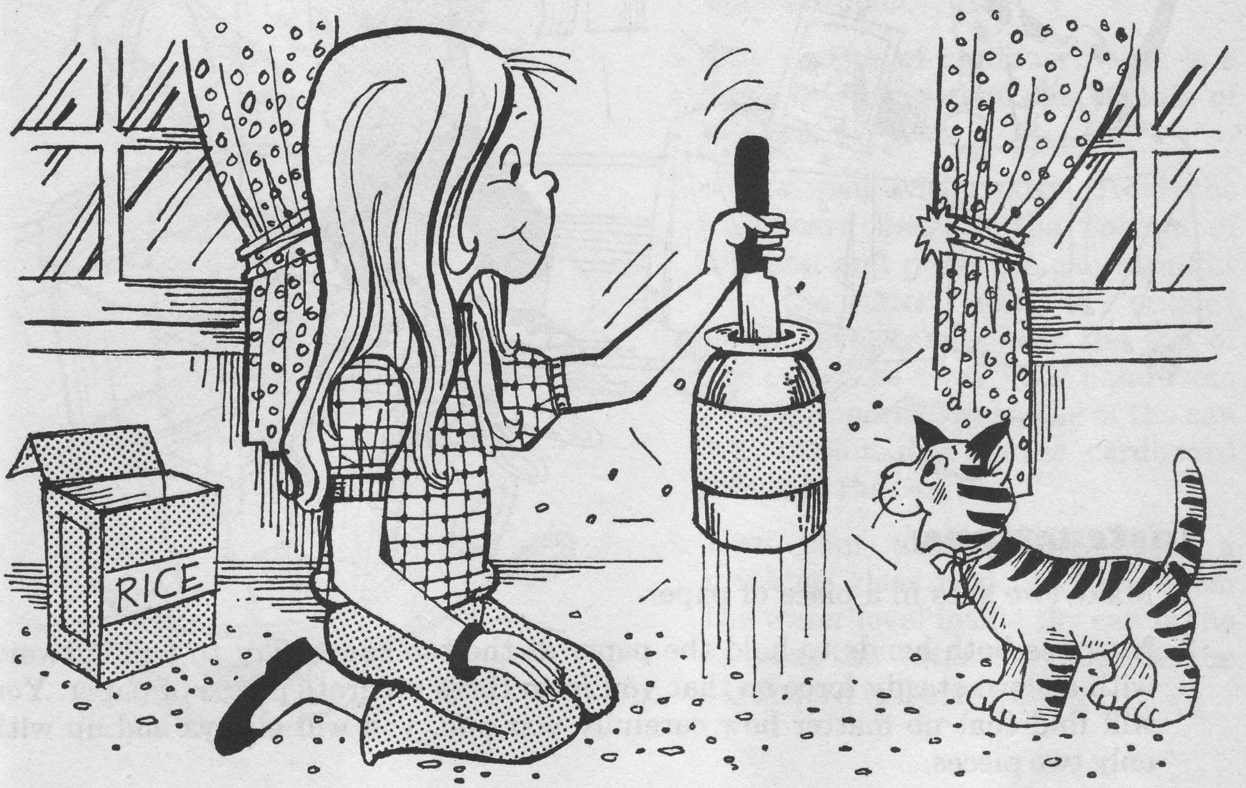
A Gripping Tale

You Will Need:

1-quart, empty mayonnaise jar
Uncooked rice
Knife with blunt, wide blade, such as a cake knife

Instructions:

1. Fill the empty mayonnaise jar with uncooked rice and pack it down firmly. Add more rice until it's even with the top of the jar.
2. Poke the blunt knife into the rice several times to a depth of about 2 inches. Then jab the knife in firmly, about 6 inches deep.
3. Now slowly pull the knife upward. You will lift the jar of rice.



This Is What Happens:

The rice grains, which fill the jar, have many air spaces between them. As you poke the knife into these grains, they become tightly packed. When you finally jab the knife deeply, the rice is pushed against the blade and holds it in place. This gripping force enables you to lift the entire jar as you raise the knife.

The Tear-Along Blues

You Will Need:

Paper
Scissors

Instructions:

1. Make two slits in a piece of paper.
2. Now use both hands to hold the paper at the top edges. Try to pull outward with a slow, steady force so that you form three separate pieces of paper. You will find that no matter how carefully you pull, you will always end up with only two pieces.

This Is What Happens:

The cuts in the paper may be equal, but one side will always be weaker than the other. As you apply force, the weaker point starts to tear first. Then all the force is directed to that spot until it is completely torn. The other two strips of paper remain attached.

Breaking Away

You Will Need:

Empty food can, such as a soup can
Can opener
Scissors
Cardboard
Pail
Water
Drinking glass
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Ask one of your parents to cut away the bottom of an empty food can with a can opener so that both ends are open.
2. Cut a piece of cardboard that is a little bit larger than the bottom of the can.
3. Fill a pail with water. Hold the cardboard beneath the bottom of the can and push the can straight into the water. When the outside water level comes near the top of the can, take away your hand from the cardboard. The inside of the can will remain dry as the cardboard clings to the can.
4. Now pour water slowly from a drinking glass into the can. When the water level inside the can is the same as the water level outside, the cardboard will break away.

This Is What Happens:

The empty can and cardboard act as if they were one solid unit in the water—the force of the water presses upward on the cardboard, keeping it pressed to the bottom rim of the can. However, when you add water to the inside of the can, you are creating an opposite force—a downward force—which balances out the water pressure in the pail, and the cardboard drifts away.

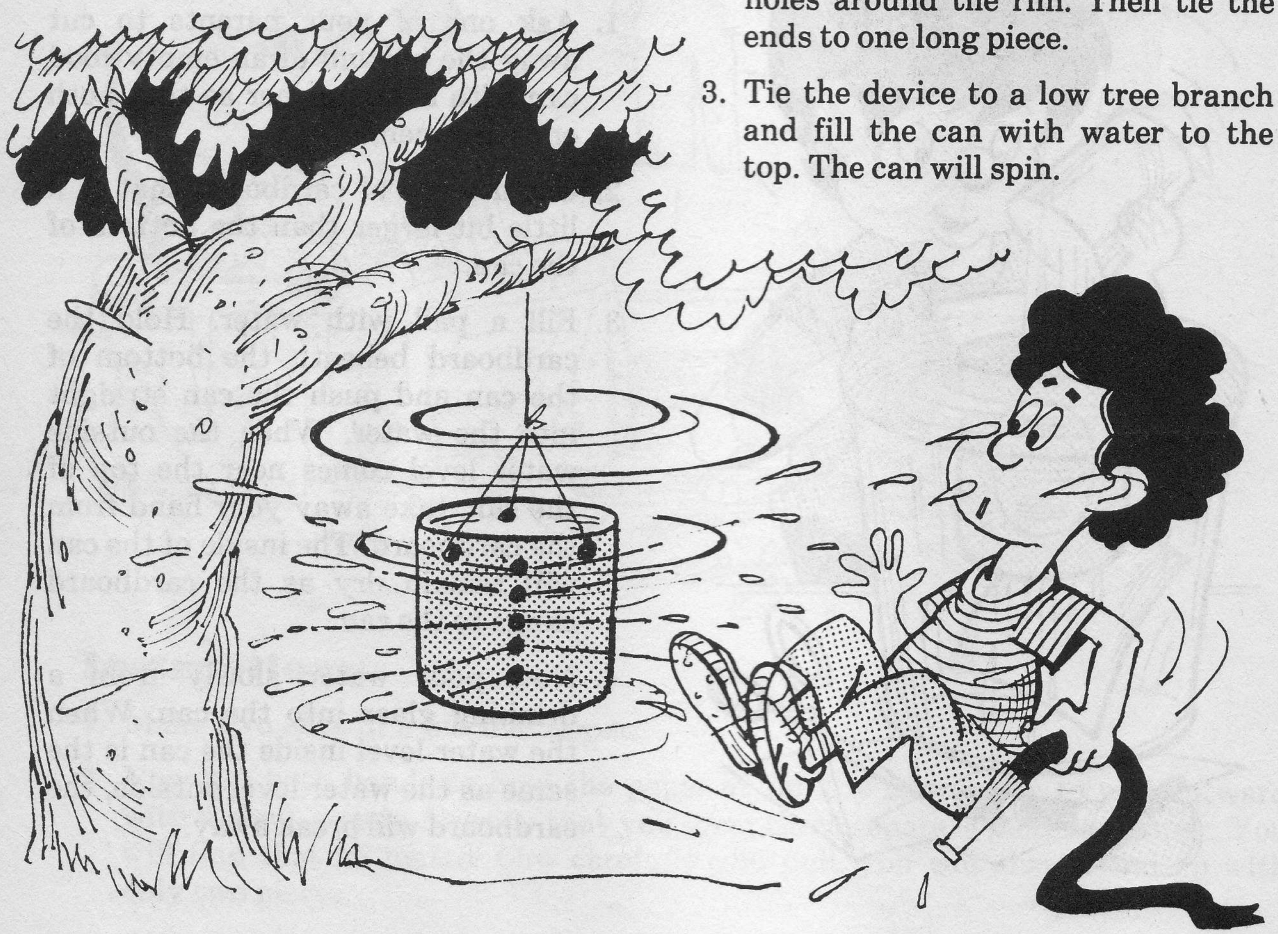
Spin the Can

You Will Need:

Hammer
Nail
Coffee can
String
Water
THE HELP OF ONE OF YOUR PARENTS

Instructions:

1. Ask one of your parents to punch 5 holes into the side of a coffee can—1 hole above the other in a vertical line—with a hammer and a small nail, then 3 more holes, equally spaced, around the top rim—8 holes in all.
2. Tie string through each of the 3 holes around the rim. Then tie the ends to one long piece.
3. Tie the device to a low tree branch and fill the can with water to the top. The can will spin.



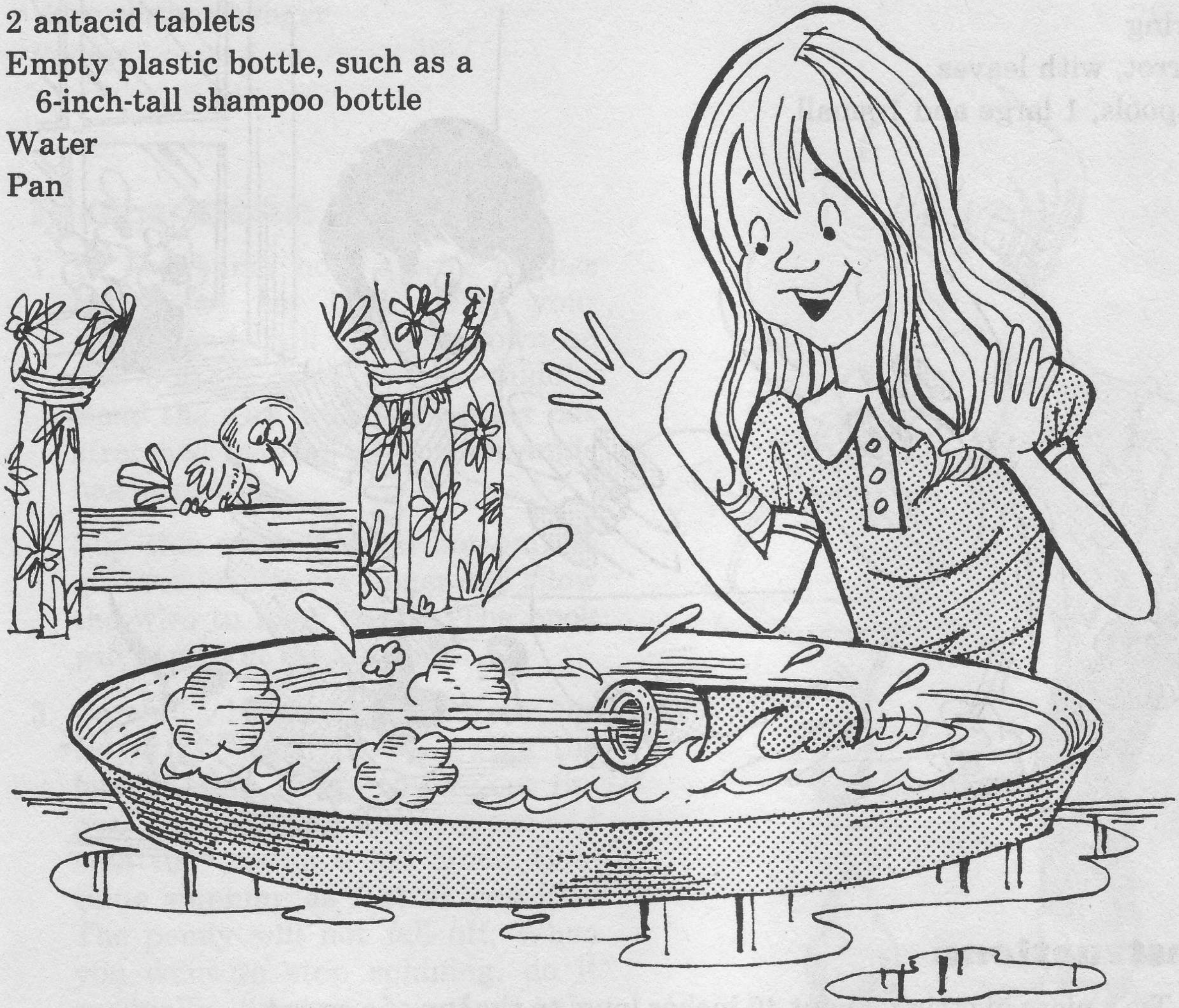
This Is What Happens:

Water squirts from the 5 holes that were punched in the side of the can. The action of these water jets creates a backward force against the can, which causes it to rotate.

Sea Cruise

You Will Need:

2 antacid tablets
Empty plastic bottle, such as a 6-inch-tall shampoo bottle
Water
Pan



Instructions:

1. Break apart two antacid tablets and put the pieces in the bottle.
2. Now fill the bottle about ¼ full with water. Rest the bottle on its side in a pan of water. You will see the bottle-boat chug along the water's surface.

This Is What Happens:

When the antacid tablets and water combine, they form a gas that escapes through the neck of the bottle. This backward motion of the escaping gas is matched by an equal forward thrust, which propels the boat ahead.

Carrot Me Up

You Will Need:

String
Carrot, with leaves
2 spools, 1 large and 1 small

Instructions:

1. Tie a piece of string, about 40 inches long, to the top of a carrot.
2. Slip the free end of the string through the large spool, then tie it to the smaller spool.
3. Hold the large spool in your hand and begin making circular motions—the small spool should swing in a circle. As you increase the speed of the motion, the carrot will rise.

This Is What Happens:

There is a force associated with the rotation of the small spool. This force pulls away from the center of the circle and is called *centrifugal force.* Since the spool is attached to the carrot, the "pulling-away" force is transmitted along the entire length of string and the carrot is pulled up.

Hang in There

You Will Need:

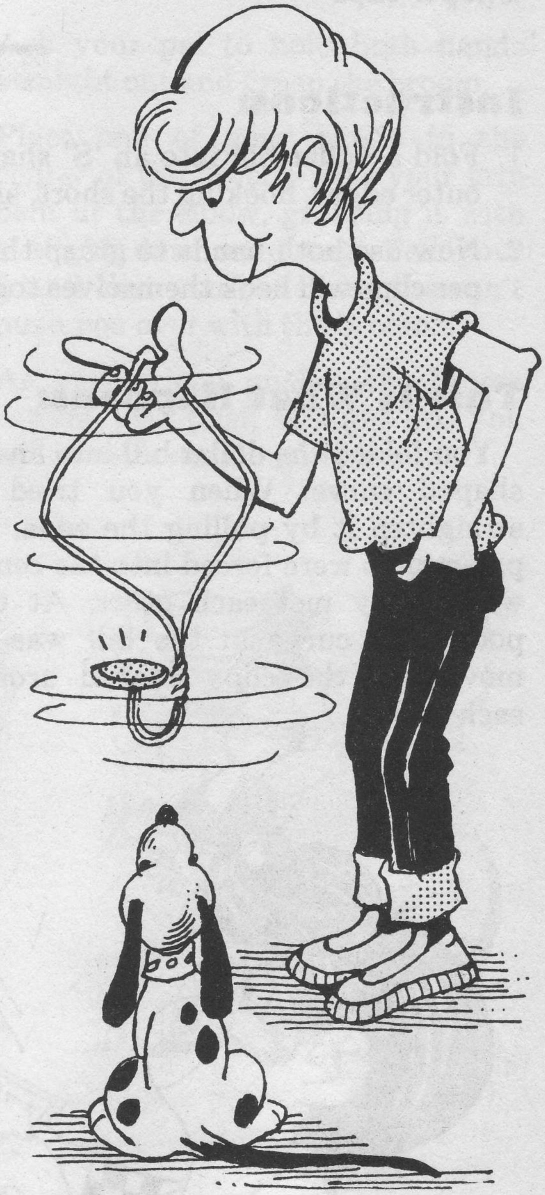
Wire clothes hanger
Penny

Instructions:

1. In one hand, hold a wire clothes hanger by the hook. With your other hand, pull straight down on the bottom wire at the middle. Bend the wire until the hanger has stretched lengthwise and an angle has formed.

2. Slip this newly-formed bottom angle over your index finger and allow the wire to hang freely. (The hook will now be at the bottom.)

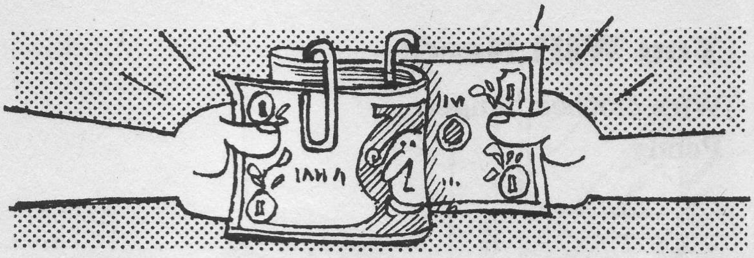
3. Carefully balance a penny on the tip of the hook. Slowly swing the hanger back and forth on your finger. Then build up a little speed and spin the wire in a full circle. Continue spinning as fast as you like. The penny will not fall off. When you want to stop spinning, do it gradually, coming to a slow halt. The penny still remains perched, as if it had been glued to the spot. If you have trouble on your first try, practice a few times and you will soon be an expert.



This Is What Happens:

While the wire is spinning, the tip of the hook exerts an inward force, which pushes the penny toward the center of the circle. This force is called *centripetal force* and prevents the coin from flying outward.

Dapper Dollar



You Will Need:

Dollar bill
2 paper clips

Instructions:

1. Fold a dollar bill into an 'S' shape. Then place a paper clip at each of the two outer edges, hooking the short, single wire over the outer layer and inner layer.
2. Now use both hands to grasp the edges of the dollar bill. Pull quickly! The paper clips will hook themselves together and jump away.

This Is What Happens:

You folded the dollar bill into an 'S'-shaped curve. When you tried to straighten it by pulling the ends, the paper clips were forced into the center where they met each other. At this point, the curve in the bill was removed as the clips hooked around each other.

Superman

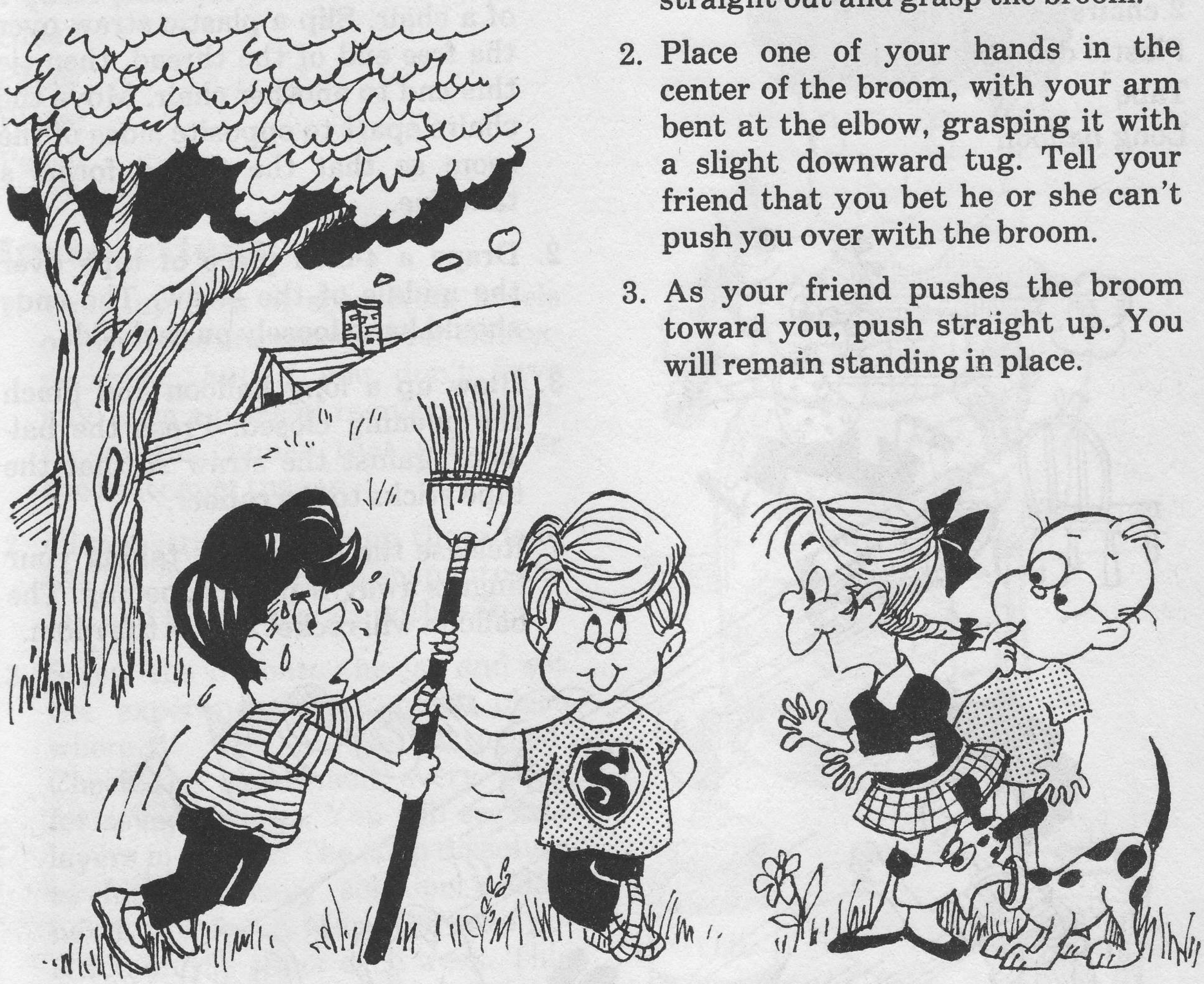
You Will Need:

A friend
Broom

Instructions:

Challenge your friend with this experiment—you'll always win!

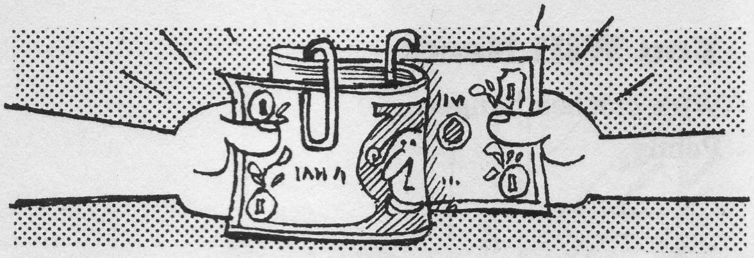
1. Ask your pal to hold both hands straight out and grasp the broom.
2. Place one of your hands in the center of the broom, with your arm bent at the elbow, grasping it with a slight downward tug. Tell your friend that you bet he or she can't push you over with the broom.
3. As your friend pushes the broom toward you, push straight up. You will remain standing in place.



This Is What Happens:

Even if your friend is bigger and stronger than you, you will always win because you have a hidden power. You have much more *leverage*—with one bent arm acting as a *lever*—than your friend has with two straight arms. A lever helps to lift weights with less effort, giving you a mechanical advantage. So the direction of your friend's pushing force is easily offset by a much smaller force from you.

Dapper Dollar



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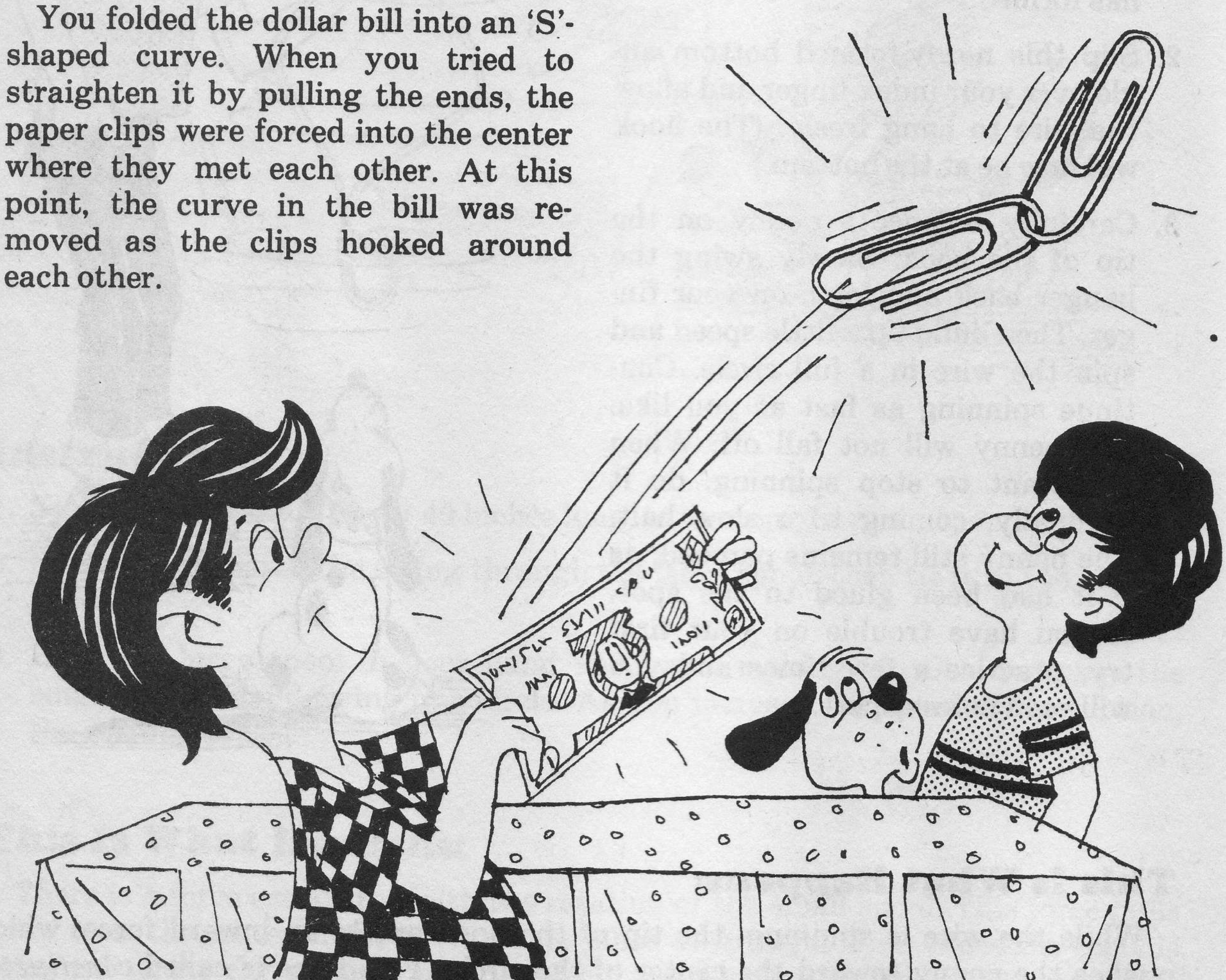


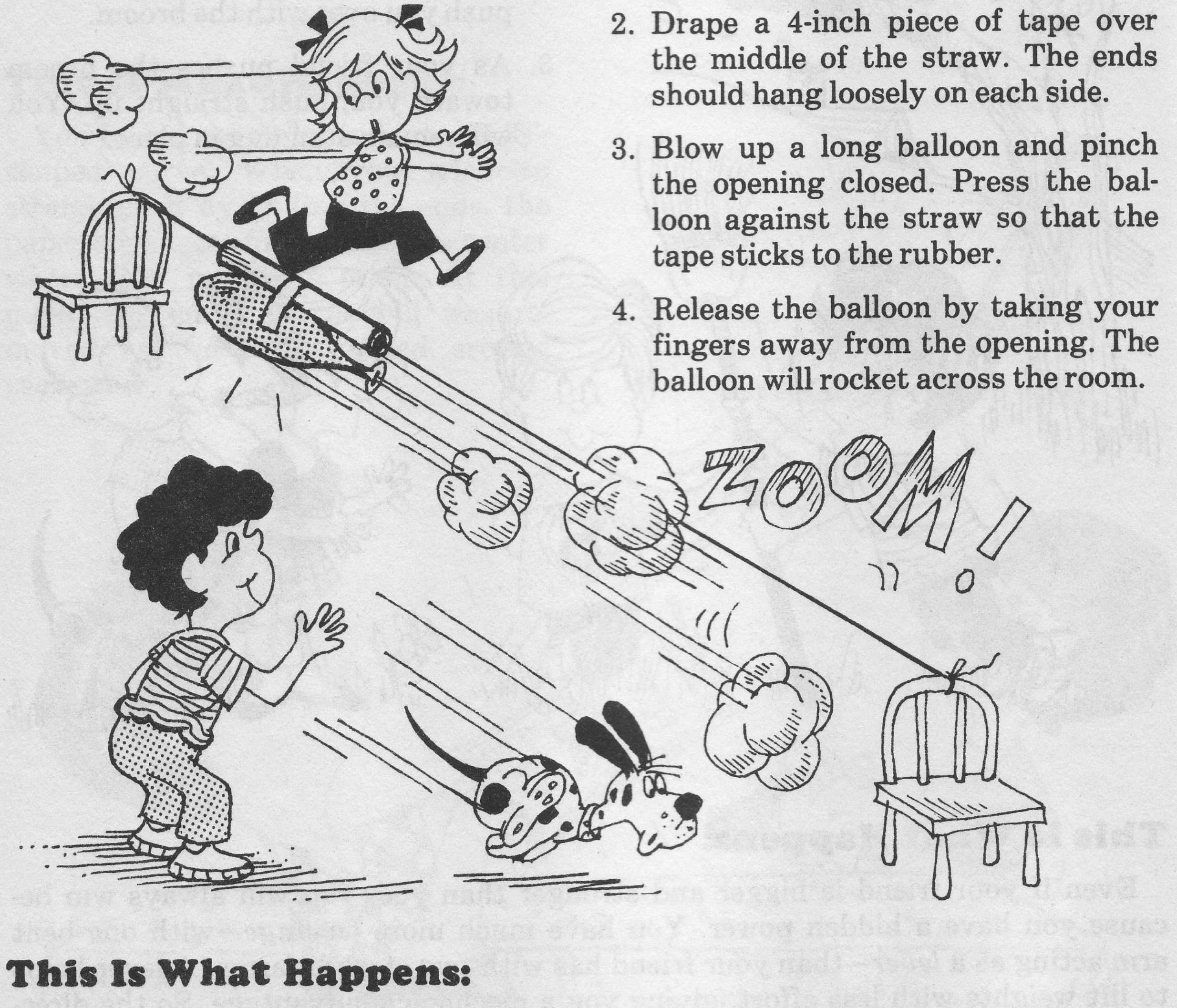
Pathway to the Stars

You Will Need:

Thread, 15 feet long
2 chairs
Plastic drinking straw
Tape
Long balloon

Instructions:

1. Tie one end of the thread to the back of a chair. Slip a plastic straw over the free end of the thread, then tie this end to another chair. Move the chairs apart to opposite sides of the room so that the thread forms a taut line.
2. Drape a 4-inch piece of tape over the middle of the straw. The ends should hang loosely on each side.
3. Blow up a long balloon and pinch the opening closed. Press the balloon against the straw so that the tape sticks to the rubber.
4. Release the balloon by taking your fingers away from the opening. The balloon will rocket across the room.



This Is What Happens:

The air in the balloon is under pressure. As the air escapes from the back opening, the thrust causes the balloon to shoot forward, along the path of the string.

Diffusion Confusion

You Will Need:

Small bar of soap,
not the kind that floats
1-quart glass jar with lid
Glue
Paper
Water
Pencil

Instructions:

1. The tiny bars of soap from hotels or airplanes are excellent for this experiment, but if you don't have any, slice a piece of regular soap into several chunks that will cover the bottom of the jar.
2. Glue a strip of paper up the side of the jar. Then drop the soap into the jar, and fill completely with water.
3. Screw the lid onto the jar and set the experiment in a quiet place where it will not be disturbed. Check the experiment every week for several weeks. You will see two layers in the jar. The soap dissolves to form a heavy solution underneath the water. Mark the soap position on the paper each week. This layer slowly creeps upward. Do you know why?

This Is What Happens:

At first, the soap dissolves in the water surrounding it. This is why you see the layer of soap solution at the bottom. However, the molecules of a substance are always in motion, even though the substance may appear to be sitting quietly. The soap and water molecules are in constant motion, always interacting. Eventually, the soap solution distributes itself throughout the entire jar of water. The scientific name for this process is *diffusion*.

You Will Need:

2 teacups
Round balloon

Instructions:

1. Place two teacups—ask your parents which ones you can use—on a table, about 5 inches apart.
2. Place the deflated balloon between the two cups and blow air into it until the sides of the balloon are touching the sides of the teacups. Then knot the opening of the balloon, without raising it from the table.
3. Slowly raise the balloon. You will lift the two cups.

This Is What Happens:

The air that you blew into the balloon pushed the rubber against the walls of the cups. The force of the air held the balloon snugly and prevented the cups from slipping away when you lifted the balloon.