Science Activities for Guides and Pathfinders

Chromatography

Cut strips from coffee filters about 3 cm x 12 cm. Using dark-coloured water colour felt pens, colour a large dot on one end of each strip. Pour water into a saucer and put the tip of the coloured end of the strip in the water with the rest of the strip over the edge. With time, the water will travel up the paper, carrying with it the ink from the coloured dot. The ink is made from several different dyes, which have differing solubilities in water. The dyes that are most soluble will travel further up the paper with the water. This separation technique is called chromatography, and the principle behind it is used in several methods of chemical analysis.

Shiny Pennies

Put some old pennies in a glass of cola overnight. In the morning, the pennies will shine like new. The acid in the cola (carbonic acid) dissolves the outside, dull layer of metal, leaving the pennies looking like they were just minted.

Separating Salt and Pepper

Mix together some salt and finely-ground pepper, then spread it out on some paper. Rub an inflated balloon against your hair, and then hold it close to the salt and pepper without touching it. The pepper will be attracted by the static charge on the balloon, and stick to it. The salt is also attracted, but it is too heavy to jump up to the balloon.

Strong Newspaper

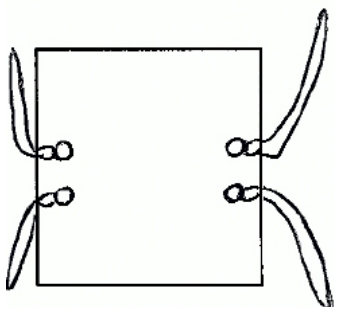
Lay a sheet of letter-size paper out beside the edge of a table, and place a ruler halfway undemeath it. Hit the exposed part of the ruler so that it will fly off the table. Now try to do the same thing with a newspaper opened up. You cannot get the newspaper to move because the air pressure on the large surface area of the newspaper is holding it down. Use a metal ruler so that it doesn't break.

Dancing Raisins

Add 1/4 c. vinegar and 1 tsp. baking soda to a glass half full of water. Add 6 raisins, and watch them dance. The carbon dioxide released from the chemical reaction causes the raisins to dance.

Image Retention

Take a piece of cardboard about 10 cm square. Punch holes about 2 cm apart on two opposite sides, about 5 mm from the edge. Loop an elastic through each hole. Draw something on each side, eg. waves on one side, fish on the other. Now, hold the two elastics from one side in one hand, and the other two in the other hand. Twirl the cardboard to wind up the elastics until they are tightly wound. Let go, and look at the image produced. The fish is now in the sea. The images appear at the same time because the retina at the back of the eye retains the image for a fraction of a second, and the images blend.



Paper Bridge

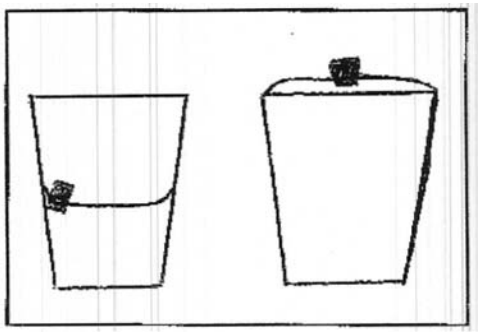
Take a strip of paper and lay it like a bridge between two books. If you put pennies on the paper it immediately collapses. Now fold the strip lengthwise on each side to create sides for the bridge. Try putting the pennies on the bridge again. The pennies don't make the bridge collapse because the fold deflects and diverts the forces on the paper. This is the same principle used in the design and construction of bridges and buildings. Corrugated cardboard uses the same principle.

Invisible Ink

Write a message on paper using lemon juice. It disappears when it is dry. Now iron the paper. The heat turns the lemon juice brown, and you can see the message.

Floating Cork

Put a cork in a glass 3/4 full of water. The cork will always float to the side. Now remove the cork and fill the glass carefully to the very top. The cork now floats in the centre. This occurs because the cork always travels to the highest point. When the glass is not full, the water, which is attracted to the side because of surface tension, is higher on the side than in the middle. When the glass is completely full, the water is attracted to the rim, and the centre of the water is higher.



Water Wizardry

Cover a glass of water with a thin piece of cardboard, press your hand firmly on top of the cardboard, then invert the glass and slowly take your hand away. The cardboard stays in place with the water inside. This is because the air pressure on the cardboard is greater than the water pressing on the inside. The trick only works if no air is between the cardboard and the water.

Blooming Flower

Cut out the shape of a 4-petal flower (4 inches across) out of newsprint or construction paper. Fold the petals into the middle so that you have a square. Now drop the folded flower, petal side up, into a bowl of water. In just a few seconds the petals will begin to unfold. The water is pulled up the petals by capillary action (through tiny tubes). As the water travels up the tubes, they swell and this causes the petals to open. This is what causes morning glories to open their petals. As the sun warms the water in the petals, the water expands and travels up tiny tubes, forcing the petals open.

"Magnifying Glass"

Draw an arrow on a piece of paper and place it behind an empty glass. Look through the glass, and the arrow appears unchanged. Pour water in the glass, and the arrow appears to have grown. This is caused by diffraction, the bending of light rays. The water causes the light to bend and distorts the image. Now slide the paper to one side. The arrow will disappear. This is caused by diffraction due to the combined effect of the water and the curve of the glass.

Milk Carton Waterfalls

Punch 3 holes at different heights in an empty milk carton. Fill it with water and observe the three streams coming out of the holes. The bottom hole's stream is more horizontal. This is because there is more water pressing down on it from above.

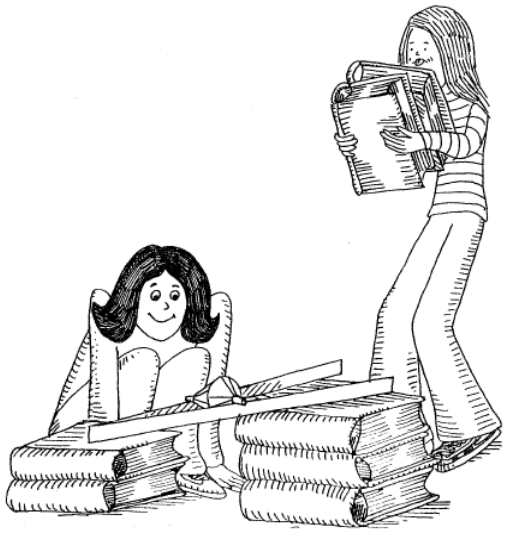
Knot Trick

Put a piece of string about 18 inches long on the table in front of you. Fold your arms across your chest. Now pick up the string, one end in each hand. Hold onto the ends of the string, and unfold your arms. The string is knotted! This is a math trick made possible by something called 'transfer of curves'. The knot was in your arms before you unfolded them. What you did was transfer the knot from your arms to the string.

Rolling Uphill

This funnel-car seems to defy gravity by rolling uphill.
You need:

- 2 plastic funnels (The larger the funnels the better)
- Glue
- 2 pieces of cardboard 14 inches by 1 inches
- several books.

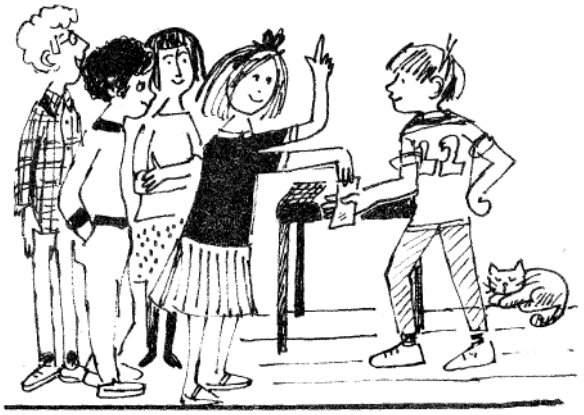


Making the funnel-car and track:
Glue the rims of the funnels together. Let the glue set. Glue the strips of cardboard together at one end. Spread the cardboard to make a V. This is your track.

The Trick:
Pile two stacks of books - one a little higher than the other. Rest the point of the track on the short pile and the ends of the track on the higher pile. Put the funnel-car on the lower end of the track. The stems should rest on the track. Now the funnel-car will roll to the top of the track.

The Science:
The funnel-car only appears to roll uphill. Nothing can roll uphill by itself because gravity pulls everything down. Watch the funnel-car from the side as it rolls. You'll see that as the track gets wider and wider, the center of the funnel-car goes lower and lower. It is really rolling downhill.

The Race Against Gravity



Here's something everyone in your audience will volunteer for: catching the dollar bill.

You need: a dollar bill.

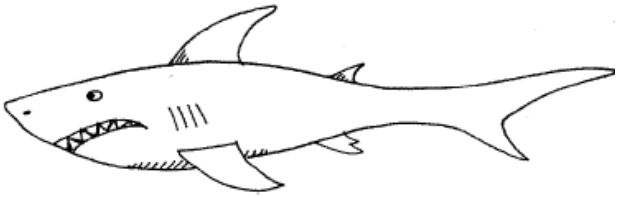
Here's what you do:

Ask for a volunteer from the audience. Have the volunteer rest his arm on the table, with his open hand over the edge, as in the picture. You hold the dollar bill between his parted fingers and thumb. Make sure that half the bill is held above his hand. Tell the volunteer to grab the bill as it falls. But DO NOT announce when you will let go. No one has been able to catch the dollar bill yet.

Why it works:

Gravity accelerates falling objects. That means that gravity causes falling objects to move faster and faster as they fall. The dollar bill is pulled through the volunteer's fingers in about 1/2 of a second. No one can grab the dollar bill that fast. The eyes, brain, and fingers must all get the message that the bill is falling before the person can grab it. By that time the bill is gone.

Swimming Shark



You can order this shark to turn around and swim the other way.

You need: pencil; paper; a jar of water.

The Trick:

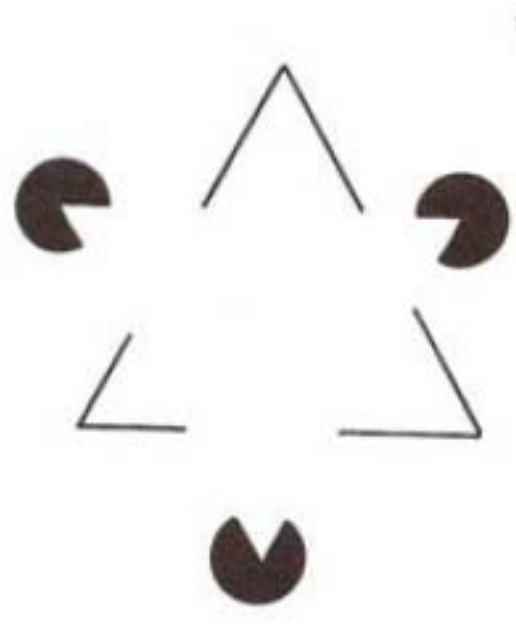
Draw a small shark on the paper, or trace the one on the next page. Put the jar of water right in front of the drawing. Slowly move the drawing back, away from the jar. You will see the shark swim in the opposite direction. (Practice this before you try it on your friends.)

The Science:

Light rays from the drawing travel straight to your eyes in air. But when they go through the water they are refracted, or bent. Because they are bent, they cross over one another and when they reach your eyes they are reversed. You see the shark turned around.

Vanishing Triangle
Make a triangle disappear.

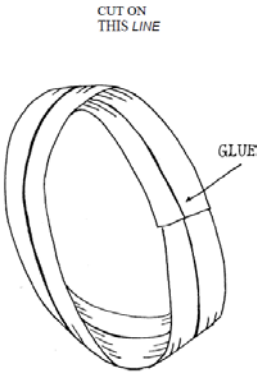
You need: picture at right, three coins



The trick:
Ask someone to look at the picture on this page, Draw their attention to the WHITE triangle between the three black spots. Place a coin on each of the black spots. The triangle has disappeared.

Magic Science :
The triangle disappears because it never existed in the first place. If you look carefully at the drawing you will see there are no lines drawn to make the triangle! It is simply an *optical illusion* (something that tricks the eyes).

Paper Magic
Cut a strip of paper in half and still have just one piece of paper.
You need: a piece of paper about 1 inch by 11 inches; glue; pencil; scissors.



The Trick:
Give one end of the strip of paper a half-twist. Then glue the ends together so that you have a loop.
Starting anywhere on the strip, draw a line down the center of the paper. Cut along the pencil line. The strip will stay in one piece.

The Science:
This paper strip has just one side. It is called a Moebius strip after the mathematician who discovered it. Mathematicians are interested in surfaces with just one side because they are so unusual. If you glue the ends of a strip of paper together to make an ordinary ring, a line drawn around the outside of the ring will never go inside. If you cut along the line, you will get two separate rings.

Acids, Bases, and the pH Scale

Acids

Acids are ionic compounds (a compound with a positive or negative charge) that break apart in water to form a hydrogen ion (H+). The strength of an acid is based on the concentration of H+ ions in the solution. The more H+ ions, the stronger the acid. Example: HCl (Hydrochloric acid) in water.

Characteristics of Acids	*Examples of Acids*
Acids taste sour	Vinegar
Acids react strongly with metals (Zn + HCl)	Stomach Acid (HCl)
Strong acids are dangerous and can burn your skin	Citrus Fruits

Characteristics of Bases	*Examples of Bases*
Bases taste bitter	Lye (Sodium Hydroxide)
Bases feel slippery	Ammonia (in glass cleaner)
Strong bases are very dangerous and can burn your skin	Baking Soda (Sodium bicarbonate)

Neutralization Reactions

When acids and bases are added to each other they react to neutralize each other if an equal number of hydrogen and hydroxide ions are present. When this reaction occurs salt and water are formed.

$HCl + NaOH \rightarrow NaCl + H_2O$

(Acid) (Base) → (Salt) (Water)

pH Scale and Indicators

The strength of an acid or base in a solution is measured on a scale called a pH scale. The pH scale is a measure of the hydrogen ion concentration. It spans from 0 to 14 with the middle point (pH 7) being neutral (neither acidic nor basic). Any pH number **greater than 7** is considered a **base** and any pH number **less than 7** is considered an **acid**. 0 is the strongest acid and 14 is the strongest base.

Red Cabbage Test

Boil a few leaves of red cabbage in a small amount of water. Remove the leaves and allow the purple liquid to cool. Put some of the liquid in several small containers. Now add different liquids or solids to see what happens. Acids will turn the water pink, and bases will turn it green. If a substance is neither acid nor base, the water stays purple (neutral). Dyes like that found in the cabbage water are called indicators, and are used by chemists to test the pH (acidity) of solutions.

Some things to test:

Vinegar
Lemon juice
Household cleaner with ammonia
Baking soda
Salt
Lemon-lime soft drink
Milk
Orange juice

Touching the Tent

You'll need:

- a piece of material (anything with a tight weave) a cup
- an elastic band
- some water.

Pour the water into the cup and place the material on the top and put an elastic band around to keep it closed. Predict what will happen if you turned the cup upside-down.

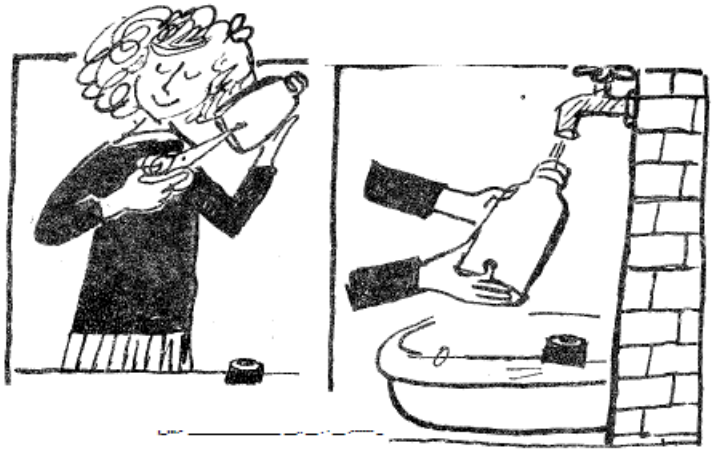
Turn the cup over and make sure that it is directly up and down. Touch the material underneath and watch the water begin to leak through. What do you think happens when you touch the side of your tent when it's raining?

What's Happening?

The surface tension of the water acts like a skin next to the layer of material - until you touch it. The pressure and the oil on your fingers disrupt the surface tension and the water is able to drip through. Surface tension is what allows pond skaters (insects) to "walk" on water.

A Hole in the Bottle

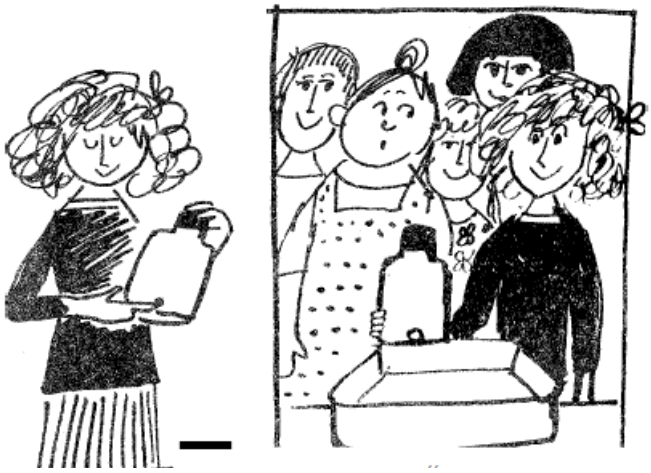
Surprise your audience by keeping water inside a bottle that has a hole below the water level.



You need: an empty plastic bottle with a screw-on cap; water; a small plastic dishpan; scissors.

Here's what you do:

With the scissors, carefully poke a small hole in the bottle, near the bottom. Cover the hole with your finger and fill the bottle right to the top with water. Don't leave an air space at the top. Screw the cap on as tightly as you can while you keep your finger over the hole. Hold the bottle on the edge of the dishpan. Don't squeeze the bottle. Take your finger away from the hole. The water won't pour out.



Why it works:

When you cap the bottle, air can't press down on the water to help push it out. Also, the air pressing against the outside of the hole prevents the water from pouring out. Water spills out of the hole when the cap is off the bottle because air pressing down on the water helps to push it out.

Weather Vane

You need:

- a soda straw
- scissors
- a piece of cardboard about 3 by 4 inches
- a pin with a big head
- a pencil with an eraser.

Here's what you do:
Cut a big triangle and a small triangle out of the cardboard. These will be the vanes of the weather vane. Make a slit, about 1/2 inch long, lengthwise, in the end of each straw. Slide the large triangle, tip first, into one slit. Slide the long side of the small triangle into the other slit. Now you have an arrow weather vane. The small triangle is in front, the big one is in back.

Hold the straw with your thumb and index finger and find the point at which the straw will balance, so that it doesn't tip forward or backward. Push the pin through the straw at this point. Then push the pin into the eraser on the pencil.

Hold the weather vane up outdoors. You can tell where the wind is coming from by watching where the arrow points. If the wind is coming from the north, the weather vane will point to the north. If the wind is from the east, the weather vane will point to the east.

References

Book	**Author**
Science in the Kitchen (Usborne)	Rebecca Heddle
Bet You Can	Vicki Cobb, Kathy Darling
Magic Science	Peter Eldwin
Quick Science	Herman and Nina Schneider
The Usborne Book of Science Fun	M. Johnson, J. G. McPherson, A. Ward
Science With Water (Usborne)	Helen Edom
Discovering Science Secrets	Sandra Markle