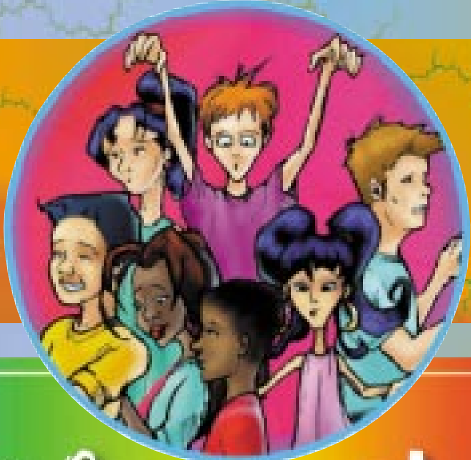
EASY

SCIENCE



Push and pull...

Forces make things happen!

Everything on Earth, including ourselves, is constantly being pushed or pulled by unseen forces.

Some people define a force as a **push** or a **pull**. If you think about it, you can't have a push (or a pull) without two things being involved – one thing being pushed and the other doing the pushing. Your finger pushes a doorbell, moving air pushes against the sail of a boat, a child pushes a toy wagon, a dropped handkerchief is pulled towards the Earth. All of these are examples of interactions between two things.

Without forces, nothing in the universe would ever happen. A book lying on a table might look as if nothing is happening to it, but it is, in fact, being held there by two balanced forces:

- the Earth's gravity acts on the book by giving it weight – a force acting downward; and
- the table which opposes the Earth's downward force with an equal, upward force.

If the book is pushed over the edge of the table, there is nothing to resist (pull back) the downward force and the book will fall to the floor. But the book will not move unless something forces it to. When it starts moving, you can be sure some force is pushing or pulling it. Yet another force will be needed to make it stop moving.

There are several different kinds of interactions, or forces. Three kinds of interactions you will hear a lot about are **gravity, inertia** and **friction.**

GRAVITY

Things fall because they are pulled towards the Earth by a force called gravity. Because of gravity, when you jump, you come back down; water always flows downhill; and balls that are dropped or even thrown forward will fall to the ground.

You can find out more about gravity by doing the following test.

You will need:

- A piece of paper
- A heavy stone

Screw up the piece of paper. Now drop the paper and stone from the same height, at the same moment, and note when they land.

The ball of paper lands at the same time as the stone, even though it is much lighter. This is because the effect of gravity is the same on all objects, no matter how heavy.

Galileo's test

Galileo Galilei (1564 - 1642) was the first person to understand the force of gravity. He discovered that gravity accelerates all falling objects downward to the same degree.

It is said that he demonstrated this by dropping two iron balls of different sizes from the Leaning Tower of Pisa in Italy. What did he discover? You can reconstruct his experiment.

You will need:

- A flat piece of wood, about 1 metre long
- Several different coins

Place coins along the piece of wood. Stand on a chair and hold the wood above your head. Tip the wood so that all the coins fall down together. Do they reach the ground at the same time? (Answer: If the coins fall at the same time, they will reach the ground together. This is because gravity acts on everything equally, pulling them down at the same speed.)

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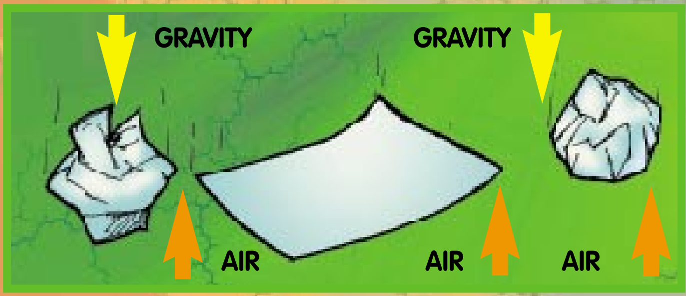

Another way of falling

Have you ever watched falling leaves and nuts, like acorns, on a still day? The acorns fall straight to the ground, but the leaves float down slowly. Can you think why this should be? Try the following experiment.

Take two pieces of paper and crumple one into a ball, as you did before. Drop them from the same height, at the same moment, and watch when they land. Try this several times.

Why do you think the flat paper always falls more slowly?

As the papers fall, air is trapped and squashed under them. This air presses up against them and stops them falling so fast. The flat paper falls more slowly than the crumpled one because it has a larger area, so more air is trapped underneath it. This is also why the large, flat leaves fall more slowly than the acorns.

Trick your friends

Tear two pages from a notebook and write the word "HEAVY" on one. Ask some friends if they can work out how to drop the papers from the same height, at the same time, and make the "HEAVY" one land first. (Answer: crumple the "HEAVY" paper so it traps less air.)

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Make a parachute

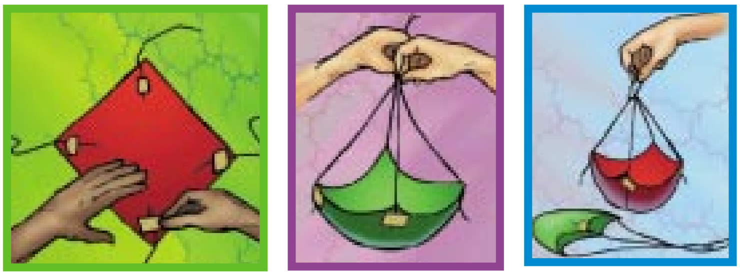
The modern parachute was invented in 1797 by André Jacques Garnerin. He jumped out of a hot air balloon and, wearing his parachute, floated safely to the ground. Let's make some paper parachutes.

You will need:

- Tissue paper
- Sticky tape
- Thread
- Paperclips

To make two parachutes, the one slightly larger than the other, cut two squares of tissue paper, one 30 cm x 30 cm and the other 20 cm x 20 cm.

Tape threads, about 15 cm long, to each corner of each piece of paper. Tie the threads (see illustration), with the taped ends on the outside of the parachute.

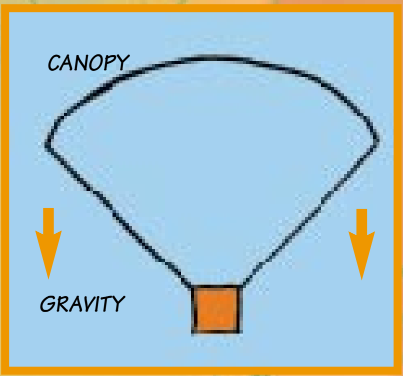


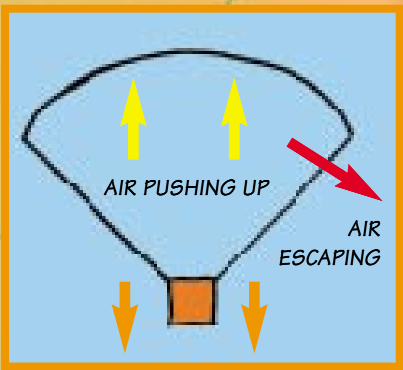
Hook two paperclips on to each parachute, so both have equal load.

To test the parachutes, drop them from the top of a flight of stairs, or stand on a chair. Why do you think one of the parachutes takes longer to fall? See what happens if you hook on more paperclips.

How parachutes work

Gravity pulls the parachute down, but as it falls, air is trapped under the canopy. The air gets squashed up or compressed, and pushes up against the canopy, making the parachute fall slowly.





Wobbly chutes?

You might find that your parachutes sway when they fall. The trapped air escapes unevenly from under the canopy, and makes the parachute sway. Try cutting a hole in the top to see if it stops this.

Garnerin's parachute wobbled badly as the trapped air escaped in sudden spurts from either side of the canopy. This made him very sick. He solved the problem by making a hole in the top of the canopy to let air escape more smoothly. All modern parachutes have a hole at the top.

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A weightless book?

You can prove to yourself that falling things have no weight if you have a bathroom scale in the house.

Put a heavy book on the scale and make a note of the weight. Then hold the book on the scale over a soft mattress. Watching the weight reading closely all the time, drop the scale with the book on top on to the bed. What happens to the reading on the scale?

As the book and scale fall, the reading swings right back to zero! The book has become weightless because it is falling and no longer resisting gravity.

As soon as the book and scale hit the bed, gravity is being resisted again and the book has the same weight as before.

A puzzle for you

Now imagine you are standing on a bathroom scale in a lift. What happens to the reading on the scale as the lift goes down?

ANSWER

As the lift goes down, the weight-reading swings back towards zero. The faster the lift goes down, the less it is resisting gravity and the more the reading swings back.

Gravity can really get you down

You will need:

- A shoe box with lid
- Tape
- Blunt-tip scissors
- Pen
- String
- 10 – 15 5c coins
- White paper
- Small nail
- Ruler
- Two metal paper clips
- Paper or plastic cup
- 30 dried beans

Cover the outside of your box lid with white paper. Use a ruler to draw a straight line on the paper down the centre of the lid. Use a small nail to punch a hole near one end of the lid on the line you have just drawn.

Cut a rubber band open and tie one end to the middle of a paper clip. Thread the other end of the rubber band through the back of the lid so that the rubber band sticks out the front. (The paper clip will keep the rubber band in place.) Tape the lid securely on the box. Tie another paper clip to the end of the rubber band.

Ask an adult partner to poke three holes at equal distances apart in the paper cup, directly below the lip of the cup. Thread each of three pieces of string

through the holes in the cup, pull through and tie a knot in each. Place tape over the holes to keep them from tearing.

Hold the ends of the three strings together and tie them to the end of another piece of string as shown. Tie the end of this string to the paper clip. Have your adult partner hold the box so the cup hangs freely. Place a mark on the centre line of the box lid right where the bottom of the paper clip is, and write the number nought (0) next to it.

Use your ruler to make marks one centimetre apart below the nought mark. Number your marks. You have just made a force scale! You can use it to measure the gravitational pull between the Earth and anything you put in the cup.

Have your adult partner hold the box while you put five 5c coins in the cup. To read your force scale, look at the number beside the bottom of the paper clip. Write it down. How many coins do you think you need to put in the cup to make the gravitational force twice as large? Try it!

Guess how many dried beans you would need to put in the cup to get the same reading as you did for five coins.
Try and find out.

Place 10 - 15 coins in the cup. Have your adult partner hold the box in the air and drop it as you watch the force scale reading. What is the reading on the scale as the box falls? You should have guessed!

The great tablecloth trick

Have you ever seen a magician pull a tablecloth out from under a set of dishes? There is really no trick to it. The magician is just using a little physics to fool the audience! You see, the magician knows that the dishes will tend to remain in place when the tablecloth is quickly jerked away.

This tendency of objects to remain at rest, even when there is a sudden brief force on them, is called inertia. Find out more about inertia in the great tablecloth trick below.

You will need:

- unbreakable plastic cup or small bowl with a smooth bottom
- metal washers or coins
- sheet of plain white paper
- table with smooth surface

Lay the paper on the table so that about 5 cm extends from the end of the table edge. This is your tablecloth.

Examine the bottom of your unbreakable cup or bowl to make sure it doesn't have any rough edges. If it looks okay, fill it at least half-full with washers or coins. Then place it in the centre of the sheet of paper.

Using both hands, grab the edge of the sheet of paper that hangs over the end of the table. Quickly, without hesitating or stopping, jerk the paper downward and out from under your dish!
Try repeating it with an empty cup or bowl.
Does it work as well?

Magicians often put food in the plates and water in the glasses when they do the tablecloth trick. Do you think this makes the trick easier or harder to perform? Why?

Read more about FRICTION in the next issue of MiniMag.

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