THE POWER OF AIR

Air is all around us, yet we cannot see, smell or taste it. We can only hear it when it rustles the leaves of trees or whistles around the corners of buildings. We can feel it when it blows on our faces. The best way to investigate air is to look at what it does to things around you.

What is air?

Our world is covered with air, called the atmosphere. The Earth's gravity keeps the atmosphere near its surface otherwise our spinning planet would fling it off into space.

Most of the air is concentrated about five kilometres above the surface of the Earth and at a height of 200 kilometres there is no air at all.

The air in the atmosphere is densest, or "thickest" near the ground. As we travel higher it becomes thinner, or more rarified.

There's air in there!

You have probably heard that all things are made of matter. Is this true for something like air that we cannot touch? One important property of matter is that it takes up space. Would you like to prove to yourself that air occupies space? You only need an empty plastic bag to do this.

- Fill the empty plastic bag with air by opening the top and moving the open end quickly through the air. The bag will swell up with air.
- Close the top by twisting the opening and holding it with your hand.
- Feel the bag with your other hand.

Does it feel as if there is something in the bag? Yes, it does, doesn't it? Air molecules have been caught inside the bag and are pressing back your hand. These air molecules are pushing out as much as you are pushing in.

If you could press on the bag hard enough and long enough, it will slowly deflate. This happens because the molecules of plastic, which make up the sides of the bag, are very big. Between them are tiny openings which you cannot see. These little openings are big enough to allow the tiny air molecules to escape.

This is also why a balloon which you have blown up looks smaller the next day. The air molecules have leaked through the openings between the larger rubber molecules. The following is another activity that will prove to you that air takes up space:

- Place a wad of paper towel in the bottom of a glass.
- Turn the glass upside down and push it straight down into a deep bowl of water.

The paper towel stays dry. Water cannot fill the glass because it is already filled with air. But, if you tilt the glass, some of the air will escape and water can then enter.

How powerful is air?

Air has mass and exerts pressure on everything around it. It pushes down on every square metre of the Earth's surface about as heavily as an adult elephant does!

EASY SCIENCE

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SAASTA

Do the following experiment to prove that air pressure is a powerful force.

You will need:

- A large sheet of poster paper
- A long ruler
- A table

Spread the paper flat on the table and slide the ruler under one side, as shown in the sketch. Now hit the ruler to try to make the paper fly into the air. (Not too hard, or you will break the ruler!)

It is very difficult to lift the paper because of the air pressing on it. This is called air pressure. How does it work?

The air presses down on the sheet of paper. Because the paper has a large area, there is a lot of air pushing down on it. This pressure is more than the pressure the ruler can exert on the paper from the bottom.

Using air

When air is squashed or compressed, its pressure increases. When you use a pump to inflate a tyre, a lot of air is squashed into the small space inside the tyre. The air pressure inside the tyres of a motor car is strong enough to hold up the entire car and the people and things inside it!

Pressurised air is used to operate pneumatic (*new-ma-tic*) machinery. A pneumatic drill used by road builders, for example, is powered by high-pressure air from a compressor.

Make an air pressure rocket

We have seen that air can be compressed and that as air is compressed, it has a higher and higher pressure. Air always tries to move from a place of higher pressure to a place of lower pressure. You can use these air pressure facts to make your own rocket.

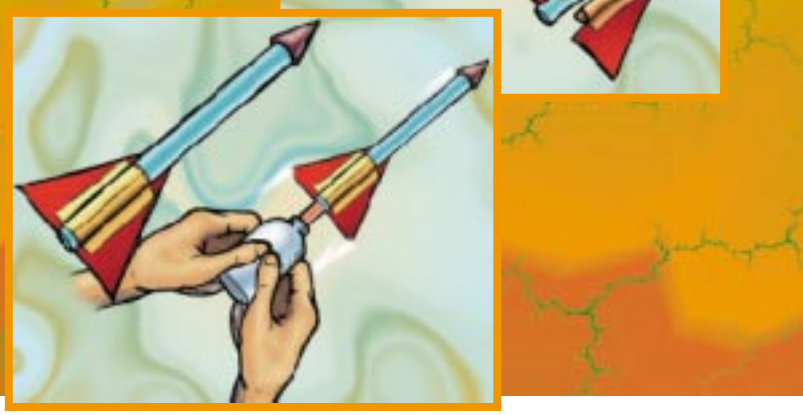
You will need:

- A soft plastic bottle with cap
- A thin straw and a thicker straw
- Modelling clay
- Poster paper

First ask an adult to help you make a hole in the cap of a soft plastic bottle. Push the thin straw through the hole and seal the joint with modelling clay or glue. This is your launch pad.

To make the rocket, cut about 10 cm off a thicker straw. Decorate it with paper triangles (see sketch). Make a "nose" for the other end with modelling clay. This is your rocket. Now slide the rocket over the launch pad. Squeeze the bottle hard and watch the compressed air in the bottle push the rocket into the air.

Try to use a different bottle, straw set-up, or rocket design to create an air pressure rocket that goes even further.



Using air to hold up water

Air presses in all directions, as the following trick shows. But be warned, it can become quite messy. Fill a clean glass to the brim with water. Press a square piece of strong, smooth cardboard on top to make a good seal. Hold your hand on the cardboard and, keeping the beaker over a sink, turn it over. Now move your hand away and the water stays inside the glass! It takes some practice, so don't give up if it doesn't work the first time.

Hint: Make sure you have a good seal between the glass and the cardboard before you turn it upside down.

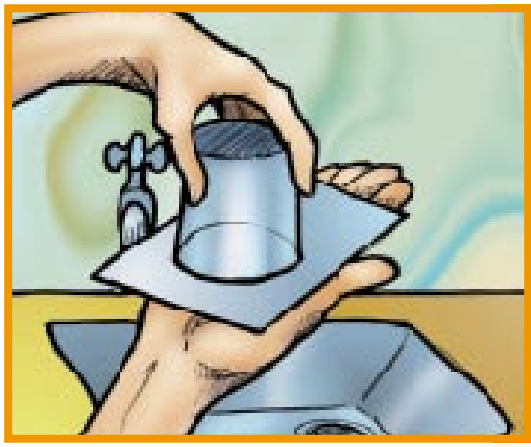
What happens? Air pushes upwards on the cardboard with enough force to hold the water in place. Because air pushes in all directions, you can even turn the glass sideways and the water won't pour out.

Push down gently on the corner of the cardboard to break the seal. Air bubbles into the water. Air now also presses down, the cardboard falls away, and the water pours out.

What is air made of?

There are many gases in the air, but just three – nitrogen, oxygen and the noble gas argon – make up 99,9% of it.

- Nitrogen (N) is used to make fertilisers, to protect perishable foods from oxygen and to freeze foods.
- Oxygen (O) supports life and makes burning possible. It is used in furnaces to produce steel.
- Argon (Ar), a noble gas, is used to fill light bulbs and in metal welding.



EASY SCIENCE

BIOTECH

THE PATTERNS OF INHERITANCE

BY VALERIE CORFIELD

Where did you get those eyes, that nose? In the previous edition of MiniMag, we learnt that genes come in pairs because they are carried on paired chromosomes. Only one gene of each pair goes into the sperm or egg that fuse together (at conception) to make a baby.

New technology shows us that very small differences in the DNA code in our genes result in different versions of genes. These genetic differences make us look different from each other, for example whether we have blue or brown eyes. How does this work?

- One member of every pair of genes that your mom has came from her dad (your grandpa).
- The other member of the pair of genes came from her mom (your grandma).
- When these genes were separated into the egg that made you, you inherited either the version of your grandpa's or your grandma's gene.
- The same is true for the genes you inherited from your dad. You have either the version that came from his mom or his dad (your other grandma or grandpa).
- If you have brothers or sisters, chance will determine whether they got the same version of each gene as you, or whether they got the other version. That is why you look different from each other.

Laws of inheritance: what happens if you inherit two different versions of a gene?

What happens if you inherit two slightly different instructions, for example, the one to make blue eyes and the one to make brown eyes? Inheritance follows its own laws and often one gene version "wins" over the other one. The feature (trait) controlled by that particular gene is called **dominant**. The one that "loses" out is called **recessive**.

Brown eye colour is dominant over blue eye colour, so if you have one gene version instructing your body to make blue eyes and the other telling it to make brown eyes, the brown-eye gene will "win". Recessive traits are only seen if you inherit two copies of the gene that codes for it, for example, if you get the blue-eye gene from both your mom and your dad.

Following the patterns and laws of inheritance

The laws that govern inheritance were first studied by an Austrian monk called Gregor Mendel in the 1800s. He worked with peas but his discoveries apply to humans and animals too. They have helped people who study genetics to understand how individual traits are inherited and the patterns seen are called Mendelian inheritance. Mendel's laws are applied in plant and animal breeding programmes and are used in genetic counselling in families who suffer from inherited diseases.

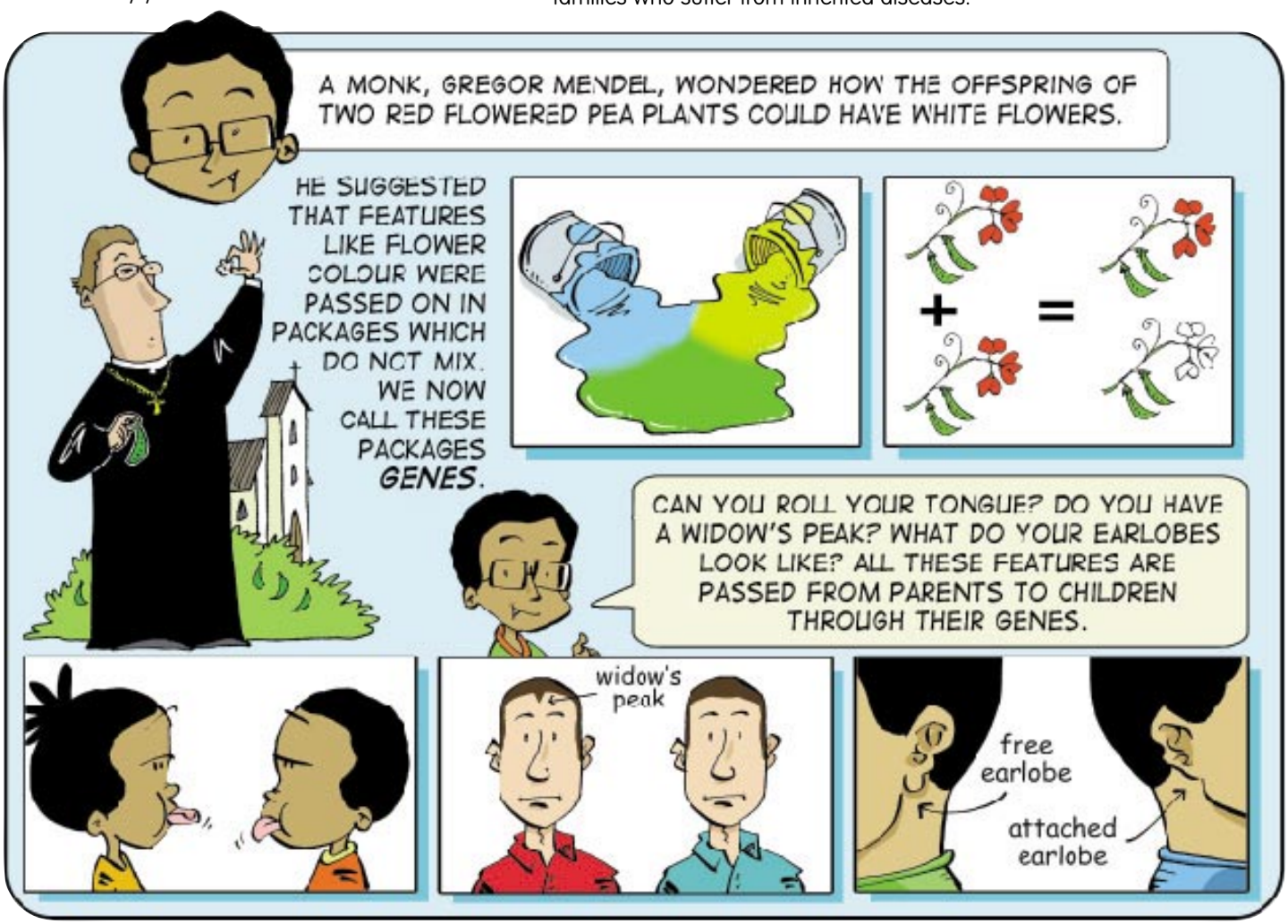


Illustration from a poster produced by Rapid Phase (Pty) Ltd on behalf of the Public Understanding of Biotechnology Programme

An experiment in genetics

You can do an experiment to check the laws of inheritance in your own family. Many facial features follow simple Mendelian patterns of inheritance, and you will be able to see if they show a dominant or a recessive pattern of inheritance. However, some inherited features are more complicated, so do not be surprised if some of the features you choose do not fit a straight forward pattern of inheritance.

1) Make a list of what features you want to study in your family. Here are some ideas:

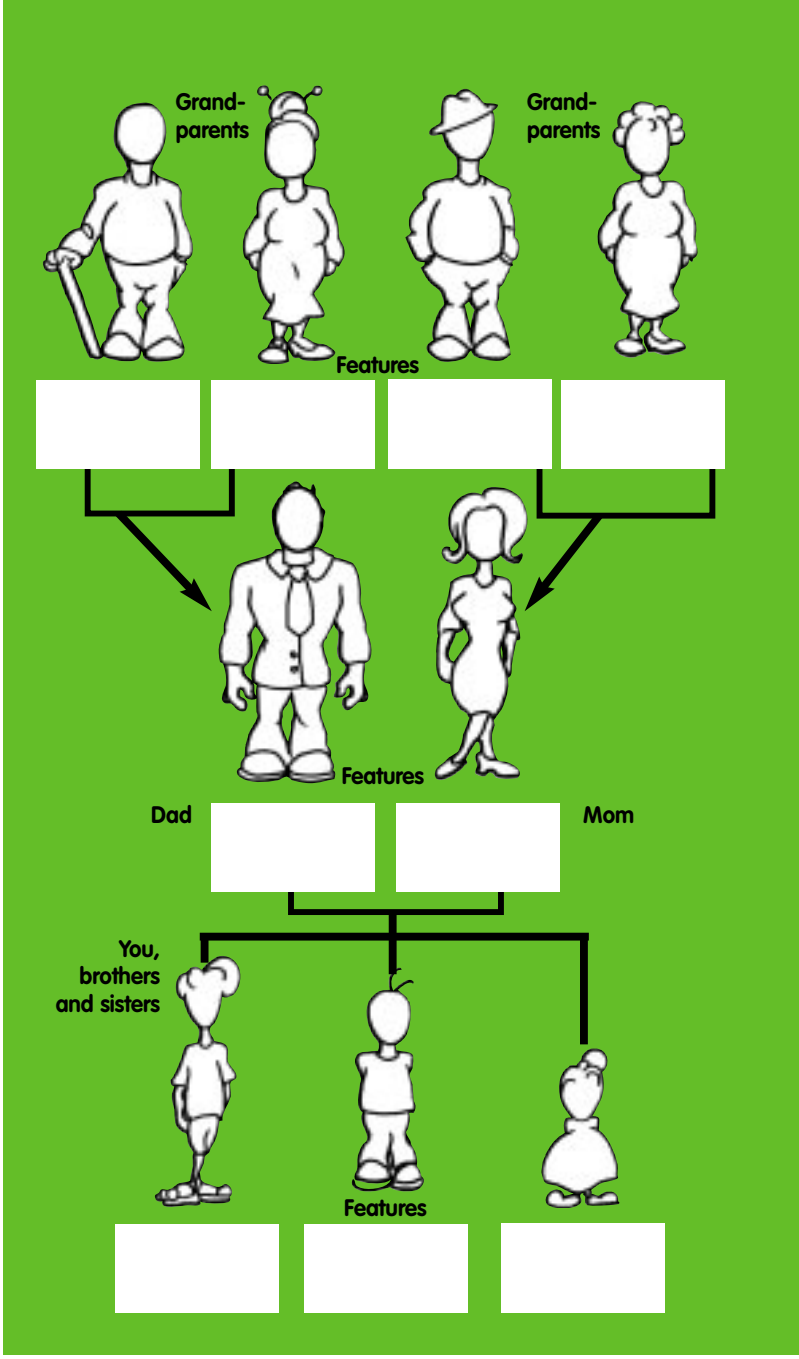
- Eye colour
- Hair colour; hair texture
- Chin dimple; chin shape
- Other dimples
- Nose shape, size, nostril shape
- Mouth and lip shape and size
- Eyebrow shape, texture, colour
- Face shape
- Curly or straight hair.

Any other feature characteristic of your family (remember the story of the Hapsburg lip in the previous issue?). What about other body parts, e.g. hand and foot shapes? You can look at photographs or ask your parents about their grandparents and even their great grandparents. Don't forget your aunts and uncles and your cousins.

2) Draw a pedigree showing all the relatives that you can investigate. On the right is an example of how geneticists draw a pedigree. You can change this to fit your family.

3) Write the version of each chosen trait (such as curly or straight hair) under each relative on the pedigree. If you have studied a lot of different traits, you might want to use abbreviations so that you can list them under each person on your pedigree.

4) What features "run" in your family? Can you see examples of dominant traits (e.g. dark eye colour, dark hair colour)? Can you see examples of recessive traits (e.g. red hair, chin dimple)?



Designer babies

New DNA technology that allows scientists to read genes raises the question of whether they can use the information to produce designer babies. Will parents be able to order a baby boy with an IQ of 200, with the ability to be a gold medal winner in the sport of choice, with blue eyes or brown eyes, and with model good looks?

As scientists begin to understand all the information written in our DNA, they will certainly be able to tell which genes specify desirable or undesirable traits. Recently, for example, they identified a version of a gene that encourages people to overeat and become fat. They also know of two genes that give a person greater athletic ability and they can tell if that person is likely to be a good sprinter or a long distance runner.

However, changing the DNA code to put new forms of designer genes into a baby who hasn't inherited them from one of the parents is not yet possible.

In the end these are issues of right and wrong that will guide scientists as to how far they should interfere with nature to produce designer babies. It is up to you, the younger generation, to understand and debate such issues.