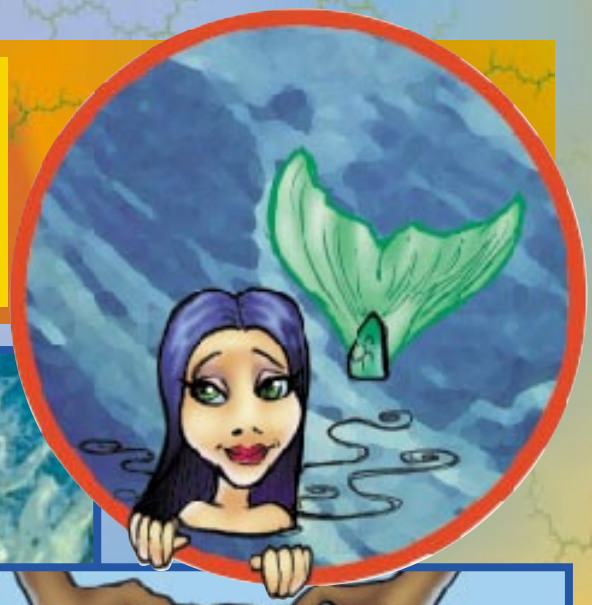
EASY SCIENCE



THE WONDERS OF WATER

How many times have you used water today? There was water in your bath or shower. It made up the biggest part of the food you ate and the drinks you had. Yes, even eggs, fruit, and meat contain more water than any other substance. It covers almost 3/4 of the Earth's surface and also makes up about 2/3 of your body weight. Water is just about everywhere and every living thing needs it to survive.

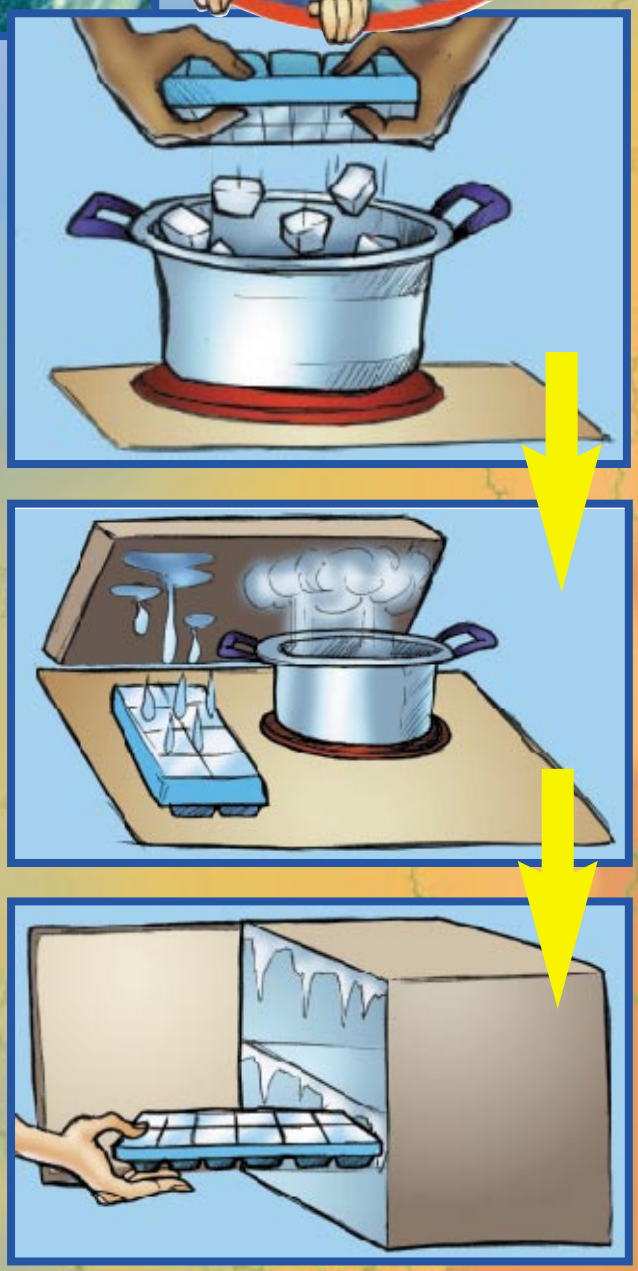
WHAT IS SO SPECIAL ABOUT WATER?

Ice, liquid and gas

A remarkable thing about water is that it is commonly found in all three states of matter: solid ice, liquid water and gaseous water vapour (or steam). If water is cooled down to a certain temperature (normally 0˚C) it freezes and changes to the solid form, called ice. If it is heated to a certain temperature (normally 100˚C) it boils. Then it changes into the form of gas known as steam or water vapour.

You can see for yourself how water goes through the full circle of all it states. Put some ice-cubes from the freezer into a saucepan and slowly heat them to melt. You have now changed a solid into a liquid. Keep on heating it and after a while the liquid will turn into steam.

Put the cold ice-cube tray into a metal bowl and place this next to your saucepan with boiling water. Cover your hands with a dishcloth and hold a metal tray over the saucepan to catch the steam. As the steam hits the tray it cools down and changes back to a liquid. Collect some of the liquid in the ice-cube tray and return it to the freezer. After a few hours you will have ice-cubes again.



Solid water floats

Water molecules act in a very special way when water freezes. When most liquids freeze, their molecules get closer together and the substance shrinks or contracts. But when water freezes, water molecules get farther apart and water expands.

After water has expanded to form ice, it can float on liquid water. This is very helpful in nature. When lakes freeze, ice forms on the surface and the water underneath stays liquid. This helps living things in the water survive cold winters.

EASY SCIENCE

EasyScience is produced by the South African Agency for Science and Technology Advancement (SAASTA), an operational unit of the National Research Foundation. SAASTA's mission is to promote the public understanding, appreciation and engagement with science and technology among all South Africans.
Visit the website: www.saasta.ac.za for more information.

SAASTA

Solving and dissolving

A very important quality of water is its ability to dissolve many substances. Different things affect how well water dissolves a certain amount of a substance: the amount of water used, the temperature of the water, and how fast the water is moving. You can investigate these three aspects of dissolving by:

- Taking 1/4 cup of cold water and 1/4 cup of warm water and placing a sugar cube in each cup. Now watch the cubes very closely. Which one dissolved the fastest?
- Taking three cups of warm water and placing a teaspoon of sugar in each. Ask a friend to stir the one cup slowly, while you stir one cup very quickly. Leave the other cup alone. Which sugar dissolved the fastest?
- Taking two cups and filling the one almost to the top with warm water and filling the other only halfway. See in which cup 3 teaspoons full of sugar will dissolve quickest.

A compound?

We say that water is the most common compound on Earth. What do we mean by that?

There is a huge variety of substances on Earth. Yet, all are made up of atoms of just more than 100 basic chemicals, called elements. When atoms of two or more elements join together, they make a molecule, called a compound.

Water is a compound because each water molecule is made up of atoms of two elements: hydrogen and oxygen. Each water molecule consists of two atoms of hydrogen linked to one atom of oxygen. That's why scientists call water H_2O, where H_2 stands for the two hydrogen atoms and O for the one oxygen atom.

Make a model of a water molecule – and then eat it!

You can't see molecules separately, because they are so small. They can only be seen through powerful electron microscopes. But you can make models of molecules. The model of an H_2O molecule looks like Mickey Mouse ears! Of course your model will not be exactly to scale. The true oxygen atom is almost 16 times larger than the hydrogen atom.

To make molecule models, you will need:

- large marshmallows to represent atoms,
- small marshmallows to represent smaller atoms, and
- toothpicks to represent the bond between atoms.

For the water molecule, take two small, coloured marshmallows for the hydrogen atoms and one large marshmallow for the oxygen atom. Stick them together with toothpicks so that the one small marshmallow is on top and the other small marshmallow is at the bottom sticking out at an angle.

Molecules on the move

The molecules which make up water are very close to one another and are always jiggling around and bumping into each other. A container of water is like a shoebox of ping-pong balls being shaken back and forth very quickly. The ping-pong balls, like the molecules of a liquid, touch and hit each other all the time, but can still move around from place to place.

Some molecules are able to escape from the liquid and become a gas. Heating the water makes the molecules move faster and more of them will gain enough speed to break away from the other molecules. This process is called evaporation.

WATER FACT FILE

- More Than 97% of all the Earth's water is in the oceans around the world. The other 3% is made up of:
  - Water on the various continents (in lakes, rivers and dams, groundwater in the Earth's surface rock, dew and fog, and juices in plants and other life forms);
  - Ice, frost, snow and hail (on the high mountain ranges and cold regions of the Earth and on the icecaps at the North and South Poles); and
  - Water vapour (in the atmosphere and the clouds).
- Heat and cold continually change water into its different forms of phases - water, ice and water vapour.
- Every living body is made up of about 3/4 water. Some animals, like jellyfish, are almost 100% water.
- Water plays an important part in a very large number of chemical reactions – from rusting to photosynthesis.
- More than 2% of the world's water is locked in the frozen ice of the polar regions.
- Ice is less dense than water and therefore floats. An iceberg is a mountain of freshwater ice floating on the ocean. Will a litre of ice have a mass greater or smaller than a litre of water?

WATER EVERYWHERE – BUT THERE IS A DROUGHT?

While there seems to be plenty water on Earth, parts of South Africa and its neighbouring countries are experiencing severe droughts. Why is that? The problem is that only a tiny percentage of it can be used by us greedy and wasteful humans.

It is important to remember that there is a fixed amount of water on Earth, whether it is in a river, the ocean, a glacier or someone's body. More than 97% of the total water on Earth is in the oceans; about 2% is in glaciers, and only 0,0001% is in rivers. Of the freshwater on Earth, much more (0,61%) is stored in the ground than is available in lakes, inland seas and rivers.

The situation is quite scary, since most of the water humans use come from rivers. Most groundwater is not accessible to us.

In South Africa, the situation is worse as, by world standards, we are a dry country.

MEASURING TEMPERATURE

Water normally freezes at 0°C and boils at 100°C. These two temperatures are exactly 100°C apart. A degree Celsius is exactly one hundredth of the temperature difference between water's freezing point and its boiling point. So water provides the basis of our temperature scale.

EASY SCIENCE

BioTECH

IT'S IN OUR GENES

By Valerie Corfield

Long before the word genetics was made up to describe inheritance, every family understood the main principle - that children look like their parents, and that brothers and sisters often have a striking "family likeness". Grannies and aunties would come to look at newborn babies, just like they do now, and declare "this baby has the Smith family nose" or "the Tshabalala eyes". A famous example of the passing down of a facial feature is the Hapsburg lip, which has been traced through at least 23 generations of the Hapsburg royal family of Europe. The children that inherited this family look had a very long pointy nose, a pouting lower lip and a jutting-out chin.

Charles II, who was King of Spain from 1665 to 1700, had the trait of the "Hapsburg lip", a feature that was passed down through the Austro-Hungarian royal family.

Photo: www.msu.edu/course/lbs/333/fall/hapsburglip.html

What runs in your family?

Many different traits (characteristics) are inherited in a simple way. Why not take a look in your own family and study some features in your Mom and Dad, Granny and Grandpa, and brothers and sisters? Have a look at:

CHIN SHAPE

HAIR LINE

EAR LOBES

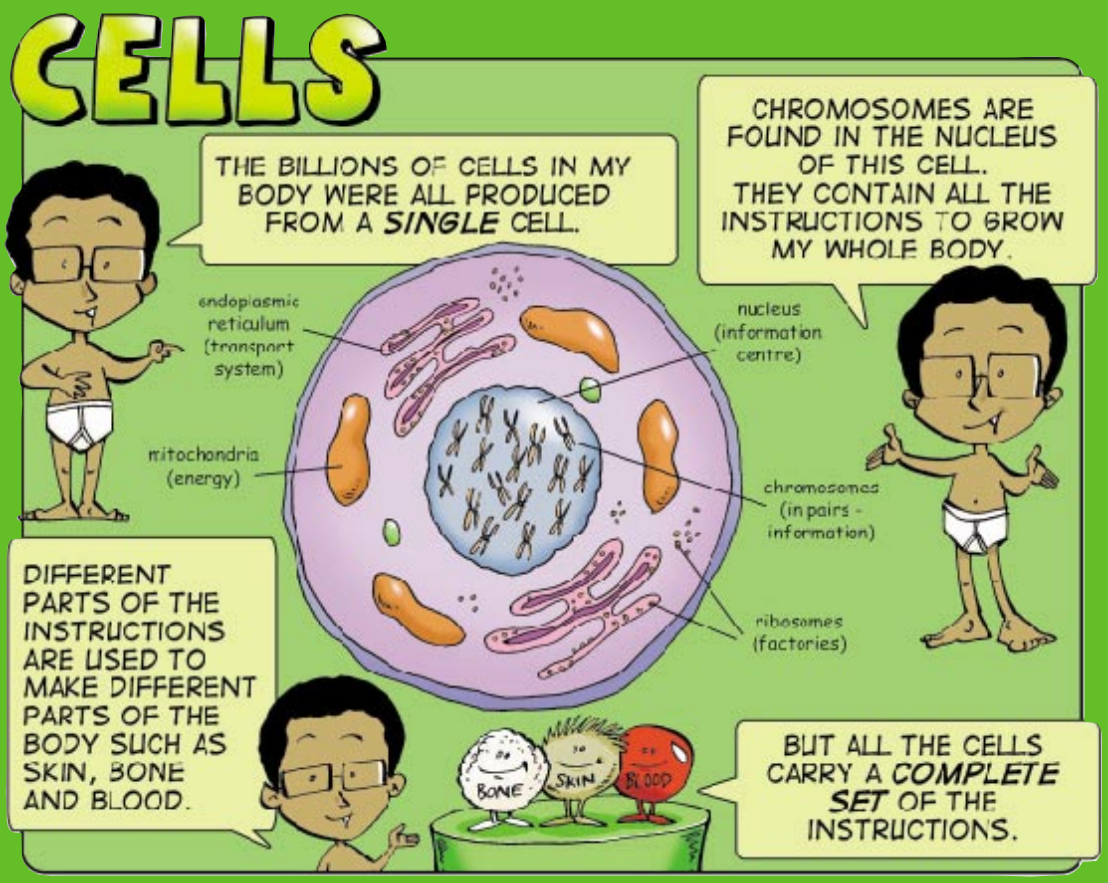
DIMPLES

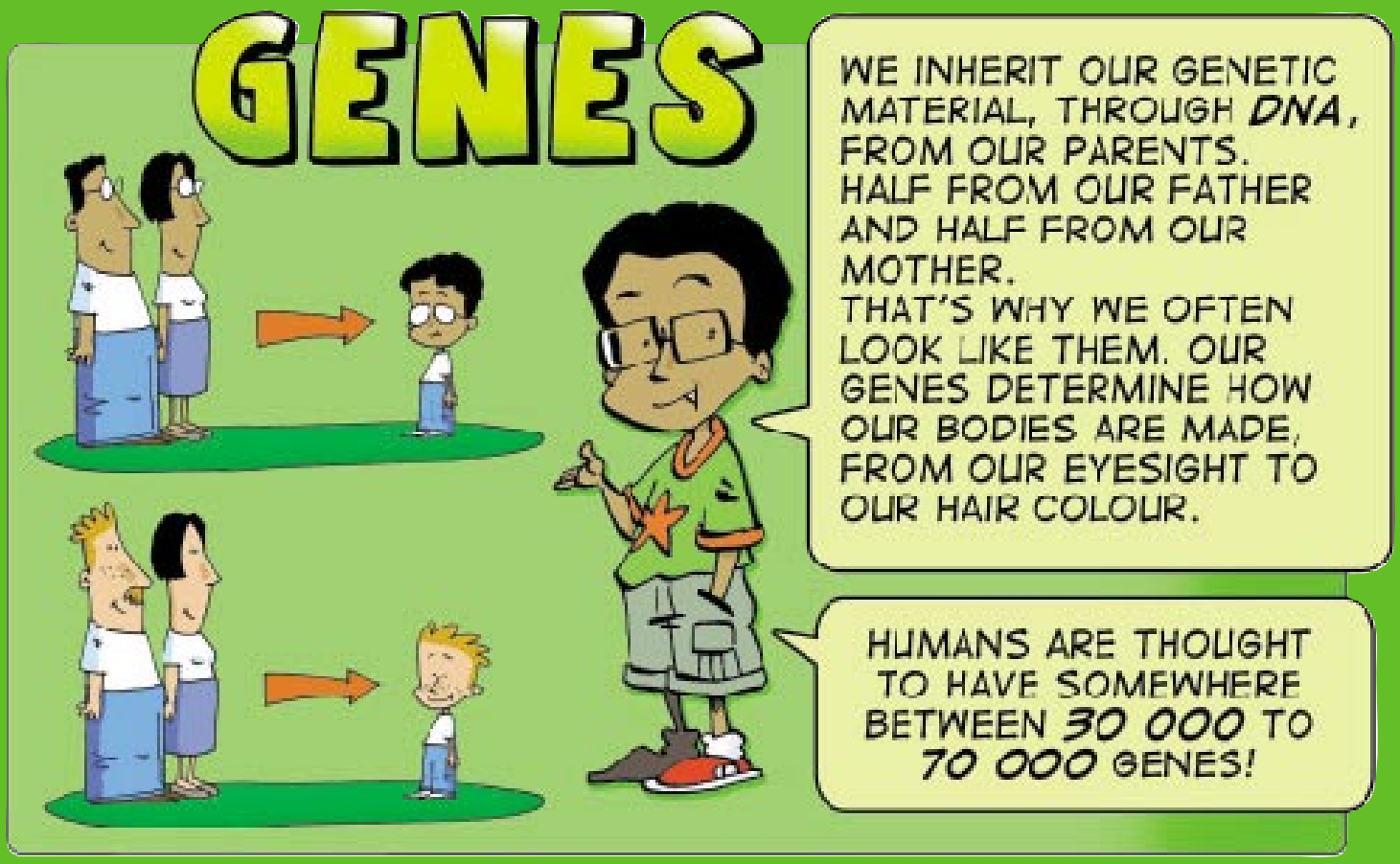
Look out in the next issue for an experiment on how to follow inherited traits in your family.

Genes come in pairs

DNA is the molecule (a tiny particle that makes up all matter) that holds the genetic instructions for life, and that passes characteristics from parents to their children. (See MiniMag October 2003 for more on DNA.) The instructions for what features we inherit are written in the DNA code in our genes, found in chromosomes.

The genes carried on the chromosomes come in pairs, and one member of the pair is inherited from a person's Mom and the other from his or her Dad. When a Mom makes an egg or a Dad makes a sperm, only one of the pair of genes goes into each egg or sperm. This separation of genes determines which features of their Mom or Dad a child will inherit.





Biotechnology and inheritance

The principles of inheritance have been used in breeding animals and plants for thousands of years. Farmers mated their prize bull with their best milk producing cow and expected that some of the calves would be champions. Hunters mated their fastest hunting dogs in the hope of breeding even faster offspring. Farmers and gardeners chose plants that produced extra large fruit or seeds and crossed (mated) them to produce bumper crops.

They didn't call it biotechnology then, but that is just what they were doing – they were using living things to produce a useful product – like a prize bull, a super milk-producing cow, a lightening fast hunting dog or the biggest pumpkin in the world.

Now that scientists know so much more about how DNA controls inheritance they are learning how to speed up plant and animal breeding programmes and introduce specific characteristics through new generation biotechnology. This process is in the early stages, and people are still talking about the "rights and wrongs" of these new methods.

Right: Valerie Corfield explains to a group of learners how DNA tests can be used to determine a child's father. Valerie is Associate Professor and Chief Specialist Scientist at the University of Stellenbosch (US)/Medical Research Council Centre for Molecular and Cellular Biology, which forms part of the Faculty of Health Sciences at the US.

Illustrations from posters produced by Rapid Phase (Pty) Ltd on behalf of the Public Understanding of Biotechnology Programme

EASY SCIENCE

PUBLIC UNDERSTANDING OF BIOTECHNOLOGY

PUBLIC UNDERSTANDING OF BIOTECHNOLOGY

The Department of Science and Technology has launched a Public Understanding of Biotechnology programme to make sure South Africans understand the scientific principles, related issues and potential of biotechnology. Biotechnology is the part of science that uses the DNA building blocks of life to make useful products from living things. If you have opinions, questions or concerns about any area of biotechnology, let's hear from you at speakup@pub.ac.za or fax 012 320 7803 or visit www.pub.ac.za for more information.

DEPARTMENT OF SCIENCE AND TECHNOLOGY