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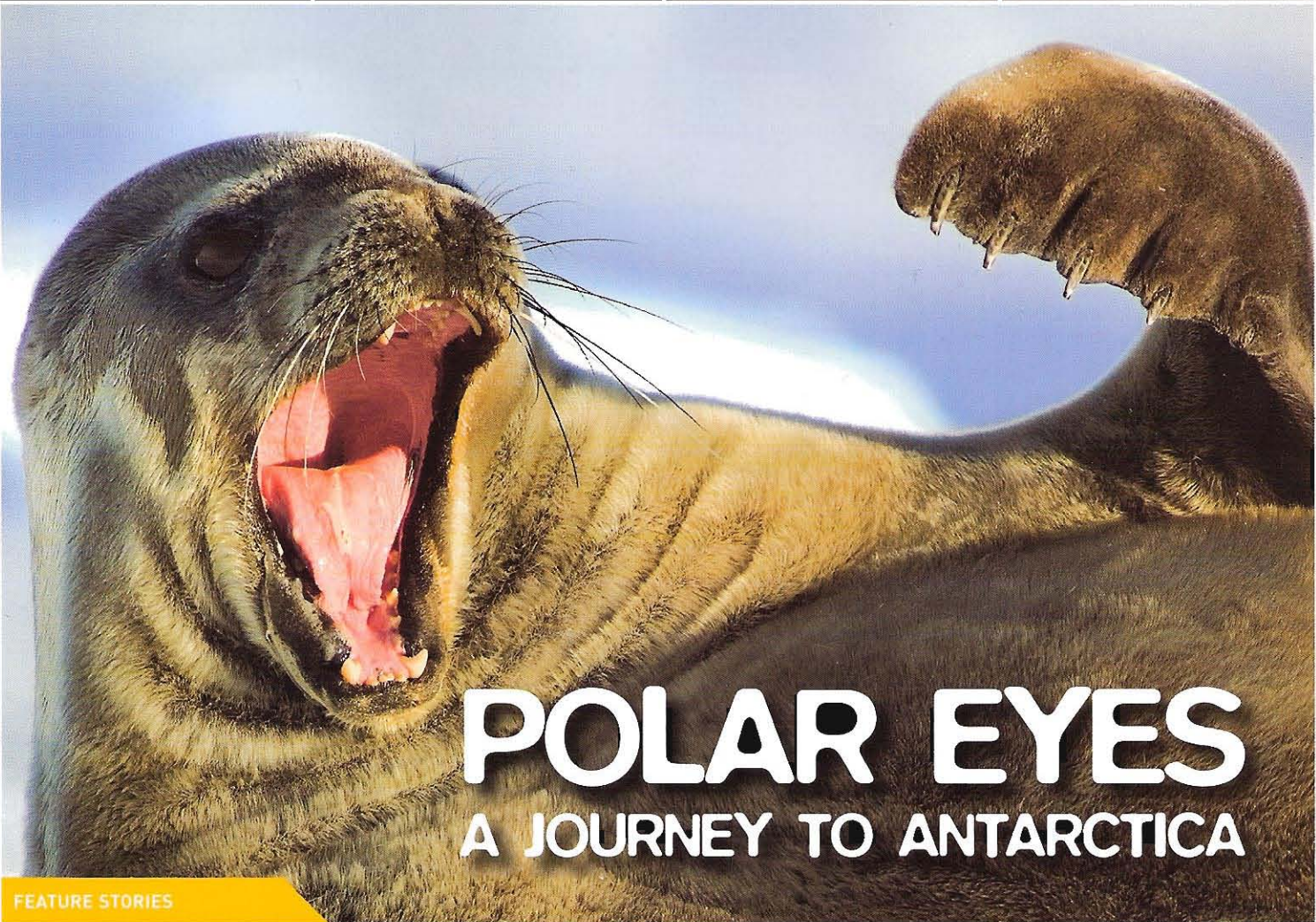


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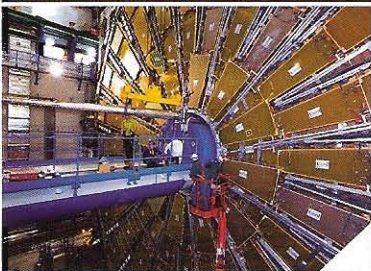


POLAR EYES

A JOURNEY TO ANTARCTICA

FEATURE STORIES

THE BIGGEST EXPERIMENT



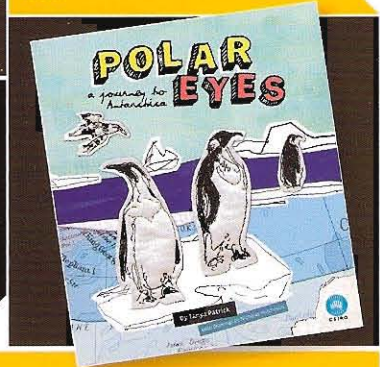
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SCIENCE
WITH A TWIST

JOURNEY INTO THE NANO-WORLD

BY KATH KOVAC

It's a place where things are very different. At the nanoscale — around one billionth of a metre — the traditional laws of physics just don't work. Substances that behave one way at the bigger end of the size scale can behave completely differently. They may conduct heat or electricity better or worse, or may become super-elastic, more chemically reactive, physically stronger or weaker. They may even change colour, or be able to withstand massive changes in temperature and pressure.

RELATIVELY SPEAKING

If a marble was shrunk one nanometre wide, then the Earth would be only one metre wide!

With the development of more accurate scientific equipment, and the ability to manipulate atoms and molecules, nanotechnology — the art of working with the insanely small — is taking advantage of these often unusual changes in the properties of materials.

EVERYDAY NANO

Around the world, more than 800 nanotechnology-based consumer products are already available. Fancy some anti-odour socks or a UV-blocking invisible sunscreen? What about a self-cleaning dog bed, an anti-fungal gym towel, or a pencil filled with nanocapsules of fragrance that pop as you write, releasing sweet smells?

From ultralight tennis racquets to fridges that fight off bacteria and bad smells, the list of nano-products is growing daily.

WHERE WILL NANOTECHNOLOGY TAKE US?

Of course, the possible benefits of nanotechnology extend far past self-deodorising socks and anti-bacterial kitchen appliances. A huge range of social, industrial and environmental benefits are expected to flow on from nanotechnology research.

We'll have new ways of saving water and enviro-friendly ways of producing energy and power. Mining could be on the way out as nano manufacturing techniques reduce our reliance on raw materials, and industrial processes will use resources more efficiently and make less waste. Nanotechnology will reduce our energy use, clean up water supplies, make computers accessible to more people and increase our medical options. Here's just a sneak peak at a few of these ideas.

SAVING ENERGY

University of Technology Sydney researcher, Professor Geoff Smith, says there is a range of ways — some already commercially available — in which the buildings of the future will save energy by using 'green' nanotechnology.

"Windows on many commercial buildings already use ultrathin layers of silver, 11 nanometres thick, to reflect heat while still letting in daylight," says Geoff. A United States company, for example, sells a paint-on coating called Nansulate® that is, according to them, the best-insulating (or, worst-conducting) material known in the world. This kind of technology can cut the need for air conditioning in half.



Nanotechnology will make it a lot easier to keep your house warm. No more knitting house-jumpers, instead it will be as simple as a coat of paint!

Geoff says that future nanotech energy savers will include light-emitting diode (LED) optical systems with energy savings way ahead of fluorescent tubes. "As an environmental bonus, LED systems, unlike fluoro tubes, contain no toxic mercury," he says.



SUPER FAST COMPUTERS

Researchers at the University of New South Wales's Centre for Quantum Computing Technology are working on bringing in a new era of mind-blowingly powerful computing compared with today's technology.

While today's computers use zeroes and ones to represent data in binary code, quantum computers use sub-atomic particles. By using the natural way in which particles act, these machines can generate massive computing power.

Working at the nano scale, the power of a quantum computer will enable us to do things that are impossible with our current fastest supercomputer.

"CLEAN UP IN AISLE 3"

Toxic chemical spills can be a real headache — not to mention a disaster for nearby people and the environment. Australian company, Enware Australia P/L, have recently started to sell 'FAST-ACT', a dry powder that can safely contain and neutralise chemical spills of the most horrendous kind.

FAST-ACT contains nanoparticles of titanium dioxide and magnesium oxide that work quickly to neutralise acids, industrial chemicals, poisons, petrochemicals — even chemical warfare agents — converting them into much safer compounds that can be easily disposed of.

Rechargeable batteries are great, but they have a pretty limited life. NanoSafe batteries, produced by a company called Altair Nanotechnologies Inc., can be recharged more than 9000 times and last for about 25 years, compared to about 75 recharges and two years life for a conventional lithium battery. They are much more powerful, and take only minutes to recharge, rather than hours, making battery-driven electric cars suddenly much more appealing.

MEDICAL NANOMIRACLES

People who find themselves in wheelchairs due to spinal injuries may soon have a good chance of walking again. Researchers have recently discovered how to repair broken spinal cords in mice in as little as six weeks. United States scientist, Doctor Samuel Stupp, injected self-assembling nanoparticles into spinal tissue of paralysed laboratory mice. According to Samuel, the nanofibres prevent harmful scar tissue from forming and help the regrowth of damaged neurons.



Scientists have developed nanometer-sized 'cargo ships' that can sail throughout the body via the bloodstream to deliver toxic anti-cancer drugs to tumours.

Cancer is another high-profile target for medical nanotechnology. One of the latest breakthroughs is the deployment of 'nanoships' containing cancer-fighting drugs through the bloodstream, direct to the site of tumours. The 50 nanometre-long ships also contain chemical markers that allow doctors to track them using magnetic resonance imaging (MRI) technology. The precise location of the tumour cells can be easily discovered, allowing earlier detection and better treatment.

METAL WITH A MEMORY



Artificial muscles developed at the University of Texas at Dallas are over a hundred times stronger than natural muscle. These artificial muscles, powered either electrically or chemically, like natural muscle, might make it possible for a humanoid robot to easily lift a car.

When you bend a piece of metal, it usually stays bent. But add a dash of nanotech into the metal mixture, and you have metal that can spring back to its original shape when it's heated. Ding your car? No problem: bring out the old hairdryer, and the evidence is gone! Luckily, this technology has many more applications than just putting panel-beaters out of business.

Nanotechnologists at the University of Texas at Dallas have used memory metal muscle wire to make hydrogen-powered and alcohol-powered artificial muscles that are 100 times stronger and able to do 100 times more work than natural muscles. Think artificial limbs, exoskeletons for astronauts and soldiers, and robots that can keep going and going...and going. In related artificial muscle research, carbon nanotubes are being developed into artificial 'skins' for aeroplane wings and wind turbine blades. The skin is hoped to decrease wind resistance, resulting in increased energy efficiency.

NANO-COOL



Apple's iPhone Nano and iPod Nano aren't just called that to be trendy.

The iPod's flash memory chips and the iPhone's touchscreen are both products

of nanotechnology. Of course, the rumour that flew around the internet just before the iPhone's release — that it would "reassemble itself when thrown against a wall" — is just not true. We may have to wait a few more years for that one!

WHAT'S FOR LUNCH?

Many nanoparticles exist in nature — smoke, dust, ash, and fine clay all contain nanoparticles — and are not solely produced in laboratories. In the same way, food and water also naturally contain nanoparticles; and this can be what makes food taste so good.



An example of the natural use of nanotechnology is mayonnaise, which is made from eggs, oil and water, but doesn't taste like any of these. If you look at mayonnaise under a powerful microscope, you can see that the lipids and proteins are all arranged into little droplets that are only a few hundred nanometres in size. The nanostructure of mayonnaise contributes to its smooth, creamy texture.

Many of the nanofood products being developed contain nutritional additives, dispersed through the food in tiny drops called micelles. The drops allow ingredients such as vitamins and minerals that usually don't dissolve in water or fats to be easily digested.

No manufactured nanofoods are available in Australia yet.

Keeping food fresh has been one of humanity's constant headaches. Today's fridge and freezer do a great job, but refrigeration is not accessible everywhere and is also pretty environmentally unfriendly! 'Smart' packaging avoids the need for refrigeration. Some types contain nanoparticles of clay that promise to keep food fresh for months by blocking the passage of oxygen and moisture, slowing the growth of bacteria. Other types of nanopackaging can change colour to alert you if the food is starting to go off, or even self-repair holes and tears.



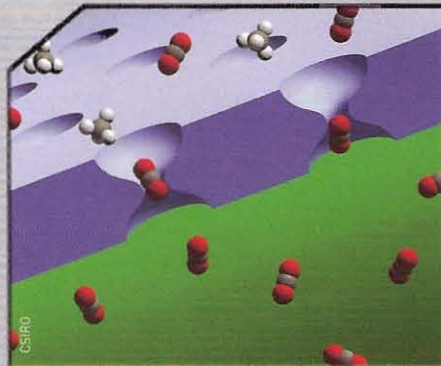
New nanocoatings for glass bottles are preserving the quality of food and drinks by protecting them from damaging light waves.

BE AN INFORMED CITIZEN

If you wish to take part in public discussions on nanotechnology, it's important to be informed. Understanding the risks and benefits of any technology helps you make better choices about how it may be used.

A WATERY ISSUE

Despite today's technological breakthroughs, a sixth of the world's population — more than one billion people — still don't have access to safe drinking water. A third of the population live in drought-stricken countries, and in only 13 years, this could be as high as two-thirds. Nanotechnology could help provide safe drinking water supplies.



A special plastic to clean water allows water molecules to filter through but stops contaminants like viruses and bacteria.

Researchers in India are working with CSIRO to develop tiny carbon nanotubes that let water molecules pass through, but prevent the passage of viruses and bacteria.

A fantastic plastic developed by CSIRO and scientists in Korea and the United States could also help solve the problem of water purification. Working on the nano level, their plastic membrane mimics pores called aquaporins found in plant cell membranes. These hourglass-shaped pores selectively conduct water molecules in and out of cells, while preventing the passage of other molecules such as salt. The secret to the new plastic membrane lies in the pores' hourglass shape, which helps to separate molecules faster and using less energy than other pore shapes.

University of South Australia scientists have also recently discovered a simple way to remove contaminants from water using a nanomaterial coating on silica (sand).

NANOSPORTS

After you've saved the planet and cured cancer, there's nothing like a nice relaxing game of tennis or golf. And, thanks to nanotech sports equipment, even amateurs can improve their game, swing or serve power.

Bicycles with ultralight carbon nanotube frames, stronger golf clubs and golf balls that go straighter even if you hit them badly are all available — if you've got the money. Professional tennis player Roger Federer won the 2006 Australian Open with a carbon nanoparticle-infused racquet, and long-lasting tennis balls containing clay nanoparticles are the official balls of the Davis Cup. Some sports stars, however, have complained that modern equipment is ruining the game. Former tennis star John McEnroe has said that modern racquets have made men's serves almost impossible to return.



A nanoparticle-infused racquet gives Roger Federer an extra edge.

SAFETY AND REGULATION

Like all technologies, nanotechnology has both risks and benefits. The novel properties of nanoparticles may also lead to new risks. In Australia, we have regulations that cover the different uses of nanotechnology to ensure it is safe for humans and the environment. The Australian Government is also working with other governments and international organisations to keep on top of any emerging health, safety and environmental issues.

SUPPORTED BY THE AUSTRALIAN OFFICE OF NANOTECHNOLOGY

The Australian Office of Nanotechnology is a federal government agency in the Department of Innovation, Industry, Science and Research. It works to implement the Australian Government's National Nanotechnology Strategy. Find out more by visiting us at www.nanotechnology.gov.au or use our freecall Australia-wide number **1800 631 276**. Discover AccessNano at www.accessnano.org to find how nanotechnology can come to your school!



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