

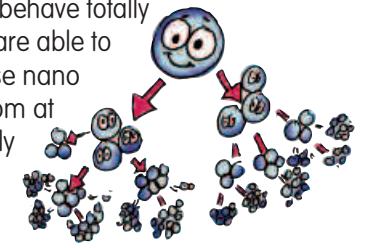
A NEW WAVE of science innovations is based on something really, really small, but smarter than ever before. Nanotechnology is the hottest buzz in labs around the world. Scientists are using this cutting edge technique to develop incredible new products, but also to work towards renewable energy, clean water, safe food and smart medicines for the growing number of people on our planet.

How small can you go?

Look at the size of one millimetre on your ruler. Now imagine slicing this up into a million equal pieces. Now you're at the extremely minute scale of atoms and molecules – the nanoscale. A single hydrogen atom is about 0.1 nm wide. A nanoparticle is any chunk of material smaller than 100 nanometres. This is way too small to see with the naked eye. Think of dust that is so fine that you cannot see it. A single hair is about 80 000 nanometres thick!

How does it work?

When you break a material down to nanoparticles, you multiply its surface area by a factor of millions. The materials become much more reactive and behave totally different. Now, scientists are able to combine and shape these nano building blocks – one atom at a time – to produce highly advanced materials and super small devices with amazing new properties.



Fact or nano fiction?

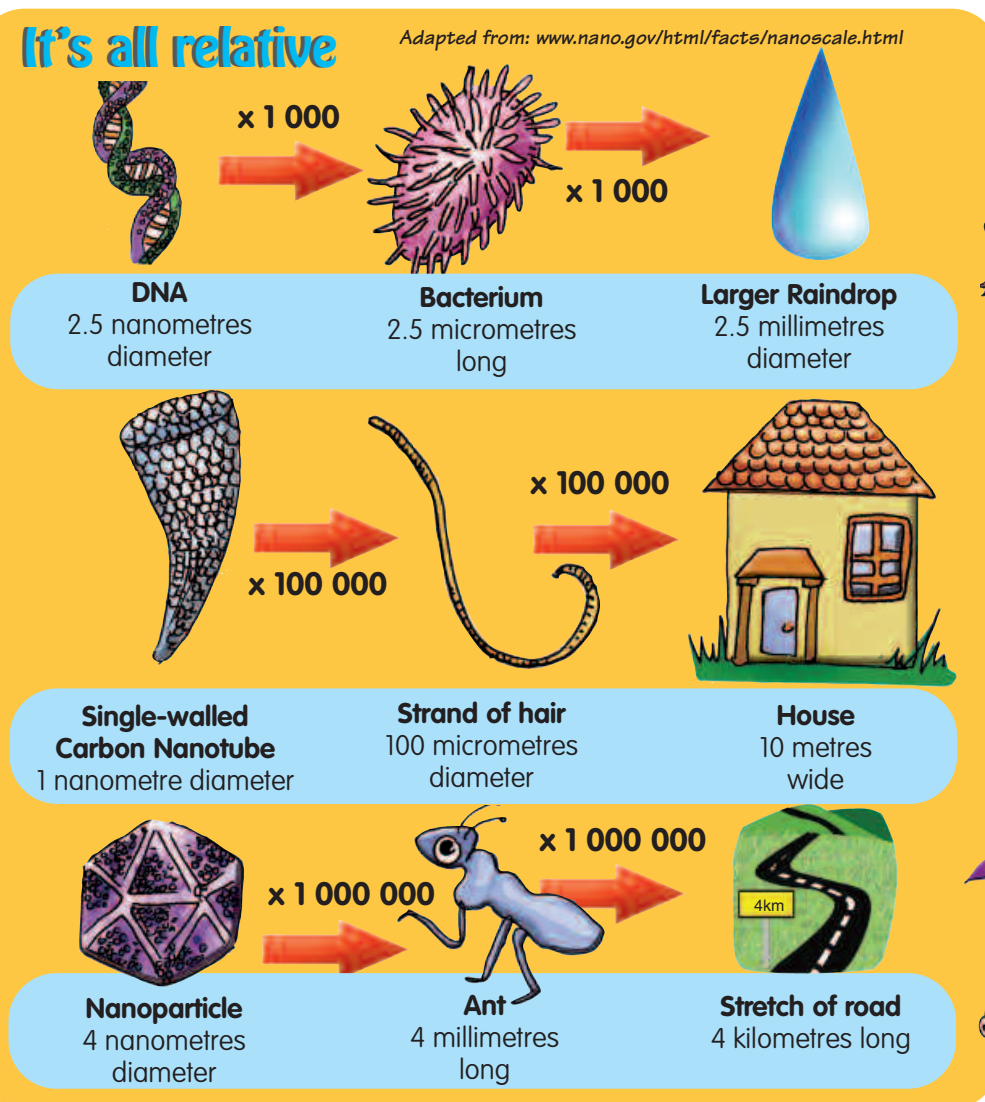
With super materials made up of nanostructures, scientists can deliver new technologies that will change our lives in many ways. In the nano future you could change the colour of your walls and clothes via a touch screen. Your speakers will be built into an invisible coating on your wall. Your clothes will never stain or get smelly. Smart socks will monitor your blood pressure and heart rate. Your shirt will keep you warm or cool and will warn you if the air you breathe is polluted. The pocket of your jeans will charge your iPod or cell phone. With an invisibly small camera implanted under your skin, you will never miss a photo opportunity!



- These are some of the future nano marvels. But, more importantly, scientists are working on thousands of "serious" nano innovations such as:
- ▶ Nanorobots that will deliver medicines directly to sick cells
 - ▶ Nanoparticles of insulin that can be inhaled through your lungs or absorbed through your skin – no more needles for diabetics!
 - ▶ Light and durable medical implants, bone and teeth replacements, as well as other body parts
 - ▶ Nutritious smart foods from crops that you can grow with very little land and water
 - ▶ Clean and renewable solar energy from panels as thin as a sheet of paper
 - ▶ Lighting that uses only a fraction of the energy required today
 - ▶ Quick and efficient cleaning of waste water and environmental spills
 - ▶ Smaller, lighter, more powerful and cheaper computers
 - ▶ High resolution displays that can be rolled up like a poster
 - ▶ Light, but ultra-strong materials to build anything from tennis rackets to aircrafts

While the large scale use of nanotechnology may take a few more years, you can already buy products with nano properties such as transparent sunscreens, silica dental fillings, stain resistant fabrics and self cleaning glass. Plasters and wound dressings with nanoscale silver particles kill bacteria and promote faster healing.

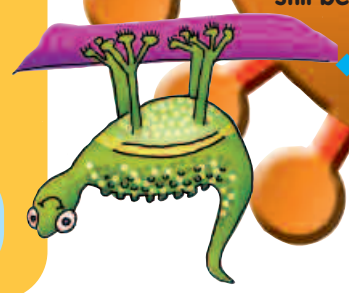
Some companies use the word 'nano' as a marketing tool to sell the idea of something small and high tech. Think of the 'Tata Nano', a car from India, and also Apple's iPod Nano. Although these products are definitely not at the nano scale, the iPod does use nanotechnology in the chips and circuitry that make it work.



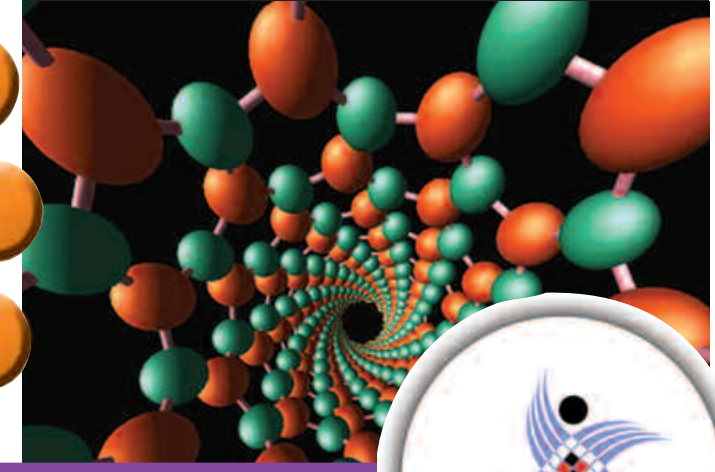
Amazing nanofacts

(Source: www.nanowhat.co.uk)

- ▶ A flea is approximately 1 million nanometres wide!
- ▶ Your fingernails grow at about 1 nanometre a second. That's 0.6 mm a week!
- ▶ A grain of sand on the beach takes about 34 million years to dissolve. A nanometre-sized grain of sand would dissolve in about 1 second!
- ▶ By 2015, the world will need 2 million people working in nanotechnology!
- ▶ Even if a gecko was 200 times heavier, it would still be able to walk on the ceiling – thanks to the nano hairs on its feet!
- ▶ If a seagull lands on the deck of an aircraft carrier, the ship will sink by 1 nanometre!



Marvel at the incredible beauty of the nanoscale
(and download a nano screensaver) at www.nsf.gov/news/overviews/nano/screensaver.jsp



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's understanding, appreciation and engagement with science and technology among all South Africans. Visit the website: www.sasta.ac.za for more information.



But, is it safe?

Nanotechnology has a huge potential for good, but it must be developed responsibly to avert possible risks and dangers. While scientists are working on cool new nano applications, they must also look at how nanotechnology may affect our societies and environment.

Most current and future nanotechnologies such as computer chips and catalysts, pose no new health or safety risks. This is because the nanomaterial is fixed onto a larger object and therefore is unable to stray into the environment. But some people are worried about manufactured nanoparticles that are free to move around. These particles are so tiny that they can easily cross biological membranes and enter the living cells in our bodies or in the environment. We don't yet have all the answers about how these nanoparticles may affect living cells and ecosystems. Therefore, scientists should acknowledge these uncertainties and proceed with utmost care.

Unless people understand and accept nanotechnology, it may be difficult or even impossible for scientists to bring nano innovations to the marketplace. Therefore, it is important that scientists listen to people's concerns and talk to them about what they are doing to ensure that the technology is safe.

Nano careers?

We are heading for an era of great nanotechnology discoveries and there will be many, exciting opportunities for thousands of nano pioneers who are enthusiastic about taking on these research challenges. Doing well in maths and science at school is the first step. At university you can do a broad based science or engineering degree followed by postgraduate studies in fields such as materials science and engineering or biotechnology. You are then on your way to embark on a career in fields such as nanomanufacturing, nanoanalytics, nanobiotechnology, nanoelectronics and nanomaterials.



Professor Tello Nyokong (left) is the Department of Science and Technology/National Research Foundation Chair of Medicinal Chemistry and Nanotechnology at Rhodes University and Director of the Nanotechnology Innovation Centre. She teaches classes on her subjects to students, from the first year to doctoral candidates and supervises numerous PhD studies. She is actively involved in research into the development of drugs for cancer and sensors for early detection of diseases.

Who's who in nanotech in South Africa?

Our government supports nanotechnology research via the Department of Science and Technology (DST). There are dedicated nanotechnology research groups at the CSIR and Mintek, working closely with several universities to find nanotechnology solutions relevant to South Africa's health, water, food and mining challenges. Find out more about the South African Nanotechnology Initiative (SANI) by visiting www.sani.org.za.

Nanotechnology is big on the Internet. Here are some good places to start surfing the nano wave:

- ◆ www.nano.gov
- ◆ www.nanoforum.org
- ◆ www.smalltalk.org.uk
- ◆ www.nanofolio.org

Find out how to organise a nanoday at <http://www.nisenet.org/nanodays/kit/digital>

Challenge your friends for a game where you have to make up your own minds about nanotechnology. Download the "DECIDE" nanotechnology card game at www.playdecide.org/download/nano/Nanotech_kit_uk.pdf

Educators can access free teaching modules, movies and animations at:

- ◆ www.nano.gov
- ◆ www.nanovic.com.au
- ◆ www.accessnano.org
- ◆ www.nanopolis.net
- ◆ www.mrsec.wisc.edu/Edetc



Buckyballs

Buckyballs are the foundation of nanotechnology. They are the roundest and most symmetrically large molecules known to man. These molecules are made up of 60 carbon atoms arranged in a structure that looks like a soccer ball (in chemistry this is written as C₆₀).

The full name for buckyballs is Buckminsterfullerenes. They are named after an American architect R. Buckminster Fuller who designed a similar shape called the 'geodesic dome'. These molecules have amazing properties and are a hot topic in research and development. For example, in medicine they are used to deliver drugs to the right spot inside the body and in manufacturing they are used to develop very strong materials such as diamond hard coatings for computer disc drives.

Make your own buckyball

You will need:

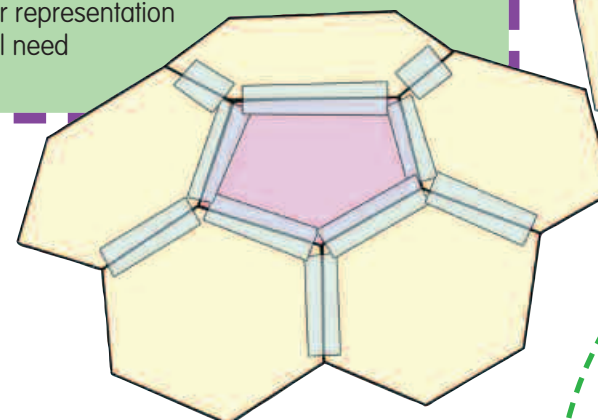
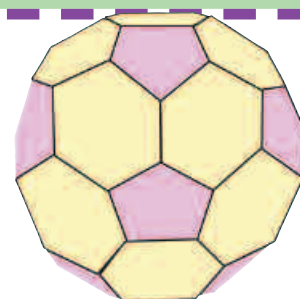
- Thin card (2 colours)
- Pencil
- Scissors
- Transparent sticky tape

Cut out the pentagon and hexagon shapes on this page. You can also resize the shapes by enlarging or reducing them on a photocopier to make larger or smaller buckyballs.

Trace 12 pentagons on one colour card and 20 hexagons on the other colour card. Cut them out carefully and very accurately.

Use the sticky tape to attach the shapes together, starting with a pentagon surrounded by five hexagons. You will notice that the shape curves upwards like a shallow bowl. Add five pentagons so that their corners fit into the gaps between the hexagons. Add five hexagons to the gaps between the pentagons. You have now built half the structure. Carry on in this way by adding five more hexagons, five pentagons, and five hexagons. Then add the final pentagon to form the soccer ball shape.

Try to build this structure with styrofoam balls and toothpicks, which will give you an even better representation of the buckyball structure. You will need 60 balls and 90 sticks.

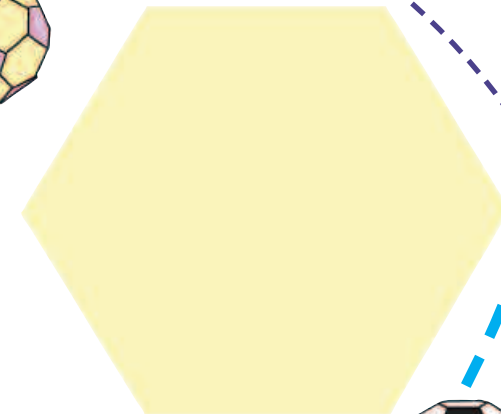


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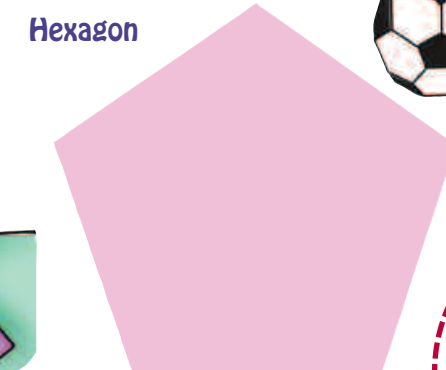
<http://invention.smithsonian.org/centerpieces/ilives/kroto/buckyball.pdf>

http://www.pbs.org/wgbh/nova/teachers/activities/pdf/2216_buckybal.pdf

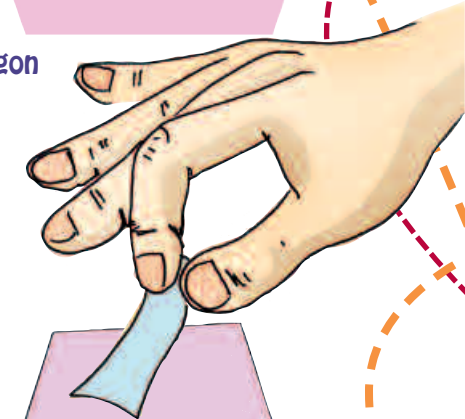
Cut Out



Hexagon



Pentagon



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