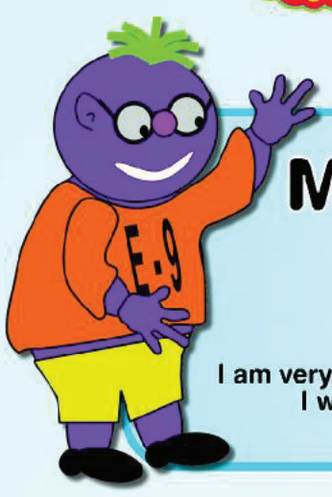
science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

The fascinating nano-world

nano-science and nano-technology by nanopopolos



MOLWENI ABANTWANA!

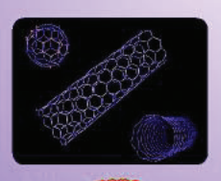
My name is nanopopolos

I am very, very small, and I live in a world where everything is also very, very small.
I will show you how small I am and why my world is important to you.
Come with me on a guided tour.

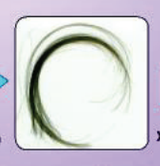
How small is my world?

In your world, you measure in metres, or kilometres (equal to 1000 metres), or even in millimetres (equal to one thousandth of a metre).

I measure in nano-metres, that is a MILLIONTH of a millimetre!
How small is one nano-metre? You can figure this out by comparing the sizes of the following objects.



x 100 000



x 100 000

Carbon nano tube: about 1 nanometre diameter

A single strand or hair: about 100 micrometre diameter (100 000 nanometres)

House: about 10 metres wide

nano technology needs science

nano science needs YOU

nano PAST

British Museum

Lycurgus cup (1600 years old) gold nanoparticles give the glass a red glow when illuminated from inside.

Platinum nanoparticles used in a car's catalytic converter.

nano FUTURE

M. Harting, UCT

silicon nanoparticles mixed in an ink, allows solar cells to be printed. This means you can charge your cell phone wherever you are.

Coneyl Jay, "Nanotechnology" 2002

Artist's view of a nanorobot injecting drug into a cell.

By the way, I am only 15 nano-metres tall. This is the reason why everyone call me nanopopolos.
nano means dwarf in the ancient Greek language.
I've blown myself up so that you cansee me.

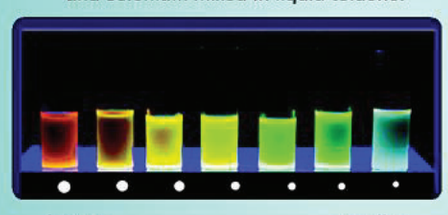
To magnify nano-objects you need a very high magnification.
The magnification needs to be so high that a magnifying glass or optical microscope won't help.

You will need an electron microscope. These are big and expensive.

FEI Titan at Virginia Tech, USA

My favourite: "Size and colour"

Here are nano particles made from the elements cadmium and selenium mixed in liquid toluene.



Larger nano particles

smaller nano particles

I love how beautifully they glow after they are exposed to light. (Scientists use the term florescence for this effect.)

Isn't it funny, if you change the size of the nano particles you get a different colour!

A funny idea! I will make a paint out of these nanoparticles, and paint my room with it. Then at night, I would have colourful lighting without a lightbulb.

How to make nano-sized things?

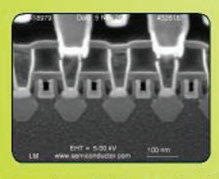
On the left is a nano-machine made from molecules.

BOTTOM-UP

means starting with atoms and molecules and putting them together to make something as big as me.

TOP-DOWN

means starting with a large piece of material and making it smaller, and smaller, and smaller ....



On the left are nano-sized transistors produced by cutting and etching a silicon wafer.

transistors in the new Intel Penryn chip

Difference between small things and LARGE things?

Try this MIND GAME:

Question 1: How many faces has a cube, e.g. this dice?
Question 2: If each side is 1 centimetre, what is its total surface area?
Question 3: If you cut the cube three times (vertically, horizontally and transversally) how many cubes will you have?
Question 4: If each side of every small cube is 0.5 centimetres, what will the total surface area be of all the small cubes?

different cuts

Yes, yes, yes!

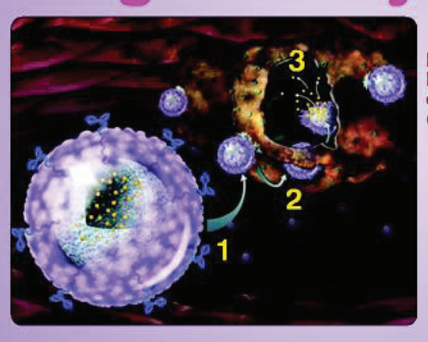
The answer is 12 cm². This is a much larger surface area than the 6 cm² surface area of the cube before cutting!

(pssst! You'll find the answers in the small box bellow.)

Given equal mass, smaller means more surface area!

ANSWERS
Question 1: 6
Question 2: 6cm²
Question 3: 8
Question 4: (0.5 cm x 0.5 cm = 0.25 cm²; 0.25 cm² x 8 = 2 cm²; 2 cm² x 6 =) 12 cm²

The other way around: Drug Delivery



A nanoparticle loaded with drug molecules.

Dangerous human cell e.g. a cancer cell

1. Nanoparticles are engineered to detect dangerous cells.
2. Nanoparticles are so small that they can enter the dangerous cell.
3. Once inside, the nanoparticle releases the drug to destroy the dangerous cell.

I can tell you drug delivery is a very hot field in science! Scientists can even attach smaller nanoparticles to the drug loaded ones, which act as light sources to monitor their movement.
The next box will show how it works.

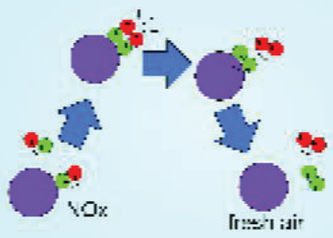
Why is a LARGE surface important?

Sugar dissolves faster when it is in powder form, and slower when it is in the form of a large lump.

SMALLER MEANS MORE REACTIVE

Here is one example of nanotechnology making our environment safer.

CLEANING CAR EXHAUST MORE EFFICIENTLY!!



NO_x the noxious (dangerous) exhaust gas is made up of molecules formed from oxygen atoms (red) and nitrogen atoms (green).

Fresh air is a mixture of oxygen molecules (red) and nitrogen molecules (green).

NO_x molecules stick to the reactive surface of the nanoparticles and cause them to break up. Oxygen and nitrogen atoms combine with other oxygen and nitrogen atoms to form oxygen and nitrogen molecules.

Result: the dangerous exhaust gas is changed to clean air!

University of Cape Town • iYunivesithi yaseKapa • Universiteit van Kaapstad

National Science Week

SAASTA
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