

## Introduction to Nanotechnology

“Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications.

### What is Nanometer?

Encompassing nanoscale science, engineering and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale.”

“The nanometre ([International spelling](#) as used by the International Bureau of Weights and Measures; SI symbol: nm) or nanometer ([American spelling](#)) is a unit of length in the metric system, equal to one billionth of a metre. [The nanometre is often used to express dimensions on an atomic scale](#)

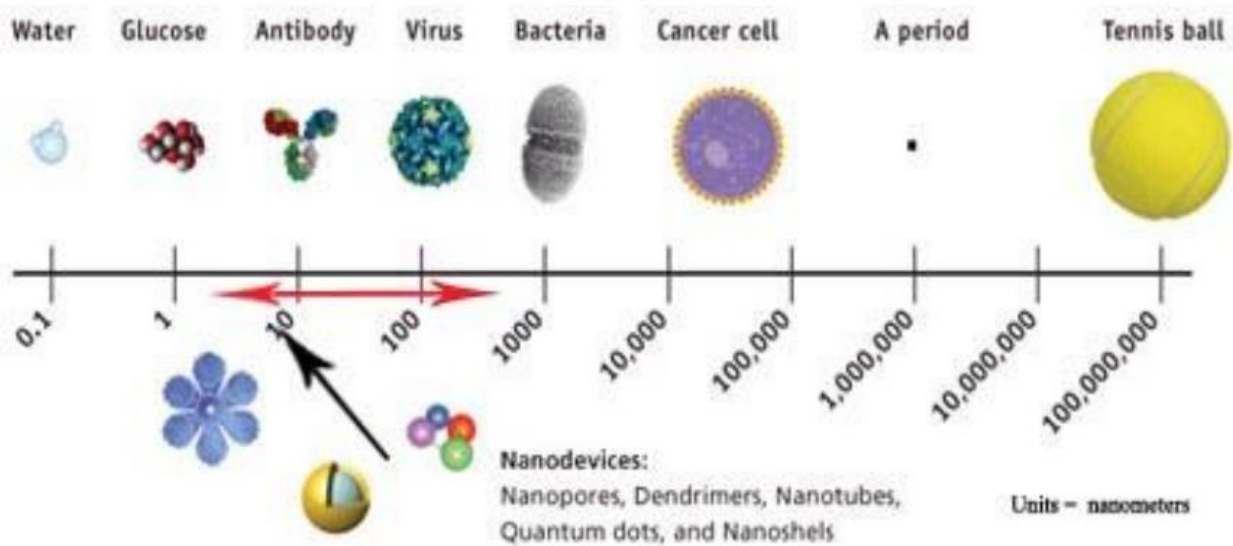
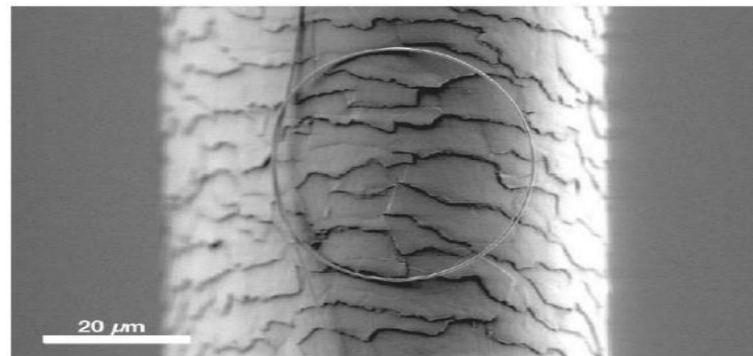
The name combines the SI prefix [nano-](#) (from the Ancient Greek νᾶνος, nanos, "[dwarf](#)") with the parent unit name [metre](#) (from Greek μέτρον, metron, "[unit of measurement](#)"). It can be written in scientific notation as  $1 \times 10^{-9}$  m, in engineering notation as 1 E-9 m, and is simply 1/1,000,000,000 m. One nanometre equals ten angstroms.

[It is a million times smaller than the smallest measurement you can see on a ruler !!!!!](#)



It is a millionth of millimeter or a billionth of a meter

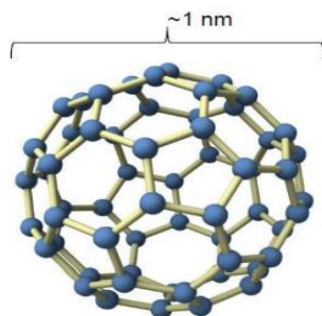
This is a silver nanowire resting on a human hair.  
Look at a strand of your own hair and imagine how small that is...



### Units in nanometers (nm)

What is a nanoparticle?

An example is a bucky ball  
- a fullerene



- ▶ Roundest and most symmetrical molecule known to man
- ▶ Compressed - becomes stronger than diamond
- ▶ Third major form of pure carbon
- ▶ Heat resistance and electrical conductivity

ratio  
earth / football

=

ratio  
football / fullerene



How big is 'nano'?

## Why is Small Good?

- Faster



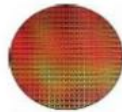
- Lighter



- Can get into small spaces



- Cheaper



- More energy efficient



- Less waste products, and uses less energy and materials to produce

- Different properties at very small scale

## Risks of Nanomaterials

### Health Risks

- Ultrafine particles can catalyze chemical reactions in the body
- Carbon nanotubes can cause infections of lungs
- They could easily cross the blood-brain barrier, a membrane that protects the brain from harmful chemicals in the bloodstream.

### Social and Ethical Risks

- More powerful weapons
- Privacy
- What happens to all the manufacturing jobs?