

# Nanophysics and Nanotechnology

## Teacher Notes

### Background

Nanotechnology is all about materials at the nanoscale, between approximately 1 and 100 nanometres. With the naked human eye we can see objects about 0.1 millimetres in size, standard microscopes can see objects down to 1 micrometer (0.001mm). Nanoscale objects can only be seen using very high powered and expensive microscopes like Atomic Force Microscopes and Transmission Electron Microscopes. Materials using nanotechnology are becoming more commonly used in everyday settings. Ultraviolet (UV) light protection in sunscreens and clothing can be provided by nanoparticles of titanium dioxide or zinc oxide, and nano particles of silver are used in wound dressings because of their antimicrobial properties.

These activities concentrate on understanding how small 'nano' is, and nanoscale carbon technologies, specifically carbon nanotubes.

Carbon is one of the elements that is a building block of everything we see around us. A carbon atom can make bonds with other carbon atoms in different ways. This gives the material that is made different properties. Graphite and diamond are both made of carbon atoms only. They have different properties because the bonds between the atoms have different arrangements. Another material that is made of carbon atoms only is graphene. A sheet of graphene is only one atom thick and can be rolled up in to tubes - a carbon nanotube. It is called a 'nanotube' because it is only one nanometre in diameter. The structure of carbon nanotubes mean that they have lots of properties that are useful to us - they can form ultra-high strength, low weight materials that conduct electricity and heat energy.

### Activity 1 - How Small is Nano?

This activity is to help understand how small things are when you talk about nanoscale. It involved students using multiplication and division to convert between units.

Equipment needed:

- Rulers
- Calculators

**Activity 2** - Build a 'Giant' Carbon Nanotube

The instructions are given to build a model of a carbon nanotube using mini marshmallows and toothpicks. This could be done in pairs or small groups.

It will need to be completed over two sessions as the marshmallows need 24 to 48 hours to dry out before attempting to make the cylinder shape in the last step.

Equipment needed:

- Mini marshmallows
- Toothpicks

**Activity 3** - Build a Carbon Nanotube Model

The template can be cut out and glued to form a model carbon nanotube.

Equipment needed:

- Scissors
- Glue