nanotechnology

this house believes that the potential benefits of nanotechnology outweigh the risks

the smallest scale

Think small. Think very, very small: so small you can't see it. So small it's hard to imagine.

In this field of science, things are measured in Nanometres (see fast facts). To see what's happening on the nanoscale you need incredibly powerful microscopes.

This is a huge area of study. It brings many branches of science together - from engineering to biology. It's about studying and making things on the nanoscale: sticking atoms and molecules together in new ways to make everything from computer chips to medicines. (Everything is made up of atoms including us).

At the nanoscale, materials have new properties. They're more reactive: colour, electrical conductivity and forces between particles are all different - so materials may be stronger or harder. Consider carbon: carbon nanotubes about 2 nanometres in size are 100 times stronger than steel. Or Zinc oxide, which is used in some sunscreens. Large particles of zinc oxide block harmful UV light, scatter visible light and appear white. But nanoparticles of zinc oxide don't scatter visible light because they are so small compared to the wavelength of visible light, that they appear clear. So no more smears of white when you don't rub sunscreen in properly.

nature did it first

Scientists can learn from what has evolved in nature. Engineers are exploring how the shells of marine animals withstand huge pressures, for example. This knowledge will help make lighter and stronger materials for cars and aircraft.

Nature was the inspiration for stain-resistant fabric. The leaves of plants like the Lotus or nasturtium are covered with waxy crystals only 1 nanometre in diameter. They form a coating which causes water droplets to run off the leaves, taking dirt with them. Scientists have used the idea to create nanoparticles that stick to clothing to make it repel dirt or soak up water.

At the moment scientists are adding nanoparticles to existing materials to create new products: ultimately the dream is to build materials up atom by atom, so there's no waste.

Advances in nanotechnology are making possible huge advances in biology. For example, scientists believe that the building blocks of life can all be made synthetically, so we can give new properties to bacteria so they could make things like rubber, and fuel, and even absorb greenhouse gases.

Nanotechnology will affect every area of our lives, from our food and houses to medicines and cars. Scientists imagine creating tiny preprogrammed nanoparticles - which could travel round the body, to repair damaged cells or deliver drugs to a diseased organ. Nanotechnology has been used to create the world's first artificial trachea (breathing tube) which was successfully transplanted into a patient with terminal tracheal cancer in July 2011.

Scientists at IBM have developed a nanoparticle 50,000 times smaller than a human hair which can destroy the cell walls of antibiotic-resistant bacteria. The nanoparticle works in the lab, but still has to be tested on animals. Could this spell the end for hospital superbugs, which kill hundreds of patients a year?

pros and cons

Potentially, nanotechnology offers huge benefits. But will there be unwanted side effects? As advances allow computers to get smaller and smaller, will nano-sensors we cannot see end up watching our every move?

No-one yet knows what the impact will be of tiny nanoparticles on human health, or the environment. Silver nanoparticles are already being used to make socks which destroy odour-causing bacteria; and in bandages which destroy harmful bacteria. But they also destroy useful kinds of bacteria. So what happens when they get into our water supply, or soil? Remember how small nanoparticles are - they will be able to cross cell walls in animals and in humans.

The food industry is trying to exploit nanotechnology to use in packaging to detect when foods are spoiled; and to deliver food that would change flavour, colour or nutrients as the consumer decides. Food scientists are working on less fattening fat; and even trying to build food with all the attributes we want, from the bottom up. Remember Willy Wonka's three course dinner chewing gum? Scientists now know how to achieve this, there's just the small problem of getting the taste right.

Nanotechnology - polymer art glass (photo Argonne National Laboratory)

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fast facts

- The nanoscale is defined as anything less than 100 nanometres. 1 nanometre = a billionth of a metre. To give you an idea of what that means: an atom is 0.1 nanometres; a piece of paper is about a million atoms thick - or 100,000 nanometres; a human hair is about 10,000 nanometres thick.

- On the nanoscale, materials have new properties: optical, magnetic, chemical and physical properties are different.

- Nature has been working at the nanoscale for a very long time, and has evolved hugely complex cellular structures.

- Nanotechnology particles are already used in sunscreens; tennis racquets, self cleaning glass; anti-bacterial bandages; stain resistant clothing; solar panels; and computing (Intel has used nanotechnology to make computer chips since 2000).

- The idea to make things at the nanoscale came from the Nobel prize winning physicist Richard Feynman, way back in 1959, before any technology existed to make it a reality.

Students weigh chemicals for testing
(photo Argonne National Laboratory)

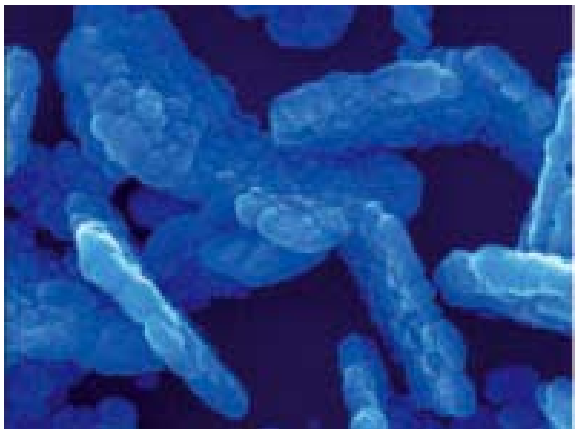
find out more

http://www.sciencemuseum.org.uk/antenna/nano/
Bite-sized and fascinating explanation of how nanotechnology is being used

http://www.at-bristol.org.uk/cz/teachers/Nano%20pairs.pdf
A pairs game to stimulate discussion on the pros and cons of nanotechnology

http://www.nanooze.org/
Cornell university site explores recent discoveries and what they might mean + Q &A sessions with young scientists

http://nobelprize.org/educational/physics/microscopes/1.html
Describes different types of microscopes and how they help scientists. You can try the techniques using simulators



Silver nanoplates (photo Argonne National Laboratory)

questions to ask

- How is nanotechnology being used?
- How could it be used?
- How will it affect us? Is it safe?
- Who decides if nanotechnology is safe?
- How do we control nanoparticles in our environment; or artificial organisms we create?
- Could we build 'better' humans?
- If nanotechnology extends healthy human life by say 10 or 20 years or more, what are the implications?

nanotechnology in fiction

Be More Chill	Ned Vizzini
The Diamond Age	Neal Stephenson

alternative motions: this house...

...would encourage nanotechnology research for human advancement
...would not use nanotechnology to create artificial life
...would use nanotechnology to monitor its citizens