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Science Dissected

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It's a *VERY* Small World After All

Nanoscience is an emerging multidisciplinary field that investigates the behavior and properties of materials at the nanoscale (1-100nm). The particles being manipulated at the nanoscale are *very* small. The nanoscale scale is so small that it may be difficult for students to comprehend it without placing the units into perspective. For example, a sheet of paper is one million nanometers thick. A red blood cell is 2,500 nm in diameter. The diameter of a DNA molecule is 2.5 nm. In fact, nano-sized particles are so small that they cannot be viewed with a light microscope. Researchers need to use tools such as a scanning tunneling microscopes to observe objects at the nanoscale. Scientists who study nanotechnology are researching materials that are the size of one billionth of a meter.

Nanoscience is an intriguing field because materials act very differently at the nanoscale level compared to when they are available in bulk form. Some materials change color as their particle sizes decreases, are stronger, or are better at conducting heat or electricity. Scientists are researching the nanoworld to enhance many products we come in contact with every day. For example, stain resistant fabrics work by embedding nano-sized particles into the fibers to repel water and basic substances. Sunscreens and cosmetics contain nano-sized particles of zinc oxide to reflect UV light and remain transparent on the skin. Nanoscale tubes of carbon are used to manufacture tennis racquets, bicycles, baseball bats, and car parts.

Researchers have been studying materials at the nanoscale for approximately two decades. The possible applications of nanotechnology are currently being discovered. The potential for nanotechnology in the medical field may lead to nanoscale machines delivering medicine to specific cells. Researchers are also experimenting with nanoscale membranes to filter and desalinate water. The University of California, Berkeley is developing solar plastics that use polymers to capture solar energy. There is also the potential to enhance the power and efficiency of electronic switching devices used in computers.

As researchers learn how to apply the properties of materials at the nanoscale, the social and environmental implications must also be considered. If nanoscale particles are used in manufacturing clothing, food preservation, and to filter the water supply, then scientists need to determine if they will cause any biological disruptions in the organisms that come into contact with the products. Concerns with the new technology include developing sensors that could invade your privacy by tracking your merchandise purchase history or assessing your potential risk as you board an airplane. Militaries may also develop new weapons that incorporate nanotechnology. The future societal and environmental implications of nanotechnology depend upon how the technology is used.

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Nanoscale: How Small is a Nanometer?

- *A nanometer is one billionth of a meter*

  1m = 1,000,000,000nm
- *A sheet of paper is 1,000,000 nm thick*
- *Diameter of a DNA molecule is 2.5nm*
- *A nanometer is smaller than the wavelength of visible light*

Products Containing Nanoscale Materials

* Stain-resistant fabrics
* Car bumpers
* Active (self-cleaning) glass
* Scratch resistant coatings
* Antimicrobial coatings
* Dental bonding agent

Did you know?

Nanoscience is the central theme of the High School PASS & Middle School MIST Summer Science Institutes.

Sources and Related Links

Nanotechnology: *Big Things from a Tiny World*: www.nano.gov/Nanotechnology_BigThingsfromaTinyWorld.pdf
How Nanotechnology Works: http://science.howstuffworks.com/nanotechnology.htm