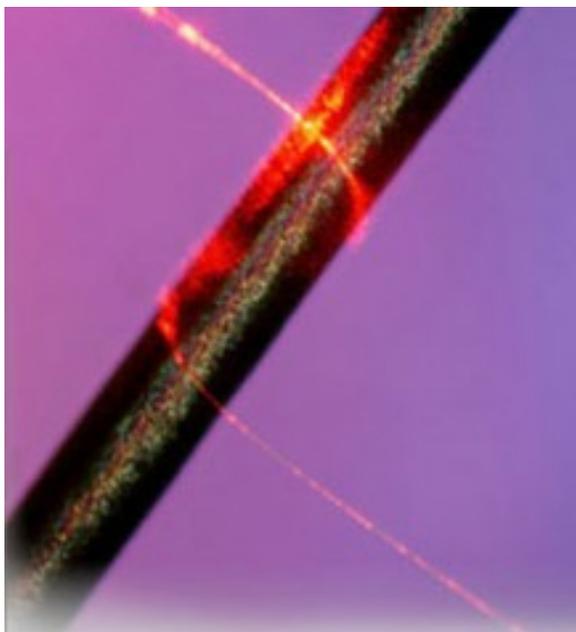


## Intro to Nano: Think Small

During the second half of the twentieth century, scientists and engineers learned to observe, measure, and manipulate individual atoms and molecules. The areas of research related to this activity—known as nanoscience and nanotechnology—are leading to the creation of materials, processes, and technologies that many scientists believe will dramatically change our daily lives.

To understand nanotechnology, you have to think small. Nanotechnology and nanoscience involve unimaginably tiny objects, which are measured in a ridiculously small unit of measurement: the nanometer. A nanometer is one-billionth of a meter (a billion being 1,000,000,000)—in other words, really really small.



*A light-conducting silica nanowire wraps a beam of light around a strand of human hair.*

## Smaller Than You Think

Here are a few facts that may help you begin to understand how small a nanometer is:

- The size of a nanometer compared to a meter is like the size of a marble compared to the earth.
- A human hair is about 50,000 nanometers in diameter.
- Five carbon atoms in a row fill a distance of one nanometer.

A billion—the number of nanometers in a meter—is a very big number. A billion is approximately three times the population of the United States. It's the approximate number of letters in 6,000 books of 500 pages each. A billion seconds is about 32 years. A billion is the number of dollars the U. S. government spent on research and development related to nanotechnology in 2005.

Are you having trouble imagining a nanometer? If you are, don't feel bad. You aren't alone.

Don Eigler, the nanotechnology pioneer who first arranged xenon atoms to spell out IBM, regularly works at the nanometer scale and has a gut-level feel for how atoms behave. But even Don Eigler admits that he has a hard time imagining a nanometer in relation to a meter.

Imagining one part in ten is easy, Eigler says, since most people have ten fingers. Imagining one part in one hundred is manageable. Most people can even imagine one part in a thousand: If you have to take a thousand steps to get somewhere, you can imagine that. But larger numbers are a problem.

There are a billion nanometers in a meter. Those numbers are very difficult—maybe impossible—for most of us to imagine.

To talk about nanotechnology, we need to talk about the nanoscale world, where objects are measured in nanometers. But don't worry if you can't imagine a nanometer. Though size is the distinguishing feature of the nanoscale world, it isn't what makes this world so interesting to researchers.