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What is Nanotechnology?

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Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers.

Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering[1].

Today, in the young field of nanotechnology, scientists and engineers are taking control of atoms and molecules individually, manipulating them and putting them to use with an extraordinary degree of precision. Word of the promise of nanotechnology is spreading rapidly, and the air is thick with news of nanotech breakthroughs. Governments and businesses are investing billions of dollars in nanotechnology R&D, and political alliances and battle lines are starting to form. Public awareness of nanotech is clearly on the rise, too, partly because references to it are becoming more common in popular culture - with mentions in movies, books, video games, and television.

Yet, there remains a great deal of confusion about just what nanotechnology is, both among the ordinary people whose lives will be changed by the new science, and among the policymakers who wittingly or unwittingly will help steer its course. Much of the confusion comes from the name "nanotechnology," which is applied to two different things, that is, to two distinct but related fields of research, one with the potential to improve today's world, the other with the potential

to utterly remake or even destroy it. The meaning that nanotechnology holds for our future depends on which definition of the word "nanotechnology" pans out. The ideas and concepts behind nanoscience and nanotechnology started with a talk entitled "There's Plenty of Room at the Bottom" by physicist Richard Feynman at an American Physical Society meeting at the California Institute of Technology (CalTech) on December 29, 1959, long before the term nanotechnology was used. In his talk, Feynman described a process in which scientists would be able to manipulate and control individual atoms and molecules. Over a decade later, in his explorations of ultra precision machining, Professor Norio Taniguchi coined the term "nanotechnology". It wasn't until 1981, with the development of the scanning tunneling microscope that could "see" individual atoms that modern nanotechnology began.

It's hard to imagine just how small nanotechnology is. One nanometer is a billionth of a meter, or 10^{-9} of a meter. Here are a few illustrative examples:

- There are 25,400,000 nanometers in an inch.
- A sheet of newspaper is about 100,000 nanometers thick.
- On a comparative scale, if a marble were a nanometer, then one meter would be the size of the Earth.

Nanoscience and nanotechnology involve the ability to see and to control individual atoms and molecules. Everything on Earth is made up of atoms — the food we eat, the clothes we wear, the buildings and houses we live in, and our own bodies.

However, something as small as an atom is impossible to see with the naked eye. In fact, it's impossible to see with the microscopes typically used in a high school science classes. The microscopes needed to see things at the nanoscale were invented relatively recently — about 30 years ago [2].

Once scientists had the right tools, such as the scanning tunneling microscope (STM) and the atomic force microscope (AFM), the age of nanotechnology was born.

Although modern nanoscience and nanotechnology are quite new, nanoscale materials were used for centuries. Alternate-sized gold and silver particles created colors in the stained glass windows of medieval churches hundreds of years ago. The artists back then just didn't know that the process they used to create these beautiful works of art actually led to changes in the composition of the materials they were working with [3].

Today's scientists and engineers are finding a wide variety of ways to deliberately make materials at the nanoscale to take advantage of their enhanced properties such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger-scale counterparts.

References:

1. Mode of access: http://www.nanotechnology.com/Press_Kit/nanotechnology-history.htm. – Date of access: 23.04.2016.
2. Mode of access: <https://en.wikipedia.org/wiki/Nanotechnology>. – Date of access: 22.04.2016.
3. Mode of access: <http://www.crnano.org/whatis.htm>. – Date of access: 22.04.2016.