

First Chapter Lesson-9: Nanotechnology and Its Application areas.

At the end of this lesson-

- 1. You will be able to explain Nanotechnology.
- 2. You will be able to explain the uses of Nanotechnology.
- 3. You will be able to explain the advantages and disadvantages of Nanotechnology.

Nanotechnology:

The concepts that seeded nanotechnology were first discussed in 1959 by renowned physicist Richard Feynman in his talk *There's Plenty of Room at the Bottom*, in which he described the possibility of synthesis via direct manipulation of atoms.

According to Online Dictionary,-

“Nanotechnology is a branch of technology where manipulation of matter on an atomic and molecular scale to create many new materials and devices.”

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

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

Two main approaches are used in nanotechnology. In the “bottom-up” approach, materials and devices are built from molecular components which assemble themselves chemically by principles of molecular recognition. In the “top-down” approach, nano-objects are constructed from larger entities without atomic-level control.

Uses of Nanotechnology:

Computer Hardware Manufacture: Nanotechnology is also related to computers. The processor that is inside the computer is a circuit of numerous small nanometer scale. And it is used in nanotechnology. In Intel processors, the circuit is patterned on silicon and its current size is 100 nanometers. In the future, its size will be 50 nanometers. The capacity to store data on a computer's hard disk is increasing day by day due to the application of nanotechnology.



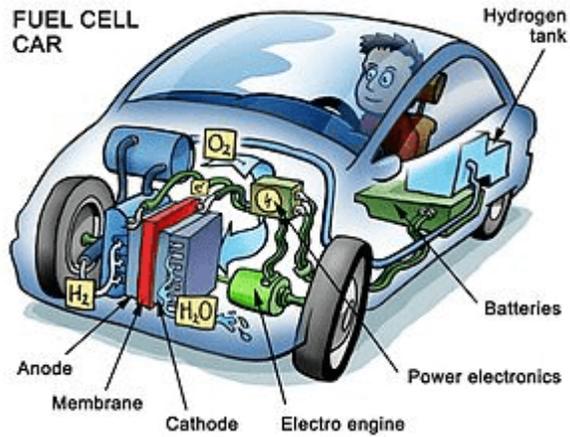
Nano Robot: The study of the creation of tiny robots using nanotechnology is under way, which will help the surgery of the human body.



Electronic Devices: As a result of the use of nanotechnology, electronics devices are small in size, light in weight and energy-efficient.



Fuel Cell: Nanotechnology is being used to create low-cost fuels, and fuel cells for various types of batteries.



Packaging & plating: Nanotechnology is being used in packaging and plating of various food products.



Drug: Nanotechnology is being used in the pharmaceutical industry to make smart drugs.



Sports Tools: Nanotechnology is being used to increase the stability of tennis balls, to keep the direction of the golf ball in the air, to increase the strength and stability of the racket.



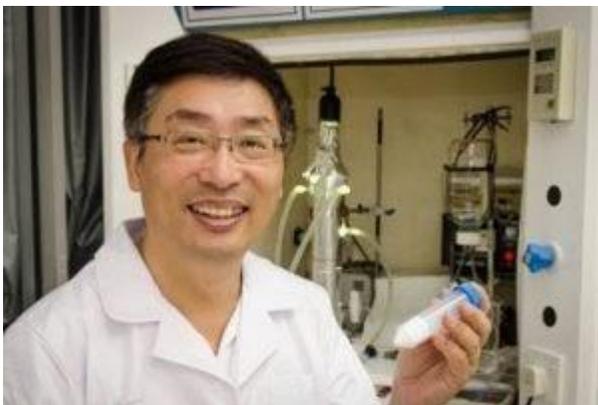
Textile Industry: Nanotechnology is being used to adjust the weight and density of fabrics in the textile industry.



Artificial Limbs: With the help of nanotechnology, it is possible to create various artificial Limbs.



Titanium Dioxide: Nanotechnology is used in the production of titanium dioxide which is used in sunscreen.



Air Purification: With the help of nanotechnology through chemicals reaction, air purification can be done by converting harmful smoke emitted from the factory to



non-harmful gas.

Space Exploration: Nanotechnology is used to lighten the various objects used in space operations.



Advantages of Nanotechnology:

- Longer lasting, small in size and light weight devices can be manufactured with this technology.
- “Smart drug” is an implementation of nanotechnology that helps cure people faster and without the side effects.
- Revolutionary development in electronics industry with the invention of Nano transistor, Nano diode, plasma display etc.
- Batteries, fuel cells, and solar cells can be built smaller but can be made to be more effective with this technology

Disadvantages of Nanotechnology:

- Atomic weapons can now be more accessible and made to be more powerful and more destructive. These can also become more accessible with nanotechnology.
- Presently, nanotechnology is very expensive and developing it can cost you a lot of money
- Nanoparticles are harmful to the human body.

Lesson Evaluation-

Knowledge Based Questions:

- a. What is Nanotechnology?

Comprehension Based Questions:

- b. Explain the technology of molecular level research.
- b. “Nanotechnology can be harmful to health”-Explain.

Creative Questions:

Read the stem and answer the question:

Chips are very favorite to everyone. A special technology is used during Chips packaging. To ensure the safety of the chips factory, a device has been set up to give fingerprints at the entrance.

d) Analyze your opinion with the advantages and disadvantages of the technology used in the chipset.

Read the stem and answer the question:

Scientists at the research firm Alpha are trying to create a molecular level device for applying drugs directly to diseased cells. They create a simulated environment to monitor the internal structure and cells of the brain.

d) Analyze how the technology of making device mentioned in the stem has an impact on the food industry.

Read the stem and answer the question:

Mr. Shihab is an aviator. He purchased a 1-terabyte hard disk from a computer fair. He was surprised to find it was quite small. Due to the advancement of technology, the size of various devices is getting smaller. Now airplane training is provided in a computer controlled environment without the use of real aircraft.

c) Describe the technology that is being used to increase the capacity of small-scale hard disk.

Multiple Choice Questions:

1. 1 Nano Equivalent is-

- a) one hundred percent of a billion b) one percent of a million
c) one-tenth of a million d) one-tenth of a billion

2. One nanometer is equal to how many meters?

- a) 10^{-6} m b) 10^{-7} m c) 10^{-8} m d) 10^{-9} m

3. At the molecular level, the science of changing and controlling substances is called –

- a) Genetic engineering b) Nuclear engineering c) Bioinformatics d) Nanotechnology

4. What is the father of nanotechnology?

- a) Johannes Mendes b) Louis Pastor c) Richard Fineman d) Marshall MacLuhan

5. How many nanometers are less than the dimensions of objects in which nanotechnology is employed?

- a) 1 b) 10 c) 100 d) 10000