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Study of Nanotechnology with the Help of Cartoons

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ABSTRACT

Nanotechnology is field of research and innovation which covers a vast and diverse array of devices derived from engineering, biology, physics and chemistry. These devices include Nano vectors for the targeted delivery of anticancer drugs and imaging contrast agents. Nanowires, Nano robot, Nano eggs and Nano cantilever arrays are among the leading approaches under development for the early detection of precancerous and malignant lesions from biological fluids. These and other Nano devices can provide essential breakthroughs in the fight against cancer. This paper mainly contains about Nanotechnology and its 'various' applications. And this tells about the history of Nanotechnology and its necessity. This also discusses how it will improve our lives and about the applications in wide range. Here in my study I use cartoons to make nanotechnology an easy and interesting one.

I. INTRODUCTION

While delivering a lecture in an Asian conference held at National University of Singapore, Singapore, Pradeep K. Srivastava used few science cartoons in order to make his lecture more informative, interesting and impactful. He coined a new name for such cartoons - SCIENTOONS.

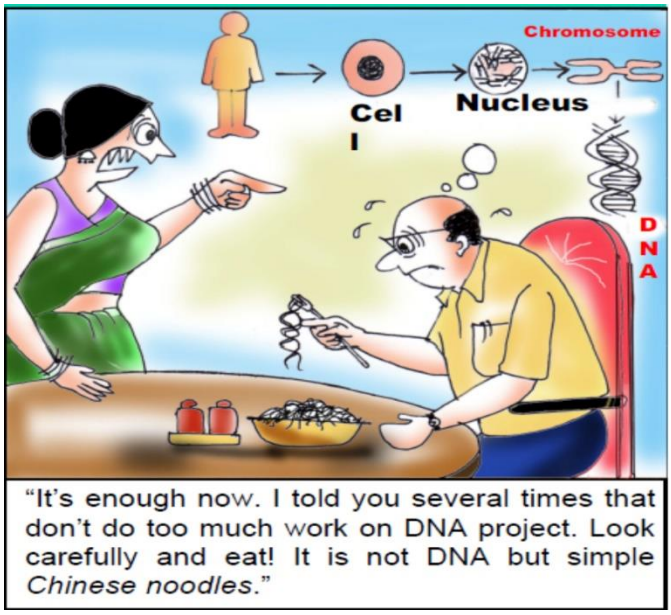
Pradeep K. Srivastava

Scientoons are the cartoons, based on science. they not only make you smile and laugh but also provide information about new researches, subjects, data & concepts in a simple, understandable and interesting thought provoking way.

Scientoonics is a new branch of science that deals with effective science communication by using a novel class of science cartoons called scientoons.

NOODLE NOT DNA

On April 2, 1953, American Biologist James D. Watson and French Physicist Francis H. Crick proposed a double helical structure of DNA (Deoxy Ribo Nucleic Acid), which is tightly packed in the 46 chromosomes in each of the 100 trillion cells of human body. DNA is a hereditary material through which traits are transferred from one generation to another.



ROAD NOT LAB

The Zig Zag movement of the suspended particles in a fluid medium is called Brownian Movement

II. FAMOUS TALK OF RICHARD FEYNMAN

In 1959 Richard P. Feynman with his famous talk "There is plenty of room at the bottom" predicted that one day we will be making things at the atomic level. And since these small things will build upwards we will be able to make them more precisely and control what we want them to do. This prediction became true at the turn of the century with the onset of nanoscience and technology and the rest is history. Nanotechnology deals with the design, characterization, production, and application of structures, devices, and systems by controlled manipulation of size and shape at the nanometer scale (atomic, molecular, and macromolecular scale) that produces structures, devices, and systems with at least one novel/superior characteristic or property. The most important characteristic of materials that are produced from nanotechnology is that they have bigger surface/volume relation desirable for many applications. Another important characteristic is related with quantum physics because nanotechnology allows us to make materials in one dimension (nanowires), in two dimensions (nanotubes) or in all three dimensions (nanoparticles), very desirable in products related with industrial uses.

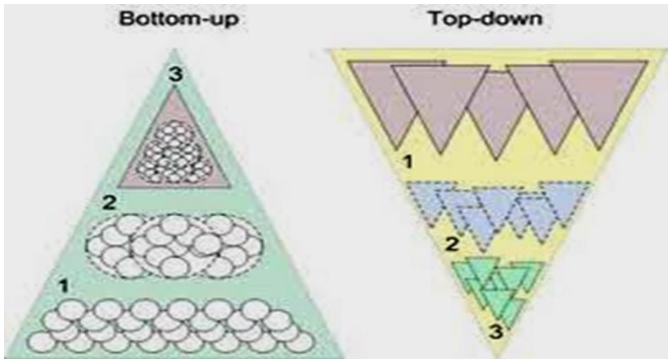
Physicist Richard Feynman

ORIGIN OF NANOTECHNOLOGY

K. Eric Drexler author of the book Engines of Creation (1985) which has advocated nanotechnology as a solution to a vast range of problems of mankind, popularized the word 'NANOTECHNOLOGY' in the 1980's, he was talking about building machines on the scale of molecules, a few nanometers wide—motors, robot arms, and even whole computers, far smaller than a cell. Drexler spent the next ten years describing and analyzing these incredible devices, and responding to accusations of science fiction

Nanotechnology is the design, characterization, production, and application of structures, devices and systems by controlling shape and size at nanometer scale. Nano in Greek means “dwarf”. A nanometer is one-billionth of a meter (10-9 m): ten times the diameter of hydrogen atom. The diameter of human hair is, on an average 80,000 nanometer.

III. BASIC STRATEGIES OF NANOTECHNOLOGY



1. Top-Down Approach

A top-down is essentially the breaking down of a system to gain insight into its compositional sub-systems. In a top-down approach an overview of the system is formulated, specifying but not detailing any first-level subsystems. Each subsystem is then refined in yet greater detail, sometimes in many additional subsystem levels, until the entire specification is reduced to base elements. A top-down model is often specified with the assistance of "black boxes", these make it easier to manipulate. However, black boxes may fail to elucidate elementary mechanisms or be detailed enough to realistically validate the model. Top down approach starts with the big picture. It breaks down from there into smaller segments.

2. Bottom- Up Approach

A bottom-up approach is the piecing together of systems to give rise to grander systems, thus making the original systems sub-systems of the emergent system. Bottom-up processing is a type of information processing based on incoming data from the environment to form a perception. Information enters the eyes in one direction (input), and is then turned into an image by the brain that can be interpreted and recognized as a perception (output). In a bottom-up approach the individual base elements of the system are first specified in great detail. These elements are then linked together to form larger subsystems, which then in turn are linked, sometimes in many levels, until a complete top-level system is formed. This strategy often resembles a "seed" model, whereby the beginnings are small but eventually grow in complexity and completeness. However, "organic strategies" may result in a tangle of elements and subsystems, developed in isolation and subject to local optimization as opposed to meeting a global purpose.

IV. NANOMATERIALS:

Materials reduced to the nanoscale can suddenly show very different properties compared to what they exhibit on a macroscale, enabling unique applications. At such scales, the ordinary rules of physics and chemistryno longer apply.The materials characteristics such as colour, strength,conductivity and reactivity can differ substantially between the nano-scale and the macro scale. Opaque substances become transparent (copper). Insulators become conductors (silicon). Gold is chemically inert at normal scales, can serve as a potent chemical catalyst at nanoscales. Opaque substances become transparent (copper) Insulators become conductors (silicon). Gold is chemically inert at normal scales, can serve as a potent chemical catalyst at nanoscales.

V. TYPES OF NANOMATERIALS

1. CARBON BASED MATERIALS

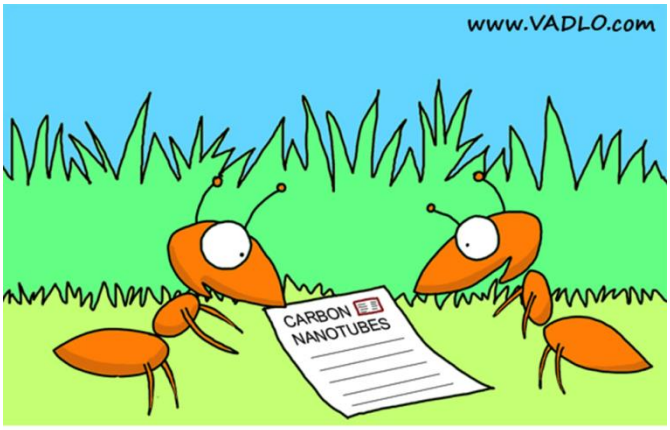
These nano particles are composed of entirely carbon taking the form of hollow sphere, ellipsoid, or tube. Ex Fullerenes, Buckminster Fullerenes, Carbon Nano Tubes, etc

2. METAL BASED MATERIALS

These nano particles' are generally composed of conductors and semiconductors. Ex Quantum dots, Gold, silver, iron, platinum and titania nano particles

VI. CARBON NANOTUBES

A tube with nano scale dimensions, which are sheets of graphite rolled upto make a tube. The dimensions are variable. With remarkable tensile strength, carbon nanotubes exhibit varying electrical properties. These can be insulating, semiconducting or conducting.



"Finally, we can drink Coke with a straw."

HYDROGEN STORAGE

Over the past few decades, the fields of science and engineering have been seeking to develop new and improved types of energy technologies that have the capability of improving life all over the world. In order to make the next leap forward from the current generation of technology, scientists and engineers have been developing energy applications of nanotechnology.

Nanotecnology will play an important role in the field of " Energy". Natural resources like oil, coal, natural gas etc required for all transportation, communication, agriculture, industry, houses and many other human activities are limited and depleting very fast. The future generation will have to look for alternative energy sources. Hydrogen has great potential as an

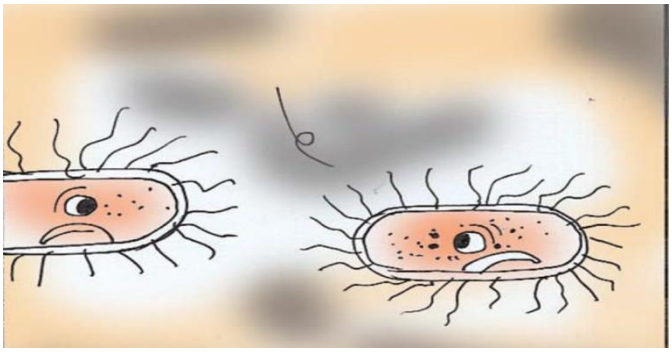
alternative source. Unlike petroleum it can be easily generated from renewable energy sources. It is non polluting.

"We have already used alternative source of energy"

Hydrogen as a part of water molecule is abundant on earth. Dissociation of water into hydrogen and oxygen is not a difficult process. Therefore abundant hydrogen fuel can be made available. When hydrogen fuel is burnt, it can only produce harmless water vapour. However main problem of using hydrogen fuel is its storage. Hydrogen gas is normally stored in a metal cylinder under high pressure. Carrying metal cylinders under high pressure not only can add to the weight of the vehicle but it dangerous also. Hydrogen in contact with air can catch fire. So the only solution is to store it in "Nanocylinder" of carbon nanotube. This could be a potent source of aero space engines and other industrial processes.

NANOBREEZE

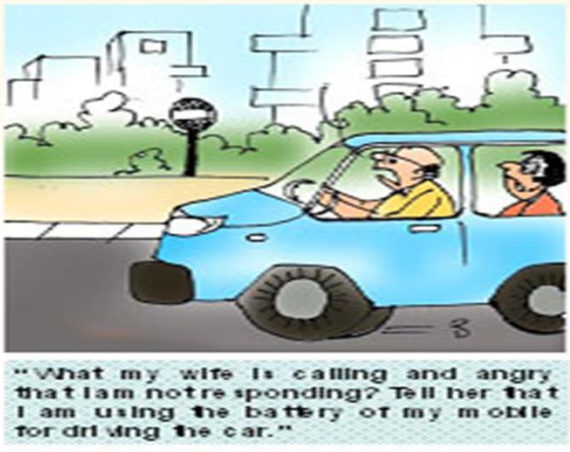
To purify the indoor environment, the NanoBreeze Room Air Purifier uses patented photocatalytic nanotechnology to clean and purify indoor air.
Technology consists Titanium dioxide (TiO2) crystals, only 40 nanometers in size, form a molecular machine powered by light. TiO2 is a semiconductor charged by ultraviolet photons. When these nanoparticles are charged, powerful oxidizing agents called hydroxyl radicals are produced. These free radicals destroy airborne germs and pollutants that circulate over the surface of the patented light tube inside the NanoBreeze Air Purifiers.



"We must leave this country immediately and Settle in any most backward countries only then we can survive."

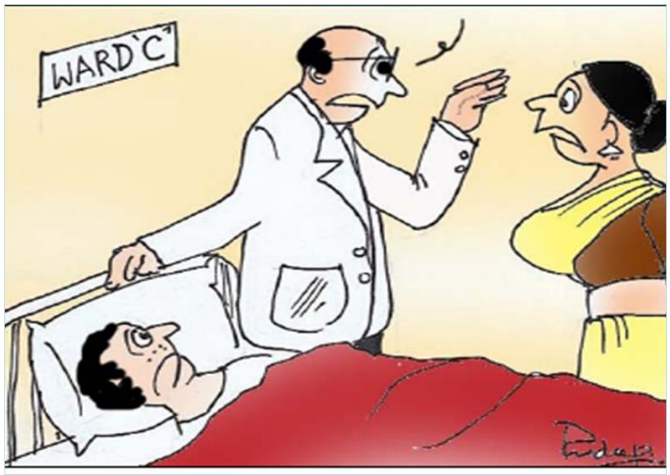
NANOBATTERIES

Numerous gadgets like laptops, cellular phones, cordless phones, portables radios, calculators etc need rechargeable light weight batteries or cells. Presently , the batteries for such gadgets need to be either replaced with new ones recharged quite frequently due to their low energy density or storage capacity. Attempts are being made to increase their energy density using metal hydride nano particles(Nickel hydride, aerogel etc)
Nano structured materials offer a tremendous potential for developing high power density Lithium ion batteries with high rate capabilities.
Trapped lithium in carbon nanostructures could help to make rechargeable nano battery for next generation communication and remote sensing devices. Or simply evaporate. Even drops of water on gass give hazy look.



NANO EGGS

The core shell nanostructure could be considered as nanoeggs. Honkong university of science and technology has developed a nanoscale egg that could safely deliver platinum a known Anticancer agent to tumar cell. The nanoscale egg having the hard cobalt shell surrounding a yolk of platinum and iron, show that it is seven more toxic than the Anticancer agent Cis platin to cancer cell.



Not at all. Don't worry if he is a strictly vegetarian. This is just a term coined for it. It has nothing to do with the real eggs

NANOFOODS

Nanofood is that nanotechnology techniques or tools are used during cultivation, production, processing, or packaging of the food . It is not atomically modified food or food produced by nanomachines.

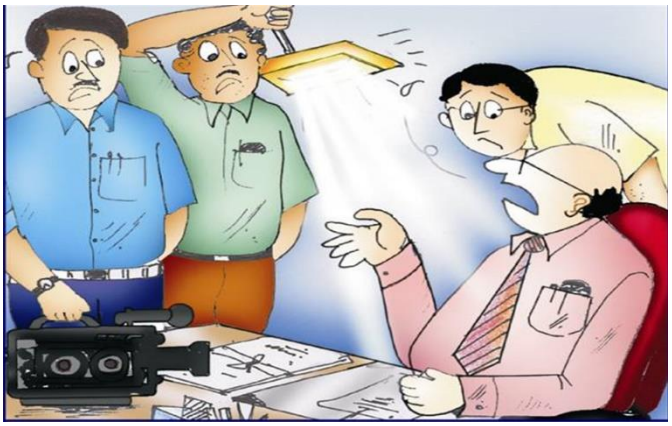
Nanofoods fall into four categories. First, and most obviously, there's the use of nanotechnology directly in a food that we eat. Second, there are supplements that use nanotechnology. And the last two categories, which are similar, are comprised of things we don't eat that use nanotechnology: food packaging and cookware.

"Take it Sir! Whatever you like, Veg, None veg, Italian, Thai, Continental! Everything is in plenty. See carefully! It is Nano food Sir."

MEMORY MATERIALS

Shape Memory materials have the ability to return to some previously defined shape or size when subjected to the appropriate thermal procedure. Alloys of Ni-Mn-Sn, Ni-Mn-In etc or molecular magnets such as A[M1(II) M2(III)(C2O4)3] etc are examples shape memory materials

The materials could find applications in Aircraft, Robotics, Telecommunication, Automotive, Piping, Cardio-vascular surgery, Orthopedic surgery, Dentistry etc.



"Look! They have come to take our interview on that memory enhancer! Do you remember anything about that?"

NANOGELS

Nanoparticles are also important in cosmetic industry. Zinc oxide and titanium oxide nanoparticles of fairly uniform size are able to absorb ultraviolet light and

protect the skin. Due to their small size, nanoparticles based creams are preferred as they can be used in small amount and do not leave any gaps between them. This gives a smooth appearance. These small particles in some of the creams scatter light in such a way that appearance of the wrinkles is diminished. Some creams using nanoparticles are already marketed. Nano based dyes and colours quite harmless to skin and can be used in hair creams or gels. SUNSCREENS utilize nanoparticles which are extremely effective at absorbing light, especially in the ultra-violet (UV) range. Due to the particle size, they spread more easily, cover better, and save money. These are transparent, unlike traditional screens which are white.

These sunscreens are so successful that by 2001 they had captured 60% of the Australian sunscreen market.

"Be careful! He is a famous nanotechnologist. I doubt that he might have made see-through nano-spex."

NANOCLOTH

Nano-textiles is an emerging and interesting application of nanotechnology. It involves dealing with nano fibers at the atomic and molecular levels in order to tweak their properties. This novel technology can give rise to incredible clothing such as water-resistant and dirt-free clothes, odor-less socks, and intelligent clothes that can perfom climate control for us.

The ever-increasing demand for sophisticated fabrics with special features and exceptional comfort drives the need for the use of nanotechnology in this industry. More and more companies are utilizing nanoadditives to enhance the surface characteristics of clothes such as water/stain-resistance, UV-protection, wrinkle resistance, color durability, flame retardancy, and better thermal performance.

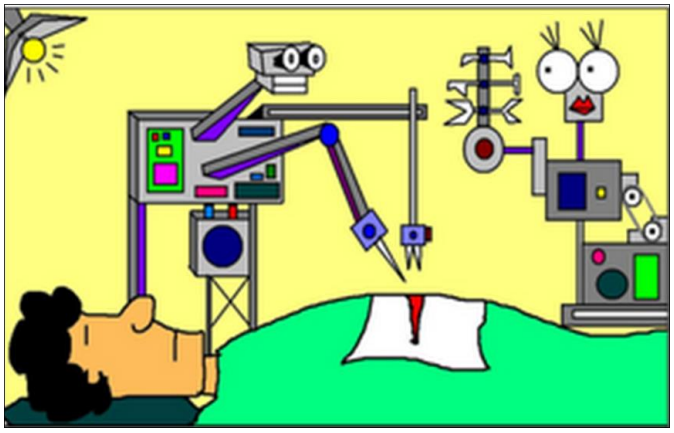
Although these nanofabrics are antimicrobial, strong and intelligent, they also pose some risks to the user and the environment.

"Oh no, my God! You are traveling in these SAME clothes for the last six month. Darling I am extremely sorry. I forgot to tell that these are not nano clothes but ordinary one."

NANOBRAIN

A nano brain is a conceptual device that executes massively parallel/ simultaneous computing following the information processing principles of human brain This machine assembly would serve as an intelligent decision making unit for the nano-robots, and could be programmed to execute particular operation for which it is designed.

This machine assembly would serve as an intelligent decision making unit for nanorobots. One essential feature of a nano brain is that it would acquire all sensory inputs from the external environment, and in processing that information, generate distinct instructions for every single execution unit connected to the nano brain simultaneously.Thus, the computing machine will communicate with the external world in a similar fashion to our central nervous system.



"Nurse, hand me another pair of scissors. I think I dropped the one you gave me earlier. Your pretty LEDs are distracting me today."

QUANTUM DOTS

Another minuscule molecule that will be used to detect cancer is a quantum dot. Quantum dots are tiny crystals that glow when they are stimulated by ultraviolet light. The wavelength, or color, of the light depends on the size of the crystal. Latex beads filled with these crystals can be designed to bind to specific DNA sequences. By combining different sized quantum dots within a single bead, scientists can create probes that release distinct colors and intensities of light. When the crystals are stimulated by UV light, each bead emits light that serves as a sort of spectral bar code, identifying a particular region of DNA.

To detect cancer, scientists can design quantum dots that bind to sequences of DNA that are associated with the disease. When the quantum dots are stimulated with light, they emit their unique bar codes, or labels, making the critical, cancer-associated DNA sequences visible. The diversity of quantum dots will allow scientists to create many unique labels, which can identify numerous regions of DNA simultaneously. This will be important in the detection of cancer, which results from the accumulation of many different changes within a cell. Another advantage of quantum dots is that they can be used in the body, eliminating the need for biopsy.

NANOSHELLS

Nanoshells are miniscule beads coated with gold. By manipulating the thickness of the layer making up the nanoshells, scientists can design these beads to absorb specific wavelengths of light. The most useful nanoshells are those that absorb near-infrared light, which can easily penetrate several centimeters of human tissue. The absorption of light by the nanoshells creates an intense heat that is lethal to cells. Researchers can already link nanoshells to antibodies that recognize cancer cells. Scientists envision letting these nanoshells seek out their cancerous targets, then applying near-infrared light. In laboratory cultures, the heat generated by the light-absorbing nanoshells has successfully killed tumor cells while leaving neighboring cells intact.

NANOROBOT

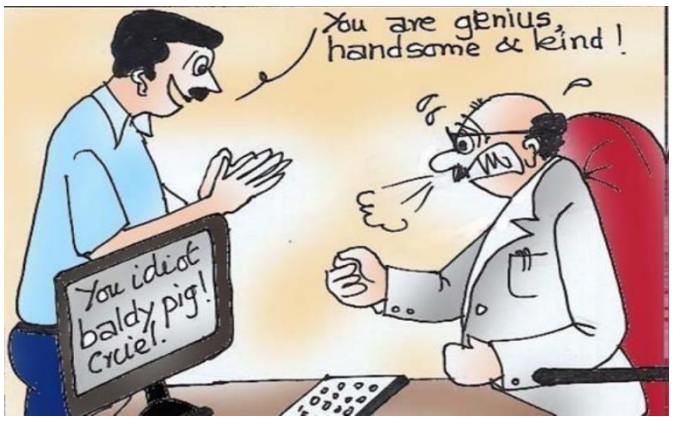
Nanotechnology is also being used to develop robots of nanosize called Nanorobots. They are of special interest to researcher in the medical industry. This has given rise to the field of nanomedicine. It has been suggested that a fleet of nanorobots might serve as antibodies or antviral agents in patients with compromised immune system, or in deseases that do not respond to more conventional measures.

These nanorobots can interact with tissues in a human body and deliver drugs and diagnose the precise nature of injury. They can also repair an organ without any surgical intervention. In theory they can remain operational for years, decade or centuries.

One more feather on the cap of nanotechnology is curing cancer with the help of a new method Trojan Horse Therapy. This therapy has the potential to directly target cancer cells with chemotherapy, rather than the current treatment that chemotherapy drugs injected into a cancer patient and attacking both cancer and healthy cells.

INTELLIGENT NANOMATERIALS

'Intelligent' Nanomaterial's which Have Sensing Properties. These could have intrinsic sensing properties, programmable optical, thermal and mechanical characteristics and self-healing properties. Nano composites consisting of conjugated polymers in a nanostructured silicate matrix changes the colour with respect to mechanical, chemical or thermal stress.



"Don't speak even a word further. I know you very well now"

VII. CONCLUSION

Since Nanotechnology is at the verge creating a significant change in our lives in near future, so it is utmost essential to popularize it among the young learners. In many parts of the world, science is being taught in such a way that most of the times students get a horrifying image of science. Scientoonic presentation would be of great help to make students believe that science is not only interesting but fun as well.

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