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Scientoonic Representation of Nanotechnology

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Abstract: *Nanotechnology is a multidisciplinary field, which covers a vast and diverse array of devices derived from engineering, biology, physics and chemistry. These devices include nanovectors for the targeted delivery of anticancer drugs and imaging contrast agents. Nanowires, nanorobot, nanoeggs and nanocantilever arrays are among the leading approaches under development for the early detection of precancerous and malignant lesions from biological fluids. These and other nanodevices 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 scientoos to make nanotechnology a easy and interesting one.
Keywords: *Aerogels, Carbon nanotube, Nanoscale , Scientoons,,*

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I. Origin of Scientoons

In 1988 while delivering a lecture entitled "Development of Drugs & Pharmaceutical Industry in Developing Countries" 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**.** The lecture was well received and enabled him win a silver medal for the best lecture.

Scientoons are the cartoons, based on science. they not only make us 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**.**

Pradeep K.Srivastava- the Sinton man

II. Explanation of Parasites Using Scientoon

Plants or animals which live in or on others and draw nutrients from them for their survival are called Parasites and study of parasites is known as Parasitology.

III. Explanation of DNA Using Scientoon

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.

A part of DNA doing specific job in the body is called a gene.

IV. Explanation of Brownian motion Using Scientoon

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

V. There's Plenty of Room at the Bottom

It is a lecture given by physicist Richard Feynman at an American Physical Society meeting at Caltech on December 29, 1959.[1] Feynman considered the possibility of direct manipulation of individual atoms as a more powerful form of synthetic chemistry than those used at the time. The talk is considered to be a seminal event in the history of nanotechnology, as it inspired the conceptual beginnings of the field decades late

Feynman considered a number of interesting ramifications of a general ability to manipulate matter on an atomic scale. He was particularly interested in the possibilities of denser computer circuitry, and

microscopes which could see things much smaller than is possible with scanning electron microscopes. These ideas were later realized by the use of the scanning tunneling microscope, the atomic force microscope and other examples of scanning probe microscopy and storage systems such as Millipede, created by researchers at IBM.

Feynman also suggested that it should be possible, in principle, to make nanoscale machines that "arrange the atoms the way we want", and do chemical synthesis by mechanical manipulation. As the sizes got smaller, one would have to redesign some tools, because the relative strength of various forces would change. Although gravity would become unimportant, surface tension would become more important, Van der Waals attraction would become important, etc.

At the meeting, Feynman concluded his talk with two challenges. The first challenge involved the construction of a tiny motor. The second challenge involved the possibility of scaling down letters small enough so as to be able to fit the entire Encyclopedia Britannica on the head of a pin.

Physicist Richard Feynman

VI. 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

K. Eric Drexler

VII. Definition of Nanotechnology

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.

VIII. Basic Strategies of Nanotechnology

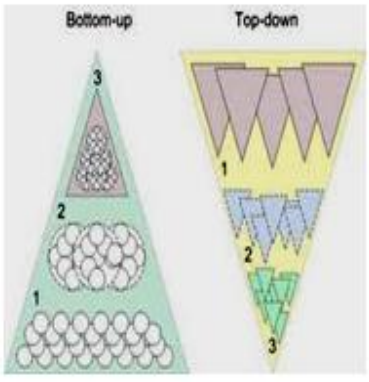
1. Top-down approach

A top-down approach (also known as stepwise design or deductive reasoning, and in many cases used as a synonym of *analysis* or *decomposition*) 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 (also known as inductive reasoning, and in many cases used as a synonym of *synthesis*) 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

"Bottom-Up" and Top-Down? You are such a Senior Professor, just Like my father; it does Not look nice when you Ask me to do it



IX. 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 chemistry no 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.

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

X. 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 nano tubes exhibit varying electrical properties. These can be insulating, semiconducting or conducting.

The properties of carbon nanotubes have caused the researchers and companies to consider using them in several fields

1. Researchers at NASA are combining carbon nano tubes with other materials into composite that can be used to build light weight space craft as carbon nanotubes have the highest strength to weight ratio of known materials.
2. Another property of nanotube is that they can easily penetrates membranes such as cell walls. Nanotubes can function like needle at the cellular level. Medical researchers are using this property by attaching molecules that are attracted to cancer cells to nanotubes to deliver drugs directly to diseased cells.
3. Another interesting property of carbon nanotubes is that their electrical resistance changes significantly when other molecules attach themselves to the carbon atoms. Companies are using this property to develop sensors that can detect chemical vapours such as carbon monoxide or biological molecules. In expensive nanotubes based sensors detect bacteria in drinking water.
4. Nanotubes pacemakers placed in the heart blood vessels could generate electricity for heart function

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

XI. 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.

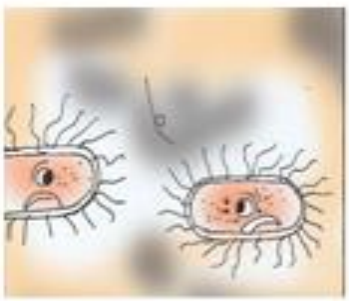
Nanotechnology will play an important role in the field of "Energy". Natural resources like oil, coal, natural gas etc required for all transportation, communication, agriculture, industry, houses and many other human activities are limited and depleting very fast. The future generation will have to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

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.

XII.Nanobreeze

To purify the indoor environment, the Nanobreeze Room Air Purifier uses patented photo catalytic 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



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XIII. Nano Batteries

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.

Now a day's cars are spray painted with nano particles. Nano particles paints provide smooth, thin attractive coating. Some research is going on to explore the possibility of applying a small voltage to change the colour of the car as desired.

One can use "self cleaning" glass so that it is not necessary to wash the windows with water. Self cleaning glass can be made by dissolving small amount of titania nanoparticles in it while manufacturing it by melting together its other ingredients. Titania is also able to dissociate organic dust in presence of U.V light available in the sun light. Once dissociated it may fall down or simply evaporate. Even drops of water on grass give hazy look.

XIV. 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 tumor 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

XV. Nonofoods

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 nano machines.

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.

Newly designed nanostructures are already being incorporated into our food and changing how food tastes, gets absorbed by the body and stays fresh. It is a process more like architecture than cooking.

A new class of foods, called nutraceuticals, is being designed to treat illnesses, like cancer, diabetes and heart disease. Scientists are developing new types of tiny structures, such as a matrix containing nanoparticles that would release substances like glucose in stages. They are also developing nanofoams which form coaxial tubes to deliver medications or other needed substances directly to capillaries.

Packaging

The use of nanotechnology in food packaging is already a commonplace reality and can be separated into two types: active packaging and smart packaging. Active packaging includes materials that constantly provide a certain feature like stopping oxygen from spoiling food. Smart packaging reacts to changes in the environment such as to indicate the presence of a pathogen

Researchers are also incorporating nanotechnology into food packaging as a high-tech means of keeping food fresh or alerting us when it isn't. Kodak, for example, has developed antimicrobial nanofilms. When added to packages, these films absorb oxygen and keep food fresh. Agro Micron, a privately held biotech company, developed a spray designed to bind Salmonella or E. coli microbes to a protein surface. When bound, the proteins begin to glow. The brighter the glow, the worse the contamination.

Beer reacts badly to plastic bottles. But Miller Brewing Company uses clay nanoparticles to create shatterproof bottles that increase a beer's shelf life by six months. Have trouble getting that last bit of ketchup out of the bottle? Researchers are developing a lining 20 nanometers thick that prevents food from sticking.

Processing foods

Nanotechnology is already making an impact in processed foods. Nanoparticles and nanocapsules are being added to various foodstuffs to increase shelf life, alter properties, enhance nutritional values and change taste. Tuna oil (a source of omega 3 fatty acids) in nanocapsules is being added to some types of bread. The capsules break and release the oil in the stomach so there is no unpleasant taste.

XVI. 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 $A[M_1(II)\ M_2(III)(C_2O_4)_3]$ etc are examples shape memory materials

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

XVII. 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."

XVIII. 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 perform 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 nano additives to enhance the surface characteristics of clothes such as water/stain-resistance, UV-protection, wrinkle resistance, color durability, flame retardancy, and better thermal performance.

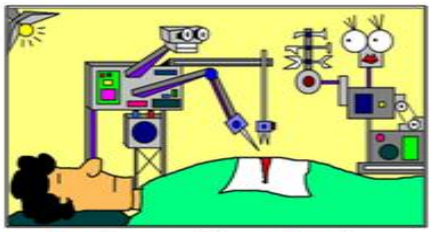
Although these nanofabrics are antimicrobial, strong and intelligent, they also pose some risks to the user and the environment.

"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."

XIX. 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.



XX. Aerogels

Space and defense scientists also are trying to adopt nanomaterials as alternative materials and replace the conventional materials. Very low density materials known as aerogels are nano porous materials. Aerogels can be of various materials. Their density is typically 0.01 to 0.8 gm/cc. So one can get an idea of how light aerogels are. Naturally it is very good to use for various applications in spacecrafts and defense to reduce the weight. Even some special lightweight suits, jackets etc can be made using aerogels as they can be made such that they are poor conductors of heat. Even some special high temperature materials which are otherwise difficult to make at lower temperature as nanomaterials

XXI. 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.

XXII. 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.

XXIII. Nanorobot

Nanotechnology is also being used to develop robots of nano size 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 antiviral agents in patients with compromised immune system, or in diseases 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.

XXIV. Quantum Computers

Next revolution is expected in computers with what is known as nonvolatile memory by which we shall not loose any data being stored on a computer if there is sudden electricity failure or we forgot to save the entries. We may also have what is being researched presently as quantum computers which will be much more powerful than the existing computers. Such computers will use the fruits of nanotechnology.

XXV. Intelligent Nanomaterials

'Intelligent' Nanomaterials which has Sensing Properties. These could have intrinsic sensing properties, programmable optical, thermal and mechanical characteristics and self healing properties.

Nanocomposites, consisting of conjugated polymers in a nanostructured silicate matrix, which changes the colour with respect to mechanical, chemical or thermal stress**.**

"Don't speak even a word Further. I know you very well Now

XXVI. 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. Scientoonics presentation would be of great help to make students believe that science is not only interesting but fun as well.

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