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Physics in Medicine: Engines Of Creation (The Coming Era Of Nanotechnology)

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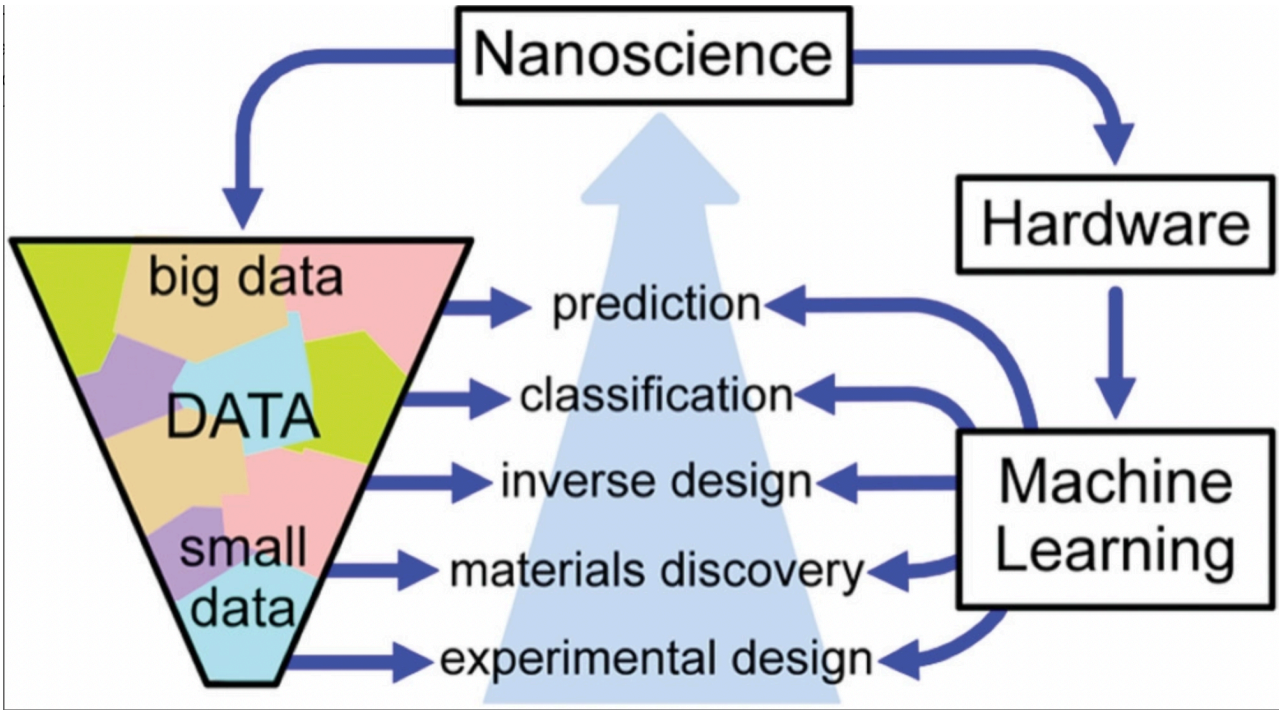
Abstract :

Nanotechnology is one of the Major in Engines Of Creation , It is ambitious and imaginative and best of all , the thinking is technically sound , But how can anyone predict where science and technology will take us??/ Although many scientists and technologists have tried to do this , first the foundations must be very firm -and Drexler has built on the soundest areas of present day technical knowledge , For one thing is

virtually impossible to predict the details of future technologies for more than perhaps half a century a head.For one thing, it is virtually impossible to predict in detail which alternatives will become technically feasible over any longer interval of time , In this paper I will write how nanotechnology and artificial intelligence meet together .

Abstract:



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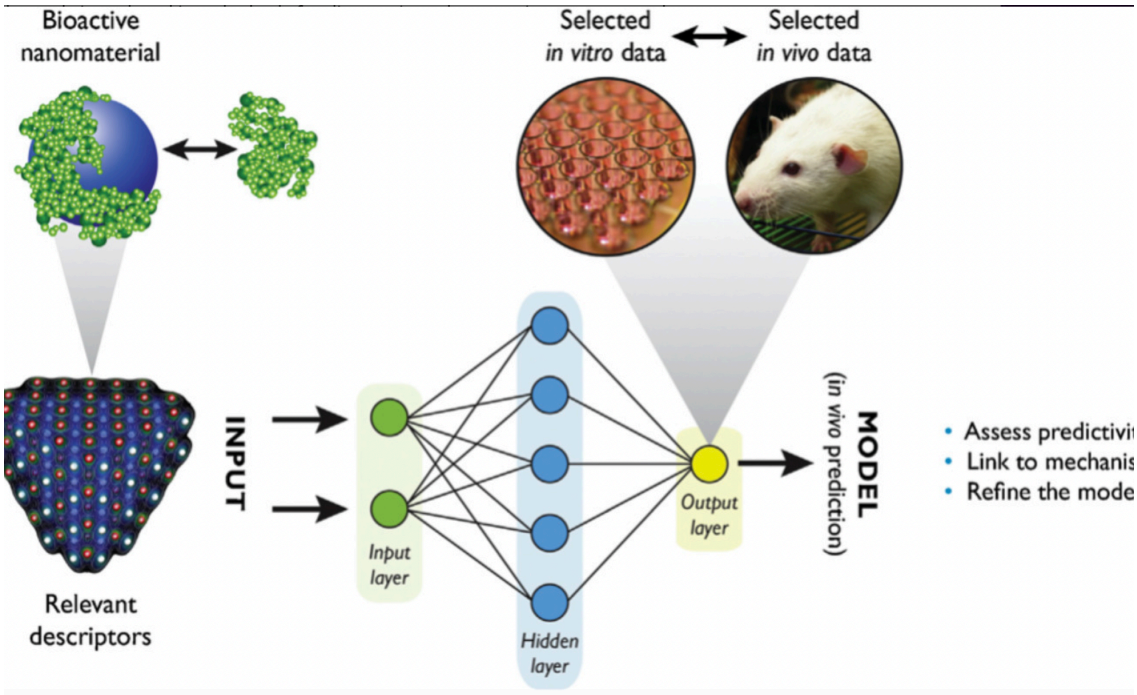
AI and Machine Learning Methods and Why They Are Important

Modeling of biological properties of nanomaterials (indeed any materials) involves several unit operations. Materials are synthesized and tested in relevant biological assays to generate a data set for training ML models. The physicochemical properties of nanomaterials must be encoded as mathematical entities called descriptors, suitable relevant features selected from the pool of descriptors, and ML methods used to generate a predictive model of the desired property. The models must be validated by prediction of an independent set of materials not used to build the models, or by cross-validation methods that involve withholding one or more materials from the model, with the withheld material being predicted by the model derived from the remaining materials **(Figure 2)**.



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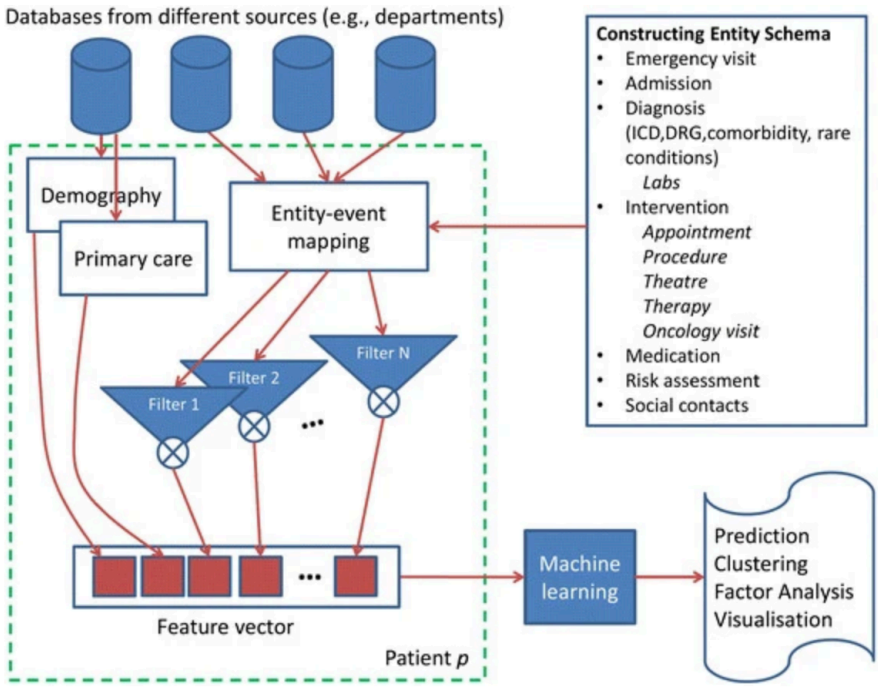
analysis of big data by machine learning offers considerable advantages for assimilation and evaluation of large amounts of complex health-care data. However, to effectively use machine learning tools in health care, several limitations must be addressed and key issues considered



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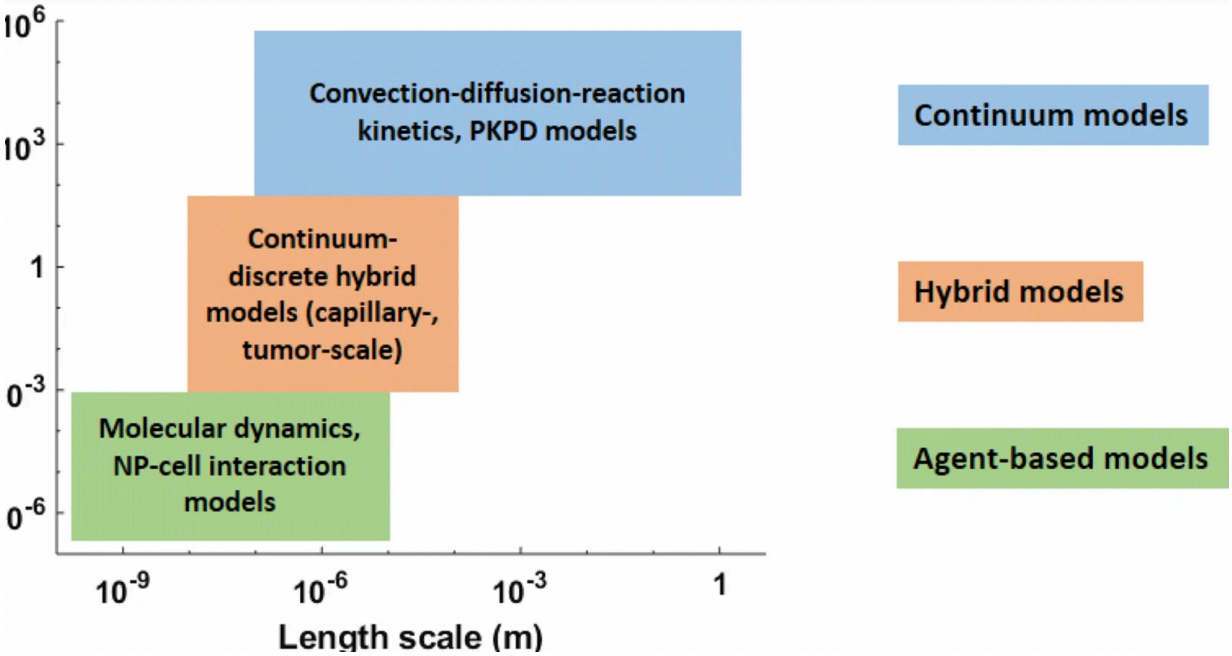
Mathematical modeling in cancer nanomedicine: a review



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[**Branches of Nanotechnology**

In this section, a brief overview is provided about the branches of nanotechnology. A number of Nanotechnology products are available and still a formidable amount of researches are going on in research laboratories and universities. Nanotechnology branches are being developed that could bang the global market for mineral, non-fuel commodities and agricultural. Presently, Nanotechnology is characterized as revolutionary discipline in terms of its influence on industrial applications. Nanotechnology offers probable solutions to several problems using emanating nano techniques. Depending on the strong inter panel character of nanotechnology there are several research fields and various potential applications that involves nanotechnology. Here are some branches where nanotechnology has been implemented [4].

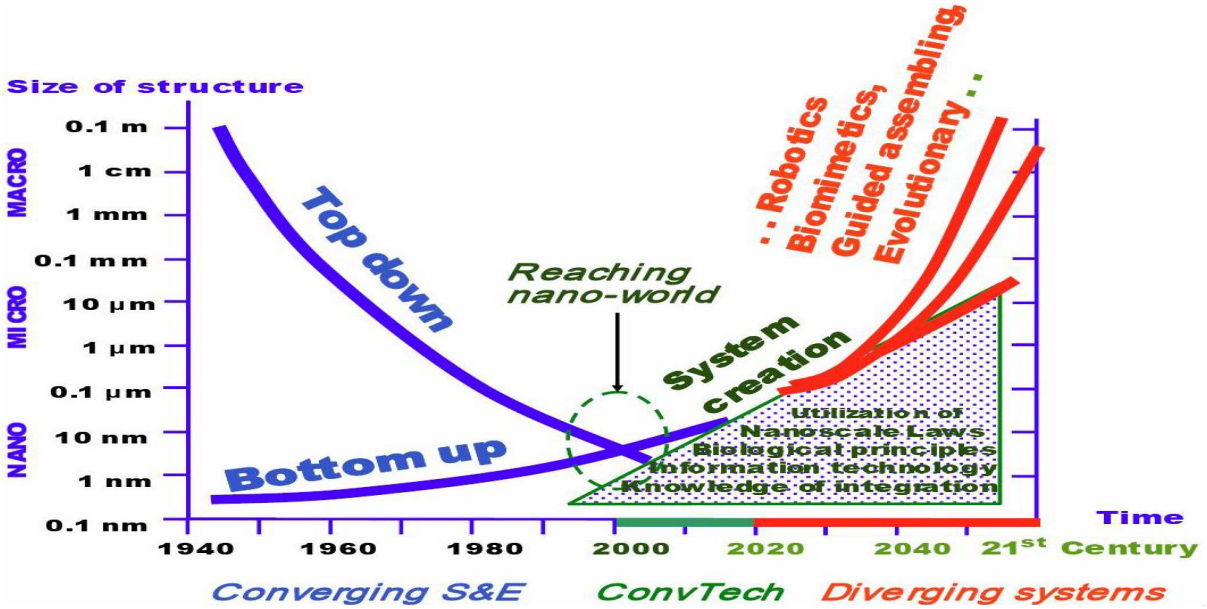

Fig.1. Reaching at the nanoworld (about 2000) and "converging technologies" approach for system creation from the nanoscale (2000-2020) towards new paradigms for nanosystem architectures in applications (after 2020). [Source 3]

1. Nano engineering

Nano engineering is the branch nanotechnology practice on the nanoscale. The name 'Nano-engineering' is derived from the nanometer, a unit of measurement equaling one billionth meters. This branch accentuates the engineering rather than the applied science aspect of the field. Scanning tunneling microscope (STM) and molecular self- assembly are two techniques of Nano engineering.STM is used to employ structures as small as a single atom whereas with Molecular self-assembly, an arbitrary sequence of DNA can synthesized and used to create custom proteins or regular patterns of amino acids [5].

2. Green Nanotechnology

Green nanotechnology is the branch of nanotechnology that enhances the environmental sustainability of processes producing negative facet. It includes manufacturing green Nano-products and then using these Nano-products in support of sustainability [6]. The goal of green nanotechnology is to minimize future environmental and human health risks associated with the use of nanotechnology products, and to boost the replacement of existing products with nano-products that are more environmentally friendly. Solar cells [7], Nano remediation and water treatment all applications are based on green nanotechnology [8].

3. Wet Nanotechnology

Wet nanotechnology refers to working up with large masses from small ones [9]. W. Eric Drexler put forth the idea of Nano-assemblers working dry. The wet nanotechnology comes out to be the first area in which a Nano-assembler attains the trading results. Pharmaceuticals and bioscience are main features of wet nanotechnology [10]. R.A.L. Jones puts the bits of natural nanotechnology into a synthetic structure biokleptic nanotechnology. Using the guiding principles of biomimetic nanotechnology, trillions of nanotech robots are designed that resemble bacteria in structural properties, entering a person's blood stream to do medical treatments like cancer [11].

Uses of Nanotechnology

From the past two decades, scientists and engineers have mastered the complexities of working with nonmaterial and research is still going on. Nowadays most of the products are manufactured by nanoscale materials. Sunscreens containing nanoscale zinc Oxide or titanium dioxide that reflects ultraviolet light to avert sunburns. A nanoscale dry powder can neutralize gas. So, the nanoscale materials are being used to manufacture the batteries for tools in order to deliver more power, more promptly and dissipating less heat. The dressing of anti bacterial wound use nanoscale silver [11]. Other uses of nanotechnology includes sports equipment, vehicle parts, storage of power in batteries, moisturizing effectiveness of cosmetics, drug delivery and other numerous techniques and products based on nanoscale material are described in brusque.

1. Carbon Nano Tubes (CNT)

Carbon nanotubes are allotropes of carbon having a cylindrical nanostructure. Nanotubes have been constructed with length-to-diameter ratio of up to 2, 80, 00,000:1 that is much larger than any other material. These cylindrical carbon molecules possess extraordinary strength and unique electrical properties. These novel properties make them substantially useful in various applications in electronics, nanotechnology, optics, materials science, as

well as in architectural fields. Their final usage, however, may be limited by their potential toxicity [11]. Nano tubes are shown in figure 2.

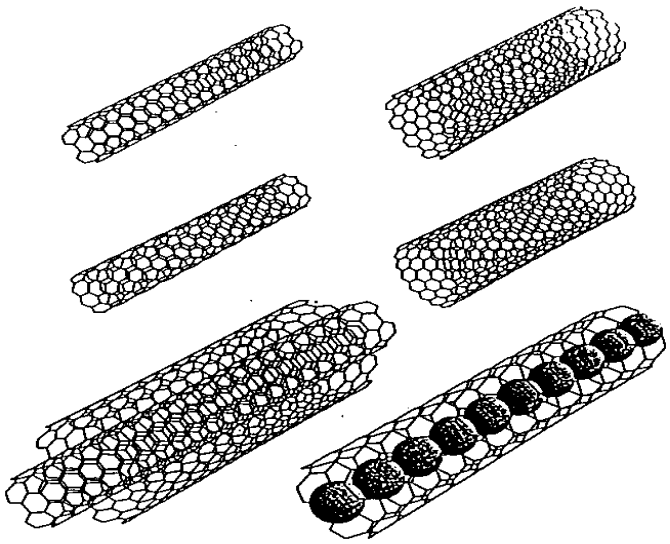

Fig.2. Carbon Nano Tubes (CNT) [Source 11]

2. Thin Nano Films

Various nanoscale materials can be used in thin films to make them water repellent, UV or IR- resistant, anti reflective, anti-microbial , self-cleaning, anti-fog, Scratch resistant or electrically conductive. Applications of Nano films include computer display, cameras and eyeglasses [11]. Nano film is shown in figure 3.

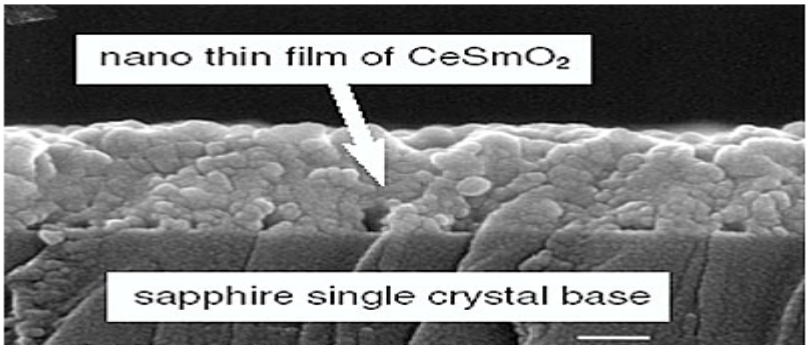

Fig.3. Thin Nano film [source 11]

3. Nano scale Transistors

A transistor is a semiconductor electronic device used to amplify or switch electronic signals and electrical power. In transistors, a small amount of electricity is used as a gate to control

the flow of larger amount of electricity. More the number of transistors are embedded in the computer, the greater will be power. Transistors sizes have been decreasing day by day, so computer have become more powerful. Upto now, the industry's best trading technology produced computer chips with transistors having 45-nanometer features. Recent announcements indicate that even more small size of transistors is possible with the help of nanotechnology [11]. Nano scale transistors are shown in figure 4.
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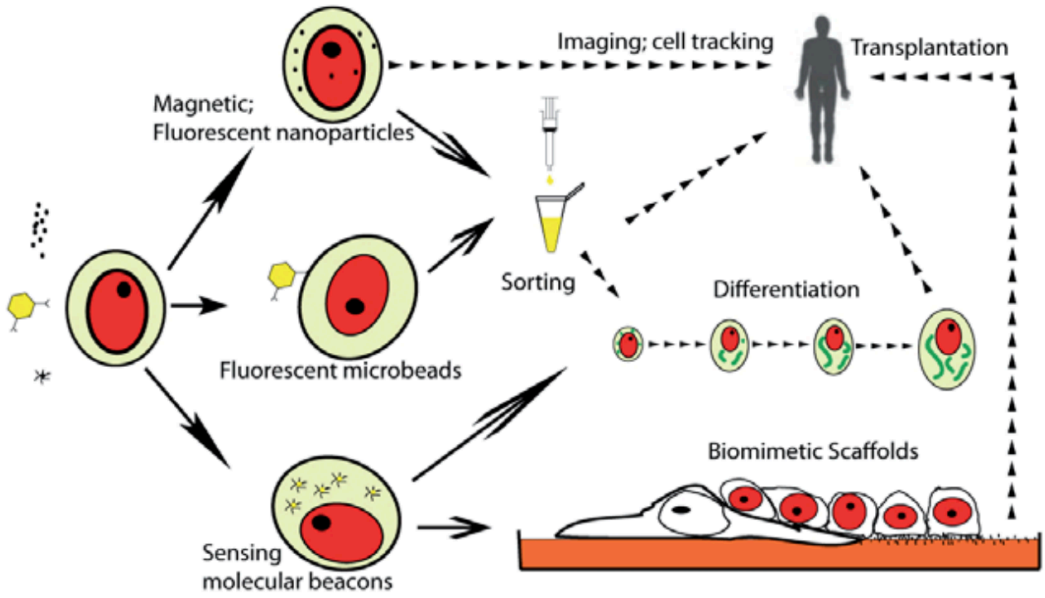


Figure 6: Nanotechnology applications in stem cell biology and medicine.

https://www.researchgate.net/publication/274837597_Nanotechnology_and_its_Applications_in_Medicine

Medical use of Nano Materials Nano medicine is a relatively new field of science and technology. By interacting with biological molecules at nano scale, nanotechnology broadens the field of research and application. Interactions of nano devices with bio molecules can be understood both in the extracellular medium and inside the human cells. Operation at nano scale allows exploitation of physical properties different from those observed at micro scale such as the volume/surface ratio. Two forms of nano medicine that have already been tested in mice and are awaiting human trials; use of gold nano shells to help diagnose and cure cancer, and the use of liposome as vaccine adjuvants and as vehicles for drug transport [6,7]. Similarly, drug detoxification is also another application for nano medicine which has been used successfully in rats. Medical technologies can make use of smaller devices are less invasive and can possibly be implanted inside the body, and their biochemical reaction times are much shorter. As compared to typical drug delivery nano devices are faster

and more sensitive [8]. Drug Delivery In nanotechnology nano particles are used for site specific drug delivery. In this technique the required drug dose is used and side-effects are lowered significantly as the active agent is deposited in the morbid region only. This highly selective approach can reduce costs and pain to the patients. Thus variety of nano particles such as dendrimers, and nano porous materials find application. Micelles obtained from block co-polymers, are used for drug encapsulation. They transport small drug molecules to the desired location. Similarly, nano electromechanical systems are utilized for the active release of drugs. Iron nano particles or gold shells are finding important application in the cancer treatment. A targeted medicine reduces the drug consumption and treatment expenses, making the treatment of patients cost effective. Nano medicines used for drug delivery, are made up of nano scale particles or molecules which can improve drug bioavailability. For maximizing bioavailability both at specific places in the body and over a period of time, molecular targeting is done by nano engineered devices such as nano robots [9]. The molecules are targeted and delivering of drugs is done with cell precision. In vivo imaging is another area where Nano tools and devises are being developed for in vivo imaging. Using nano particle images such as in ultrasound and MRI, nano particles are used as contrast. The nano engineered materials are being developed for effectively treating illnesses and

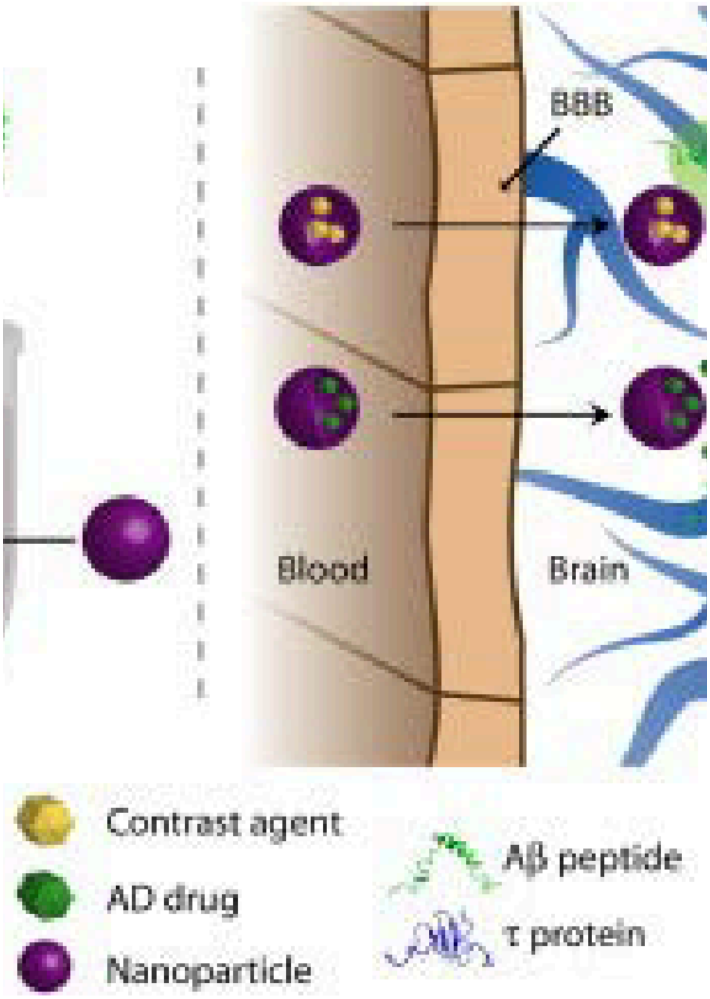


Figure 8: Use of nano particles in Alzheimer's disease.

diseasessuch as cancer. With the advancement of nanotechnology, self-assembled biocompatible nano devices can be created which will detect the cancerous cells and automatically evaluate the disease, will cure and prepare reports. The pharmacological and therapeutic properties of drugs can be improved by proper designing of drug delivery systems, by use of lipid and polymer based nano particles [10]. The strength of drug delivery systems is their ability to alter the pharmacokinetics and biodistribution of the drug. Nano particles are designed to avoid the body's defense mechanisms [11] can be used to improve drug delivery. New, complex drug delivery mechanisms are being developed, which can get drugs through cell membranes and into cell cytoplasm, thereby increasing efficiency. Triggered response is one way for drug molecules to be used more efficiently. Drugs that are placed in the body can activate only on receiving a particular signal. A drug with poor solubility will be replaced by a drug delivery system, having improved solubility] src : https://www.researchgate.net/publication/274837597_Nanotechnology_and_its_Applications_in_Medicine

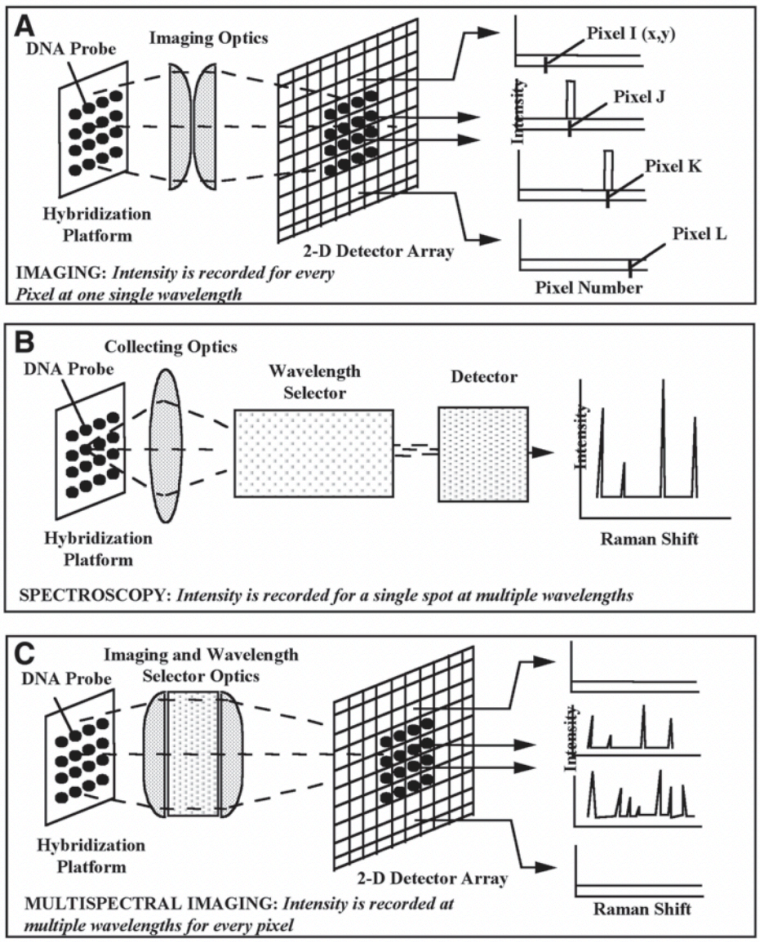
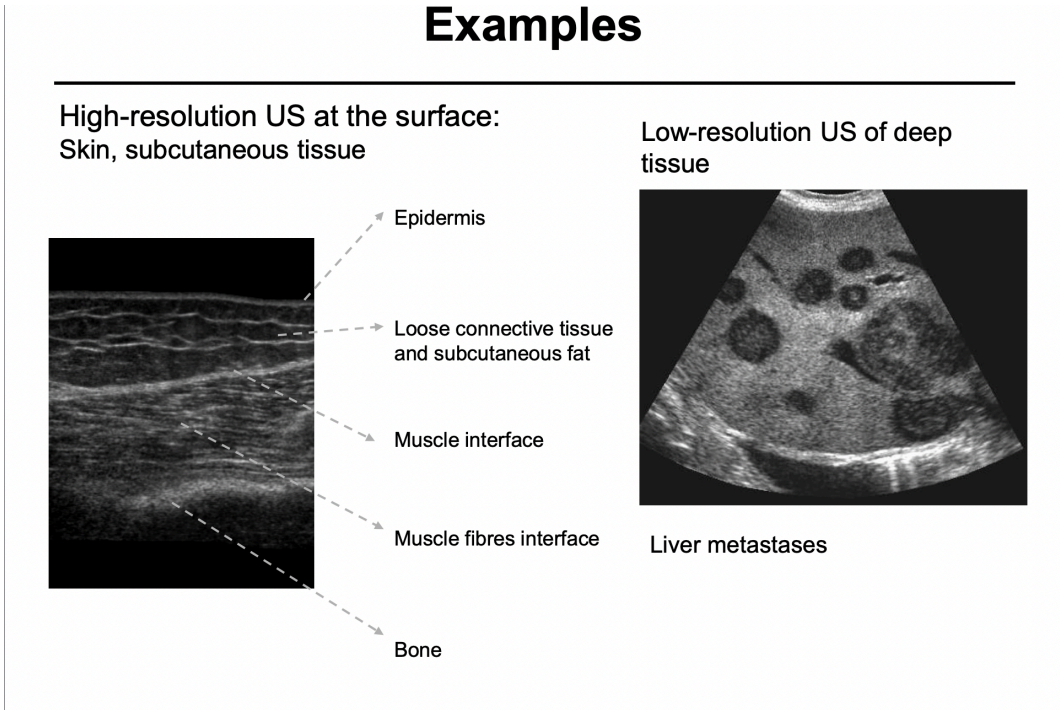


Fig. 4. Various modes of data acquisition from bioassay platforms: **(A)** imaging; **(B)** spectroscopy; **(C)** MSI.

What Are Some Examples of Nanomedicine?

Some specific ways that nanomedicine is being used or studied are for:

COVID-19 vaccines. Nanoparticles are a key element of two of the COVID vaccines, those from Pfizer and Moderna. Those vaccines use messenger RNA (mRNA) to help you develop immunity to the COVID virus. But mRNA breaks down quickly. It needs something to carry it through your body before it falls apart. So scientists put it inside nanoparticles, which deliver it to your immune cells. There, it can do its work.



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Cancer treatment.Chemotherapy delivers cancer-fighting drugs to your entire body. That's why you may lose your hair and have side effects like nausea. Nanomedicine lets doctors target the medicine to your cancer cells and limit damage to healthy ones.

MRIs. Magnetic resonance imaging (MRI) uses radio waves and magnetic fields to create detailed pictures of your organs and tissue. Some patients get what's called a contrast material through an IV. It makes details more clear on the images. But fluorescent nanoparticles deliver clearer pictures than traditional contrast agents. Because the imaging methods that use them are simple and less expensive, they may eventually make MRIs more affordable.

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